JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

Syllabus for Pre-Ph. D Examination

Mechanical

PAPER – II		Subject Code
S. No	**Subject**	
1	Mechanics of Composite Materials	**1303101**
2	Design of Mechanisms and Manipulators	**1303102**
3	Failure Analysis and Design	**1303103**
4	Acoustics Engineering	**1303104**
5	Signal Analysis and Condition Monitoring	**1303105**
6	Bearing Design & Rotor Dynamics	**1303106**
7	Fracture Mechanics	**1303107**
8	Fuels, combustion & Environmental Pollution Control	**1303108**
9	Convective Heat & Mass Transfer	**1303109**
10	Advanced Thermodynamics	**1303110**
11	Computational Methods in Thermal Engineering	**1303111**
12	Thermal Systems Simulation & Design	**1303112**
13	Combustion & Emission in Engines	**1303113**
14	Computational Fluid Dynamics	**1303114**
15	Advanced Optimization Techniques	**1303115**
16	Theory of Metal Cutting & Tool Design	**1303116**
17	Metal Forming Processes	**1303117**
18	Rapid Prototyping & Tooling	**1303118**
19	Non-Destructive Evaluation	**1303119**
20	Quality Engineering and Manufacturing	**1303120**
21	Mechanics and Manufacturing Methods of Composites	**1303121**

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Mechanical

PAPER – III		Subject Code
S. No	**Subject**	
1	CAD Theory & Practice	**1303201**
2	Experimental Stress Analysis	**1303202**
3	Advanced Mechanical Vibrations	**1303203**
4	Simulation and Modeling	**1303204**
5	Design of Hydraulic & Pneumatic Systems	**1303205**
6	Design of Pumps and Compressors	**1303206**
7	Theory of Plasticity	**1303207**
8	Electric & Hybrid Vehicles	**1303208**
9	Design of Heat Transfer Equipment	**1303209**
10	Refrigeration Equipment & Controls	**1303210**
11	IC Engines & Alternative Fuels	**1303211**
12	Thermal & Nuclear Power Plants	**1303212**
13	Experimental Methods in Thermal Engineering	**1303213**
14	Electronic Engine Management Systems	**1303214**
15	Intelligent Manufacturing Systems	**1303215**
16	Logistics & Supply Chain Management	**1303216**
17	Advances in Manufacturing Technology	**1303217**
18	Production & Operations Management	**1303218**
19	Advances in Casting & Welding Processes	**1303219**
20	Materials Technology	**1303220**
21	Statistical Quality Control	**1303221**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
Mechanical

PAPER – II

MECHANICS OF COMPOSITE MATERIALS

UNIT I
Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.
Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT II
Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.
UNIT III
Coordinate transformations: Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness modulus, off - axis compliance.

UNIT IV
Elastic behavior of unidirectional composites: Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.
Strength of unidirectional lamina: Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micro mechanical predictions of elastic constants.

UNIT V
Analysis of laminated composite plates
Introduction, thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.
Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

Suggested Assignment:
To refer ASTM Series of Journal of composites, Technology and Research for giving a seminar on any current topic of relevance.

REFERENCE BOOKS:
1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York.
2. Engineering Mechanics of Composite Materials by Isaac and M.Daniel, Oxford University Press.
3. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York.
4. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

DESIGN OF MECHANISMS AND MANIPULATORS

UNIT I

Mobility analysis, Degree of freedom, Mixed mobility, Total, partial and fractional DOF, Closed and open chain systems, Structural analysis and synthesis of mechanisms.

UNIT II

Alternative design solutions, Coding, Evaluation and selection of optimum mechanism, Type synthesis, Number synthesis, and design of mechanisms,

UNIT III

Indexes of merit, Graphical, Algebraic and optimization techniques, Matrix method of design and analysis, Design of function path and motion generators, Structural and mechanical error,

UNIT IV

Design and analysis using software like ADAMS. Design of Manipulators: Classification, Actuation and transmission systems, Co-ordinate transformations, DH notations.

UNIT V

Inverse and forward kinematics, Manipulators dynamics from Lagrangian and Newtonian point of view.

Suggested Assignment:

To refer ASME Series of Journal of Mechanism and Robotics, Journal of Mechanical Design for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1.Robot Design Handbook G.B. Andeen McGraw Hill
2.Introduction to Robotics, Mechanics and Control J.J. Craig Addison Wesley
3.Robotic Manipulators: Mathematics, Programming and Control R.P. Paul MIT Press
4.Robot Dynamics and Control M. Spong and M.Vidyasagar, JohnWiley, NY
5.Dextrous Robot Hands S.T. Venkataraman Springer-Verlag

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

FAILURE ANALYSIS AND DESIGN

UNIT I

Role of Failure Prevention Analysis in Mechanical Design: Introduction, a definition of design, a challenge, some design objectives. **Modes of Mechanical Failure**: Definition of failure mode, failure modes observed in practice, a glossary of mechanical failure modes. Introduction to Fracture Mechanics: An introduction to linear elastic fracture mechanics, use of fracture mechanics design, elastic-plastic fracture mechanics.

UNIT II

High-Cycle Fatigue: Introduction, historical remarks, nature of fatigue, fatigue loading, laboratory fatigue testing, the S-N-P curves, factors that affect S-N-P curves, using the factors in design, the influence of nonzero mean stress, multiaxial fatigue stresses, using multiaxial fatigue failure theories.

UNIT III

Cumulative Damage, Life Prediction and Fracture Control: Introduction, the Linear damage theory, cumulative damage theories, life prediction based on local stress-strain and fracture mechanics concepts, service loading simulation and full scale fatigue testing, damage tolerance and fracture control.

UNIT IV

Low-Cycle Fatigue: Introduction, the strain cycling concept, the strain life curve and low-cycle fatigue relationships, the influence of nonzero mean strain and nonzero mean stress, cumulative damage rule in low-cycle fatigue. **Creep, Stress Rupture and Fatigue**: Introduction, prediction of long-term creep behavior, theories for predicting creep behavior, creep under uniaxial state of stress and multi axial state of stress, cumulative creep concept, combined creep and fatigue.

UNIT V

Fretting, Fretting Fatigue and Fretting Wear: Introduction, variables of importance in the fretting process, fretting fatigue, fretting wear, fretting corrosion, minimizing or preventing fretting damage. **Wear and Corrosion**: Introduction, wear – Adhesive, abrasive, corrosion, surface fatigue, deformation, fretting, impact, empirical model of zero wear, corrosion, stress corrosion cracking.

Suggested Assignment:

To refer ASME Series of Journal of Mechanism and Robotics, Journal of Mechanical Design for giving a seminar on any current topic of relevance.

TEXT BOOK:

1. Failure of Materials in Mechanical Design: Analysis, Prediction, Prevention, J. A. Collins, John Wiley & Sons, Inc.

REFERENCES:

1. Fatigue of Materials, S. Suresh, Cambridge University Press.
2. Fracture Mechanics: Fundamentals and Applications, T. L. Anderson, CRC Press.

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Syllabus for Pre-Ph. D Examination

Mechanical

ACOUSTICS ENGINEERING

UNIT I

Introduction to the propagation of acoustic disturbances: Longitudinal wave motion. Introduction to plane wave acoustics. Sound speed, frequency, wavelength, wavenumber. Acoustic impedance. Thermodynamics of acoustic pressure perturbations. Acoustic energy density. Acoustic intensity.

UNIT II

One-dimensional wave motion

Mass continuity and momentum conservation equations in one dimension. Linearization of the governing equation and the derivation of the one-dimensional wave equation. Solutions to the one dimensional wave equation. Linearity and the principle of superposition. Energy density and intensity.

UNIT III

Waves in three dimensions

Conservation equations in three dimensions. The three dimensional wave equation and its solution in free field. Spherically symmetric radiation. Acoustic impedance of spherical waves.

UNIT IV

Sound Radiation

The pulsating sphere. The point monopole source. Source strength. Acoustic power output. Monopole source radiation in the vicinity of a perfectly rigid plane boundary. Radiation from a plane vibrating piston. Near field and far field. Radiation impedance. Radiation efficiency of spherical sources.

UNIT V

Sound field in rooms

Separable solutions to the three dimensional wave equation. Eigen functions and Eigen values. Direct fields and reverberation.

Suggested Assignment:

To refer ASME Series of Journal of Vibration and Acoustics for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1. Foundations of Engineering Acoustics by FGrank J Fahy, Elsevier Academic Press
2. Foundations of Engineering Acoustics by Lawrence E Kinsler, John Wiley
3. Acoustics an Introduction by Heinrich Kuttruff, Taylor Francis group Publishers
4. Fundamentals of Physical Acoustics by David T. Blackstock, John Wiley Publishers
5. Fundamentals of Acoustics by Michel Bruneau, ISTE Publishers, USA.

SIGNAL ANALYSIS AND CONDITION MONITORING

UNIT-I

Introduction: Basic concepts. Fourier analysis. Bandwidth. Signal types. Convolution. Signal analysis: Filter response time. Detectors. Recorders. Analog analyzer types.

UNIT-II

Practical analysis of stationary signals: Stepped filter analysis. Swept filter analysis. High speed analysis. Real-time analysis.

UNIT-III

Practical analysis of continuous non-stationary signals: Choice of window type. Choice of window length. Choice of incremental step. Practical details. Scaling of the results.

UNIT-IV

Practical analysis of transients: Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth). Analysis by repeated playback (variable bandwidth).

UNIT-V

Condition monitoring in real systems: Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Preheater fan. Field balancing of rotors. ISO standards on vibrations.

Suggested Assignment:

To refer ASME Series of Journal of Tribology for giving a seminar on any current topic of relevance.

TEXT BOOK:

1. Condition Monitoring of Mechanical Systems by Kolacat

REFERENCES:

1. Frequency Analysis by R.B.Randall. Bruel Kjaer, 3rd Ed. 1987
2. Mechanical Vibrations Practice with Basic Theory by V. Ramamurti, Narosa Publishing House.

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Syllabus for Pre-Ph. D Examination

Mechanical

BEARING DESIGN AND ROTOR DYNAMICS

UNIT I
CLASSIFICATION AND SELECTION OF BEARINGS
Selection criteria-Dry and Boundary Lubrication Bearings-Hydrodynamic and Hydrostatic bearings- Electro Magnetic bearings-Dry bearings-Rolling Element bearings- Bearings for Precision Applications-Foil Bearings-Special bearings- Selection of plain Bearing materials – Metallic and Non metallic bearings

UNIT II
DESIGN OF FLUID FILM BEARINGS
Design and performance analysis of Thrust and Journal bearings – Full, partial, fixed and pivoted journal bearings design procedure-Minimum film thickness – lubricant flow and delivery – power loss, Heat and temperature distribution calculations- Design based on Charts & Tables and Experimental curves-Design of Foil bearings-Air Bearings- Design of Hydrostatic bearings-Thrust and Journal bearings- Stiffness consideration - flow regulators and pump design

UNIT III
SELECTION AND DESIGN OF ROLLING BEARINGS
Contact Stresses in Rolling bearings- Centrifugal stresses-Elasto hydrodynamic lubrication- Fatique life calculations- Bearing operating temperature- Lubrication- Selection of lubricants- Internal clearance – Shaft and housing fit- -Mounting arrangements-Materials for rolling bearings- Manufacturing methods- Ceramic bearings-Rolling bearing cages-bearing seals selection

UNIT IV
DYNAMICS OF HYDRODYNAMIC BEARINGS
Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings -Rotating loads , alternating and impulse loads in journal bearings – Journal centre Trajectory- Analysis of short bearings under dynamic conditions-Finite difference solution for dynamic conditions

UNIT V
ROTOR DYNAMICS
Rotor vibration and Rotor critical speeds- support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings-computation and measurements of journal bearing coefficients -Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip- Design configurations of stable journal bearings

Suggested Assignment:
To refer ASME Series of Journal of Tribology, Journal of Mechanical Design for giving a seminar on any current topic of relevance.

REFERENCES:

1. 1.Neale, M.J. “Tribology Hand Book”, Butterworth Heinemann, United Kingdom 2001.
2. Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1981
3. Halling, J. (Editor) – “Principles of Tribology “, Macmillian – 1984.
4. Williams J.A. “ Engineering Tribology”, Oxford Univ. Press, 1994.
5. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,”Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd , New Delhi, 2005
6. G.W.Stachowiak & A.W .Batchelor , Engineering Tribology, Butterworth-Heinemann, UK, 2005

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Syllabus for Pre-Ph. D Examination
Mechanical

FRACTURE MECHANICS

UNIT I
Introduction sources of micro and macro cracks fracture criterion based on stress concentration and theoretical strength Griffith's energy - various approach - Stress Analysis for Members with Cracks.

UNIT II
Crack tip Plastic Zone: Plastic zone estimation - yielding fracture mechanics.

UNIT III
Elastic–Plastic Fracture Mechanics - Path-independent integrals, J-integral , J-integral fracture criterion, crack opening displacement(COD), experimental determination of Jintegral and COD - Fatigue and Fatigue crack growth rate.

UNIT IV
Linear static fracture Mechanics Design Concepts - Introduction, the stress criterion, strain energy density, 2-D linear elastic crack problems.

UNIT V
Dynamic Fracture: Mohr's model, strain energy release rates, crack branching, practical applications of crack arresting techniques. Experimental determination of dynamic SIF. - NDT and Fracture Mechanics

Suggested Assignment:
To refer Springer Publishers International Journal of Fracture for giving a seminar on any current topic of relevance.

REFERENCES
1. S.A. Maguid,, "Engineering Fracture Mechanics", Elsevier, 1996
2. David Broke., "Elementary Engineering Fracture Mechanics", Noordhoff, 1995.
3. Karen Hellan, "Introduction to Fracture Mechanics", Mc Graw Hill, 1982.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

FUELS, COMBUSTION AND ENVIRONMENTAL POLLUTION CONTROL

UNIT I

Fuels:- Detailed classification-Conventional and unconventional, solid, liquid, gaseous fuels – Coal-carbonization, Gasification and liquefaction – Lignite; Petroleum based fuels-problems associated with low calorific value gases. Coal gas, Blast furnace gas, Alcohols, Biogas and Nuclear fuels.

UNIT II

Principles of Combustion:- Chemical kinetics – Adiabatic flame temperature – Laminar and turbulent flame propagation and structure – Flame stability – Combustion of fuel droplets and sprays – Combustion systems – pulverized fuel furnaces – Fixed, entrained and fluidized bed systems.

UNIT III

Environmental considerations:- Air pollution – Effects on environment, human health, etc., Principal pollutants – Legislative measures – Methods of emission control. Environmental segments, Natural cycles of environment, Atmospheric structure, Green house effect, Ozone hole, Effect of pollution on living systems, Minimum national standards.

UNIT IV

AIR POLLUTION -Sources and classification of pollutants, Effect of air pollution, Pollution from industries, Chemical reactions in a contaminated atmosphere, urban air pollution, Acid rain, Photo chemical smog, Meteorological aspects of air pollution. Air pollution sampling and measurement, Air pollution control methods and equipment.

UNIT V

WATER POLLUTION AND CONTROL - Origin of waste water, Types of water pollutants and their effects ,Water pollution laws and standards Waste water sampling and analysis , Treatment of waste water.

SOLID WASTE MANAGEMENT - Sources and classification, Public health aspects, methods of collection, Disposal methods, Potential methods of disposal.

NOISE POLLUTION - Human acoustics, Sound and its general features, Noise and its measurement, Noise pollution hazards & Controlling methods.

Suggested Assignment:

To refer Elsevier Publishers International Journal of Environmental Pollution, Inder Science Publishers International Journal of Environment and Pollution for giving a seminar on any current topic of relevance.

TEXTBOOKS:

1. Combustion Fundamentals by Roger A. Strehlow – Mc.Graw Hill
2. Fuels and Combustion by Sharma and Chander Mohan – Tata Mc.Graw Hill.
3. Combustion Engineering and fuel Technology by Shaha A.K. – Oxford and IBH.
4. Principles of Combustion by Kenneth K. Kou – wiley & Sons.
5. Pollution control in process industries - S.P. Mahajan/Tata Mc Graw Hill
6. Environmental pollution control engineering - C.S.Rao/New age Int. Pvt.Ltd
7. Air pollution - M.N.Rao and M.V.N.Rao /Tata Mc Graw Hill
8. Energy Technology - S.Rao and B.B.Parulekar /Khanna publishers

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Mechanical

CONVECTIVE HEAT & MASS TRANSFER

UNIT I

Introduction to convection, review of conservation equations - Forced convection in laminar flow - Exact and approximate solutions of Boundary layer energy equation for plane isothermal plate in longitudinal flow - problems. Forced convection heat transfer in laminar tube flow - forced convection in turbulent flow – Internal Flows-Correlations-Problems.

UNIT II

Approximate analysis of laminar free convective heat transfer on a vertical plate-external flows-correlations-problems. Boiling and condensation: Analysis of film condensation on a vertical surface – pool boiling - forced convection boiling inside tubes - problems.

UNIT III

Definitions of concentration and velocities relevant to mass transfer, Fick's law, species conservation equation in different forms. Steady state diffusion in dilute solutions in stationary media, transient diffusion in dilute solutions in stationary media, one dimensional non dilute diffusion in gases with one component stationary.

UNIT IV

Convective mass transfer - governing equations-forced diffusion from flat plate- Dimension less correlation’s for mass transfer.

UNIT V

Simultaneous heat and mass transfer - analogy between heat, mass and momentum transfer.

Suggested Assignment:

To refer ASME Series of Journal of Heat Transfer for giving a seminar on any current topic of relevance.

REFERENCES:

1. Heat transfer - J. P. Holman.
2. Heat and Mass transfer- R.C. Sachdeva
3. Convective Heat and Mass transfer-Kays.
4. Heat and Mass transfer - V.Gupta and I.Srinivasan - Tata Mc.Graw Hill

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Mechanical

ADVANCED THERMODYNAMICS

UNIT I

BASIC CONCEPTS: Thermodynamics - Temperature and zeroth law of thermodynamics - first law of thermodynamics - limitations of first law - concept of internal energy – second law of thermodynamics - concept of entropy.

THERMODYNAMIC RELATIONS : Introduction - Helmholtz free energy function - Gibbs free energy function - co-efficient of volumetric expansion – isothermal compressibility - differential relation for U, H, G & F - Maxwell relations.

UNIT II

GENERALIZED RELATIONS : Generalized relation for Cp, Cv, K □- relations for internal energy and enthalpy -the various Tds equation - clapeyron equation - gas tables - enthalpy and internal energy - pressure ratio - volume ratio - change of entropy – Introduction to third law of thermodynamics.

EXERGY : Introduction - availability of heat - availability of a closed system - availability function of the closed system - availability of steady flow system – availability function of open system.

UNIT III

IRREVERSIBILITY : Introduction - irreversibility for closed and open system - steady flow process - effectiveness - second law analysis of the power plant.

NON RELATIVE GAS MIXTURES : Introduction - basic definitions for gas mixtures - PVT relations ship for mixtures of ideal gases - properties of mixtures of ideal gases - entropy change due to mixing - mixtures of perfect gases at different initial pressure and temperatures.

UNIT IV

GAS POWER CYCLES: Introduction - air standard cycles - Carnot cycle - Otto cycle - diesel cycle - dual cycles - comparison between Otto, diesel, dual cycles - variations between the air standard Otto cycle and actual cycle - Sterling cycle - Erickson cycle – Atkinson cycle - Bray ton cycle - Lenoir cycle.

UNIT V

DIRECT ENERGY CONVERSION : Introduction - thermoelectric converters - thermo-ionic converters magneto hydrodynamics generators - solar power cells plant – fuel cells hydrogen - hydrogen fuel cells - direct and indirect oxidation fuel cells- biochemical fuels cells.

Suggested Assignment:

To refer Elsevier Publishers Journal of Applied Thermal Engineering for giving a seminar on any current topic of relevance.

REFERENCE BOOKS:

1. Advanced Thermodynamics: Van Wyllan , TMGH
2. Engineering Thermodynamics: P.K.Nag, TMGH
3. Advanced Thermodynamics: Ray & Sarao, Central Publishers.

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Syllabus for Pre-Ph. D Examination

Mechanical

COMPUTATIONAL METHODS IN THERMAL ENGINEERING

UNIT-I
Review of basic fluid mechanics and the governing (Navier-Stokes) equations, Techniques for solutions of PDEs.

UNIT-II
Finite difference method (FD), finite element method and finite volume method. Finite volume (FV) method in one-dimension, Differencing schemes, steady and unsteady calculations

UNIT-III
Boundary conditions, FV discretization in two and three dimensions, SIMPLE algorithm and flow field calculations, variants of SIMPLE, Introduction to Turbulence and turbulence modeling, illustrative flow computations

UNIT-IV
Introduction to commercial software's FLUENT and CFX – grid generation, flow prediction and post-processing Application of FD methods for unsteady and steady heat conduction problems.

UNIT-V
GLOBAL MODELLING UNDER DYNAMIC CONDITIONS: numerical methods for integrating ordinary differential equations and systems of equations; use of EES software; applications to systems with thermal storage, mass storage, etc.

Suggested Assignment:
To refer ASME Series of Journal of Heat Transfer, Journal of Fluids Engineering, Journal of Thermal Science and Engineering Applications Elsevier Publishers Journal of Applied Thermal Engineering, Journal of Finite Elements in Analysis and Design for giving a seminar on any current topic of relevance.

TEXT BOOKS:
1. K.Muralidhar and T.Sundararajan, "Computational Fluid Flow and Heat Transfer", Narosa Publishing House ,New Delhi1995.
2. P.S., Ghoshdasdidar, "Computer Simulation of flow and heat transfer" TMH Ltd., 1998.
3. S.V. Patankar, "Numerical heat transfer fluid flow", Hemisphere Publishing Co, 1980.
4. D.A. Anderson, I.I. Tannehill, and R.H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Hemishphere Publishing Corporation, New York, USA, 1984.
5. C.A.J. Fletcher, ,"Computational Techniques for Fluid Dynamics - Fundamental and General Techniques, Springer-Verlag,1987.
6. T.K. Bose, "Numerical Fluid Dynamics" Narosa Publishing House, 1997.
7. T.K. Sengupta, Fundamentals of Fluid Dynamics, University Press, Hyderabad.

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Syllabus for Pre-Ph. D Examination

Mechanical

THERMAL SYSTEMS SIMULATION AND DESIGN

AIM: To provide review and use knowledge from thermodynamics, heat transfer and fluid mechanics, modeling and simulation techniques for thermal system component analysis and their synthesis in integral engineering systems and processes

OBJECTIVES:
To learn basic principles underlying piping, pumping, heat exchangers; modeling and optimization in design of thermal systems. To develop representational modes of real processes and systems. To optimization concerning design of thermal systems.

UNIT I
DESIGN CONCEPTS
Design Principles , Workable Systems , Optimal Systems , Matching of System Components , Economic Analysis , Depreciation , Gradient Present Worth factor.

UNIT II
MATHEMATICAL MODELLING
Equation Fitting , Nomography , Empirical Equation , Regression Analysis , Different Modes of Mathematical Models , Selectio n, Computer Programmes for Models.
UNIT III
MODELLING THERMAL EQUIPMENTS
Modelling Heat Exchangers , Evaporators , Condensers , Absorption and Rectification Columns, Compressors, Pumps, Simulation Studies, Information Flow Diagram , Solution Procedures.

UNIT IV
OPTIMIZATION
Objective Function Formulation , Constraint Equations , Mathematical Formulation , Calculus Method , Dynamic Programming , Search Methods , ANN and Genetic Algorithm.
UNIT V
DYNAMIC BEHAVIOUR
Steady state Simulation , Laplace Transformation , Feedback Control Loops , Stability Analysis , Non-Linearities.

Suggested Assignment:
To refer ASME Series of Journal of Heat Transfer, Elsevier Publishers Journal of Applied Thermal Engineering, AIAA Transactions of Journal of Energy for giving a seminar on any current topic of relevance.
TEXT BOOKS:
1. Stoecker W. F., Design of Thermal Systems , McGraw Hill Edition , 1989.
2. Bejan A., George Tsatsaronis , Michael J. Moran , Thermal Design and Optimization , Wiley , 1996.
REFERENCES:
1. Kaput J. N., Mathematical Modelling , Wiley Eastern Ltd , New York , 1989.
2. Yogesh Jaluria , Design and Optimization of Thermal Systems , CRC Press , 2007.
3. Rao S. S., Engineering Optimization Theory and Practice , New Age Publishers , 2000.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

COMBUSTION AND EMISSION IN ENGINES

AIM

To Demonstrate extensive mastery of the fundamental principles which govern the design and operation of internal combustion engines as well as a sound technical framework for understanding real world problems.

OBJECTIVE :

(i) Understand combustion in spark ignition and diesel engines.

(ii) To identify the nature and extent of the problem of pollutant formation and control in internal combustion engines government legislation.

UNIT I

COMBUSTION PRINCIPLES

Combustion – Combustion equations, heat of combustion - Theoretical flame temperature - chemical equilibrium and dissociation - Theories of Combustion - Pre-flame reactions - Reaction rates - Laminar and Turbulent Flame Propagation in Engines.

UNIT II

COMBUSTION IN S.I. ENGINE

Initiation of combustion, stages of combustion, normal and abnormal combustion, knocking combustion, pre-ignition, knock and engine variables, features and design consideration of combustion chambers. Flame structure and speed, Cycle by cycle variations, Lean burn combustion, stratified charge combustion systems. Heat release correlations. After treatment devices for SI engines.

UNIT III

COMBUSTION IN C.I. ENGINE

Stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl measurement, knock and engine variables, features and design considerations of combustion chambers, delay period correlations, heat release correlations, Influence of the injection system on combustion. Direct and indirect injection systems. Afer treatment devices for diesel enignes.

UNIT IV

COMBUSTION IN GAS TURBINES

Flame stability, re-circulation zone and requirements - Combustion chamber configuration, materials.

UNIT V

EMISSIONS

Main pollutants in engines, Kinetics of NO formation, NOx formation in SI and CI engines. Unburned hydrocarbons, sources, formation in SI and CI engines, Soot formation and oxidation, Particulates in diesel engines, Emission control measures for SI and CI engines, Effect of emissions on Environment and human beings.

Suggested Assignment:

To refer SAE Transactions International Journal of Engines, International Journal of Fuels and Lubrications for giving a seminar on any current topic of relevance.

TEXT BOOKS :

1. Ramalingam, K.K., Internal Combustion Engines, Scitech Publications (India) Pvt. Ltd., 2004.
2. Ganesan, V, Internal Combustion Engines, Tata McGraw Hill Book Co., 2003.
3. John B.Heywood, Internal Combustion Engine Fundamentals,McGraw Hill Book, 1998

REFERENCES :

1. Mathur,M.L., and Sharma,R.P., A Course in Internal Combustion Engines, Dhanpat Rai Publications Pvt. New Delhi-2, 1993.
2. Obert,E.F., Internal Combustion Engine and Air Pollution, International Text Book Publishers, 1983.
3. Cohen,H, Rogers,G,E.C, and Saravanamuttoo, H.I.H., Gas Turbine Theory, Longman Group Ltd., 1980.

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Mechanical

COMPUTATIONAL FLUID DYNAMICS

UNIT I
Introduction: Basic tools of CFD, Numerical Vs experimental tools. ; Mathematical Behavior of PDEs: Parabolic, Hyperbolic and Elliptic PDEs.

UNIT II
Methodology of CFDHT: Discrete representation of flow and heat transfer domain: Grid generation, Governing equations and boundary conditions based on FVM/FDM, Solution of resulting set of linear algebraic equations, Graphical representation and analysis of qualitative results, Error analysis in discretization using FVM/FDM.

UNIT III
Solution of 1-D/2-D steady/unsteady: Diffusion problems, Convection problems, Convection-diffusion problems, source term linearization. ; Explicit and Implicit Approach: Explicit and implicit formulation of unsteady problems,

UNIT IV
Stability analysis. ; Solution of Navier-Stokes Equations for Incompressible Flows: Staggered and collocated grid system, SIMPLE and SIMPLER algorithms. ;

UNIT V
Special Topics in CFDHT: Numerical Methodology for Complex Geometry, Multi-block structured grid system, Solution of phase change Problems.

Suggested Assignment:
To refer ASME Series of Journal of Fluids Engineering for giving a seminar on any current topic of relevance.

TEXT BOOK:
1. S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Taylor and Francis, ISBN-10: 0891165223.

REFERENCES:
1. H. K. Versteeg and W. Malalasekra, Introduction to Computational Fluid Dynamics: The Finite Volume Method, Prentice Hall (2nd Edition), ISBN-10: 0131274988.
2. Jr. D. A. Anderson, Computational Fluid Mechanics and Heat Transfer by McGraw-Hill Education
3. M. N. Ozisik, Finite Difference Method, CRC (1st Edition).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

ADVANCED OPTIMIZATION TECHNIQUES

UNIT I

Linear programming: Two-phase simplex method, Big-M method, duality, interpretation, applications.

Assignment problem: Hungarian's algorithm, Degeneracy, applications, unbalanced problems, traveling salesman problem.

UNIT II

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT III

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

UNIT IV

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

Multi-Objective GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems .

UNIT V

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

Suggested Assignment:

To refer ASME Series of Journal of Engineering Materials and Technology, Journal of Mechanical Design, Elsevier Publishers Finite Elements in Analysis and Design, Simulation modeling Practice and Theory for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S.Rao, New Age Publishers

REFERENCES:

1.Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Genetic Programming- Koza
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

THEORY OF METAL CUTTING AND TOOL DESIGN

UNIT I

Mechanics of Metal Cutting: Geometry of Metal Cutting Process, Chip formation, Chip Thickness ratio, radius of chip curvature, cutting speed, feed and depth of cut - Types of Chips, Chip breakers.

Orthogonal and Oblique cutting processes-definition, Forces and energy calculations (Merchant's Analysis).- Power consumed – MRR – Effect of Cutting variables on Forces, Force measurement using Dynamometers.

UNIT II

Single Point Cutting Tool: Various systems of specifications, single point cutting tool geometry and their inter-relation. Theories of formation of built-up edge and their effect, design of single point contact tools throwaway inserts.

UNIT III

Multipoint Cutting Tools: Drill geometry, design of drills, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speed & feed – machining time – design - from cutters.

Grinding: Specifications of grinding of grinding wheel, mechanics of grinding, Effect of Grinding conditions on wheel wear and grinding ratio. Depth of cut, speed, machining time, temperature, power.

UNIT IV

Tool Life and Tool Wear: Theories of tool wear-adhesion, abrasive and diffusion wear mechanisms, forms of wear, Tool life criteria and machinability index.

Types of sliding contact, real area of contact, laws of friction and nature of frictional force in metal cutting. Effect of Tool angle, Economics, cost analysis, mean co-efficient of friction.

UNIT V

Cutting Temperature: Sources of heat in metal cutting, influence of metal conditions. Temperature distribution, zones, experimental techniques, analytical approach. Use of tool work thermocouple for determination of temperature. Temperature distribution in Metal Cutting

Suggested Assignment:

To refer ASME Series of Journal of Manufacturing Science and Engineering, Springer Publishers International Journal of Advanced Manufacturing Technology for giving a seminar on any current topic of relevance.

REFERENCES:

1. Metal Cutting Principles - M C Shaw / Oxford and IBH Publications, New Delhi
2. Fundamentals of Machining - Boothryd / Edward Amold publishers Ltd.
3. Metal cutting theory and cutting tool design -V. Arshinov and G. Alekseev / Mir Publishers, Moscow
4. Fundamentals of Metal cutting and Machine tools -B.L.Juneja, G. S. Sekhom and Nitin Seth / New Age International publishers

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

METAL FORMING PROCESSES

UNIT I

Fundamentals of Metal Forming: Classification of forming processes, mechanism of metal forming, temperature of metal working, hot working, cold working, friction and lubricants. Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations.

UNIT II

Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging. Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, production of seamless pipes.

UNIT III

Drawing: Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis of wire, deep drawing and tube drawing. Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defect in formed parts.

UNIT IV

Advanced Metal forming processes: HERF, Electromagnetic forming, residual stresses, in process heat treatment, computer applications in metal forming. Press tool design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming and drawing dies.

UNIT V

Jigs and Fixture design: Principles of location, six-point location principle, clamping elements and methods.

Suggested Assignment:

To refer ASME Series of Journal of Manufacturing Science and Engineering, Springer Publishers International Journal of Advanced Manufacturing Technology SAE Transactions International Journal of Materials and Manufacturing for giving a seminar on any current topic of relevance

REFERENCE BOOKS:

1. Mechanical Metallurgy / G.E. Dieter / Tata McGraw Hill
2. Principles of Metal Working / Sunder Kumar
3. Jig and Fixture Design – Edward G. Hoffman, Thomson
4. Principles of Metal Working processes / G.W. Rowe
5. ASM Metal Forming Hand book.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

RAPID PROTOTYPING AND TOOLING

UNIT I
INTRODUCTION
Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping and Tooling on Product Development – Benefits- Applications – Digital prototyping - Virtual prototyping.

UNIT II
LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS
Stereolithography Apparatus, Fused deposition Modeling, Laminated object manufacturing, Three dimensional printing: Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT III
POWDER BASED RAPID PROTOTYPING SYSTEMS
Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies.

UNIT IV
REVERSE ENGINEERING AND CAD MODELING
Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

UNIT V
RAPID TOOLING
Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies - automotive, aerospace and electronic industries.

Suggested Assignment:
To refer ASME Series of Journal of Manufacturing Science and Engineering, Springer Publishers International Journal of Advanced Manufacturing Technology SAE Transactions International Journal of Materials and Manufacturing for giving a seminar on any current topic of relevance

TEXT BOOKS:

1. Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
2. Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.

REFERENCES:

1. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.
2. Rapid Prototyping and Engineering applications : A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.
3. Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

NON - DESTRUCTIVE EVALUATION

UNIT I

Ultra Sonic Hardness Testing: Flaw Detection Using Dye Penetrants. MagneticParticle Inspection introduction to electrical impedance, Principles of Eddy Current testing, Flaw detection using eddy currents.

Introduction to X-Ray Radiography: The Radiographic process, X-Ray and Gamma-ray sources, Geometric Principles, Factors Governing Exposure, Radio graphic screens, Scattered radiation, Arithmetic of exposure, Radiographic image quality and detail visibility, Industrial X-Ray films,

UNIT II

X-Ray Radiography processes: Fundamentals of processing techniques, Process control, The processing Room, Special Processing techniques, Paper Radiography, Sensitometric characteristics of x-ray films, Film graininess signal to noise ratio in radiographs, The photographic latent image, Radiation Protection,

UNIT III

Introduction to Ultrasonic Testing: Generation of ultrasonic waves, Horizontal and shear waves, Near field and far field acoustic wave description, Ultrasonic probes straight beam, direct contact type, Angle beam, Transmission/reflection type, and delay line transducers, acoustic coupling and media,

UNIT IV

Ultrasonic tests: Transmission and pulse echo methods, A-scan, B-scan, C-scan,F-scan and P-scan modes, Flaw sizing in ultrasonic inspection: AVG, Amplitude, Transmission, TOFD, Satellite pulse, Multi-modal transducer, Zonal method using focused beam. Flow location methods, Signal processing in Ultrasonic NDT; Mimics, spurious echos and noise. Ultrasonic flaw evaluation.

UNIT V

Holography: Principles and practices of Optical holography, acoustical, microwave, x-ray and electron beam holography techniques.

Applications - I: NDT in flaw analysis of Pressure vessels, piping

Applications - II: NDT in Castings, Welded constructions, etc., Case studies.

Suggested Assignment:

To refer ASTM Series of Journal of Testing and Evaluation for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1. Ultrasonic testing by Krautkramer and Krautkramer
2. Ultrasonic inspection & Training for NDT : E. A. Gingel, Prometheus Press,
3. ASTM Standards, Vol 3.01, Metals and alloys

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

QUALITY ENGINEERING AND MANUFACTURING

UNIT-I

Quality value and Engineering: An overall quality system, quality engineering in production design, quality engineering in design production processes.

Loss function and quality level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances (N-type-, S-type and L-type)

UNIT-II

Tolerance Design and Tolerancing: Functional limits, tolerance design for N-type, L-type and S-type characteristics, tolerance allocation for multiple components.

Parameter and tolerance design: Introduction to parameter design, signal to noise ratios, parameter design strategy, Introduction to tolerance design, tolerance design using the loss function, identification of tolerance design factors.

UNIT-III

Design of Experiments: Introduction, Task aids and Responsibilites for DOE process steps, DOE process steps description.

Analysis of variance (ANOVA): no-WAY anova, One-way ANOVA, two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT-IV

Orthogonal Arrays: Typical test strategies, better test strategies, efficient test strategies, conducting and analyzing an experiment.

UNIT-V

Interpolation of experimental results: Interpretation methods, percent contribution, estimating the mean.

ISO-9000 Quality system, BDRE,6-sigma, bench marking, quality circles-brain storming fishbone diagram-problem analysis.

Suggested Assignment:

To refer ASME Series of Journal of Manufacturing Science and Engineering, Springer Publishers International Journal of Advanced Manufacturing Technology SAE Transactions International Journal of Materials and Manufacturing for giving a seminar on any current topic of relevance

REFERENCE BOOKS:

1. Taguchi techniques for quality engineering/Philip J.Ross / McGraw Hill Intl. 2nd Edition.
2. Quality Engineering in Production systems/G.Taguchi, A.Elasayed et al/Mc.Graw Hill Intl. Edition.
3. Taguchi methods explained: Practical steps to Robust Design/Papan P.Bagchi/Prentice Hall Ind. Pvt. Ltd. New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

MECHANICS AND MANUFACTURING METHODS OF COMPOSITES

UNIT I

Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.

Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT II

Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.

UNIT III

Coordinate transformations: Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness modulus, off - axis compliance.

UNIT IV

Elastic behavior of unidirectional composites: Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

Strength of unidirectional lamina: Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micro mechanical predictions of elastic constants.

UNIT V

Analysis of laminated composite plates

Introduction, thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

Suggested Assignment:

To refer ASTM Series of Journal of Composites, Technology and Research and ASTM e-news for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials by Isaac and M.Daniel, Oxford University Press, 1994.

REFERENCES:

1. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
Mechanical

PAPER III

CAD THEORY AND PRACTICE

UNIT I
CAD TOOLS:
Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software.

GEOMETRICMODELLING:
Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves

UNIT II
SURFACE MODELING :
Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.
PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES –
Hermite Bi-cubic surface, Bezier surface, B- Spline surface, COONs surface, Blending surface , Sculptured surface, Surface manipulation – Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

UNIT III
GEOMETRICMODELLING-3D:
Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).
CAD/CAM data Exchange: Evaluation of data – exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

UNIT IV
DESIGN APPLICATIONS:
Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.

UNIT V
Collaborative Engineering: Collaborative Design, Principles, Approaches,
Tools, Design Systems.

Suggested Assignment:
To refer ASME Series of *Journal of Tribology, Journal of Mechanical Design* for giving a seminar on any current topic of relevance.

REFERENCES :

1. CAD/CAM Theory and Practice / Ibrhim Zeid / Mc Graw Hill international.
2. Mastering CAD/CAM / Ibrhim Zeid / Mc Graw Hill international.
3. CAD/CAM / P.N.Rao / TMH.
4. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)
5. Concurrent Engineering Fundamentals: Integrated Product Development/ Prasad / Prentice Hall.
6. Successful Implementation of Concurrent Product and Process / Sammy G Sinha / Wiley, John and Sons Inc..

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

EXPERIMENTAL STRESS ANALYSIS

UNIT I

Introduction: Theory of Elasticity, Plane stress and plane strain conditions, Compatibility conditions. Problems using plane stress and plane strain conditions, Threedimensional stress strain relations.

Strain Measurement Methods: Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain gauge circuits

UNIT II

Recording Instruments: Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.

Brittle coatings: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

UNIT III

Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, the displacement field approach to Moire- Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire-Fringes, experimental procedure and techniques.

UNIT IV

Photo elasticity: Photo elasticity – Polariscope – Plane and circularly polarized light, Bright and dark field setups, Photo elastic materials – Isochromatic fringes – Isoclinics

Three dimensional Photo elasticity : Introduction, locking in model deformation, materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered-light method.

UNIT V

Birefringent Coatings Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe order determinations in coatings, stress separation methods.

Suggested Assignment:

To refer ASME Series of *Journal of Tribology, Journal of Mechanical Design, Journal of Turo Machinery, Journal of Dynamic Systems Measurement and Control* for giving a seminar on any current topic of relevance.

REFERENCES:

1. Theory of Elasticity by Timoshenke and Goodier Jr
2. Experimental stress analysis by Dally and Riley,Mc Graw-Hill
3. A treatise on Mathematical theory of Elasticity by LOVE .A.H
4. Photo Elasticity by Frocht

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

ADVANCED MECHANICAL VIBRATIONS

UNIT I

Introduction: Characterization of engineering vibration problems, Review of single degree freedom systems with free, damped and forced vibrations

Two-degree of Freedom Systems: Principal modes of vibration, Spring coupled and mass coupled systems, Forced vibration of an undamped close coupled and far coupled systems, Undamped vibration absorbers, Forced damped vibrations, Vibration isolation.

UNIT II

Multi-degree Freedom systems: Eigen-value problem, Close coupled and far coupled systems, Orthogonality of mode shapes, Modal analysis for free, damped and forced vibration systems, Approximate methods for fundamental frequency- Rayleigh's, Dunkerely, Stodola and Holzer method, Method of matrix iteration, Finite element method for close coupled and far coupled systems.

UNIT III

Free and forced vibration of continuous elastic systems. Longitudinal vibration of rods. The effects of boundaries and discontinuities on longitudinal vibration transmission. Phase closure principle and natural frequencies.

UNIT IV Transient Vibrations: Response to an impulsive, step and pulse input, Shock spectrum

Non-linear Vibrations: Non-linear systems, Undamped and forced vibration with non-linear spring forces, Self-excited vibrations.

UNIT V

Flexural vibration of beams: Derivation of the equation of motion and the procedure to obtain free vibration solutions. Introduction to forced response (harmonic).

Suggested Assignment:

To refer ASME Series of *Journal of Vibration and Acoustics, Journal of Mechanical Design* for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1. Theory and practice of Mechanical Vibrations J.S. Rao and K. Gupta New Age International
2. Mechanical Vibrations (3rd edition), S.S. Rao, Addiston Wesley
3. Mechanical Vibrations G.K. Groover Nem Chand & Brothers
4. Mechanical Vibration Practice V. Ramamurti Narosa Publications
5. Mechanical Vibrations V.P. Singh Dhanpat Rai & sons
6. Textbook of Mechanical Vibrations R.V. Dukkipati & J. Srinivas Prentice Hall of India

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

SIMULATION AND MODELLING

UNIT I

System – ways to analyze the system – Model - types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages & Disadvantages. Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates – independent – dependent – hypothesis – types of hypothesis- steps – types 1& 2 errors – Framing – strang law of large numbers.

UNIT II

Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – Techniques for verification – statistical procedures for developing credible model. Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.

UNIT III

Generation of random variates – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – weibull – normal Bernoullie – Binomial – uniform – poisson

UNIT IV

Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs Simulators – software features – statistical capabilities – G P S S – SIMAN- SIMSCRIPT –Simulation of M/M/1 queue – comparison of simulation languages.

UNIT V

Output data analysis – Types of Simulation w.r.t output dat analysis – warmup period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons. Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – Newboy paper problem.

Suggested Assignment:

To refer Elsevier Publishers *Journal of Simulation Modeling Practice and Theory and ASME Journal of Mechanical Design* for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1. Simulation Modelling and Analysis, Law, A.M.& Kelton, McGraw Hill, 2nd Edition, New York.
2. Discrete Event System Simulation, Banks J. & Carson J.S., PH, Englewood Cliffs, NJ.
3. Simulation of Manufacturing Systems, by Carrie A., Wiley, NY.
4. A Course in Simulation, Ross, S.M., McMillan, NY.
5. Simulation Modelling and SIMNET, Taha H.A., PH, Englewood Cliffs, NJ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS

AIM

To impart knowledge on the Design of Hydraulic and Pneumatic Systems as practiced in industries.

OBJECTIVE

To study the principles, practices and techniques of Design of Hydraulic and Pneumatic Systems.

UNIT I

OIL HYDRAULIC SYSTEMS

Hydraulic Power Generators - Selection and specification of pumps, pump characteristics - Linear and Rotary Actuators - selection, specification and characteristics - Pressure - direction and flow control valves - relief valves, non-return and safety valves - Hydraulic actuation systems.

UNIT II

HYDRAULIC CIRCUIT DESIGN

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits – press circuits - hydraulic milling machine - grinding, planning, copying, forklift, earth mover circuits – Design and methodology-Sequential circuits, cascade, circuits - Compound and combination circuit design - selection of components - safety and emergency mandrels.

UNIT III

PNEUMATIC SYSTEMS AND CIRCUITS

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions - modules and their integration.

UNIT IV

PNEUMATIC CIRCUIT DESIGN

Sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design - hydro pneumatic circuits - Pneumatic equipments - selection of components - design calculations –application.

UNIT V

COMPUTER CONTROL &MAINTENANCE OF FLUID POWER CIRCUITS:

Fuzzy logic in fluid power circuits- PLC in fluid powers- PLC ladder diagram – Low cost automation - Robotic circuits - Installation -Fault finding in fluid power circuits.

Suggested Assignment:

To refer ASME Series of *Journal of Tribology, Journal of Mechanical Design, Journal of Pressure Vessel Technology* for giving a seminar on any current topic of relevance.

TEXTBOOK:

1. Antony Espossito, “Fluid power with Applications ", Prentice Hall, 1980.

REFERENCES:

1. Dudleyt, A.Pease and John J.Pippenger, " Basic Fluid Power ", Prentice Hall, 1987.
2. Andrew Parr, " Hydraulic and Pneumatics ", (HB), Jaico Publishing House, 1999.
3. Bolton. W. “Pneumatic and Hydraulic Systems ", Butterworth - Heineman, 1997.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

DESIGN OF PUMPS AND COMPRESSORS

UNIT I

Introduction to pumps and compressors. Characteristics of working fluids, Fluid mechanics concepts and governing laws of fluid flow.

UNIT II

Pumps – various components and their functions. Classification of pumping systems – based on the applications and working fluids. Design of pumps – data required for the design of pump and design calculations. Selection of the drive – Types of drives, their behavior and advantages, Selection of the pumps – types of pumps. Selection of piping and other components. Development of a schematic layout of the piping system.

UNIT III

Operation and maintenance – installation of pumping system. Testing of the pumping systems – Various methods based on the working fluid, drive and pump etc., Maintenance of the pumps – Prediction and correction methods, Factors affecting the maintenance and their evaluation.

UNIT IV

Rotary compressor system – various components and their functions. Classification of compressors. Design of compressor – data and analysis. Characteristics of the compressors. Selection of the drive and compressors. Development of the schematic layout of the compressor system.

UNIT V

Design of impeller, Types of impellers – centrifugal and axial. Design of a diffuser – Vaneless and vaned diffuser. Types of casings, casing design. Performance characteristics of turbo compressors.

Suggested Assignment:

To refer ASME Series of *Journal of Tribology, Journal of Mechanical Design, Journal of Pressure Vessel Technology* for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1. S.M. Yahya, Turbines, Compressors and Fans, Tata McGraw Hill Publishing Co.
2. Val.S. Lobanoff and Robert R. Ross, Centrifugal Pumps – Designs and Application, Jaico book publishing Co.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

THEORY OF PLASTICITY

UNIT I
Iinvariance in terms of the deviatoric stresses, representative stress - Engineering and natural strains, cubical dilation, finite strains co-efficients, Octahedral strain, strain rate and the strain rate tensor.

UNIT II
Yield criteria for ductile metal - Yield criteria for an anisotropic material. Stress – Strain Relations – Plastic stress-strain relations, Prandtl Roeuss Saint Venant, Levy – Von Mises, Yield locus, symmetry convexity, normality rule.

UNIT III
Application to problems, simple forms of indentation problems using upper bounds. Problems of metal forming.

UNIT IV
Crystal Plasticity, the crystalline state, crystallographic indices, the preferential planes and directions, critical shear stress, theory of simultaneous slip, slip bands, the plastic bending in crystals, dislocations and crystal growth, polycrystals and grain boundaries,

UNIT V
Plane plastic strain and the theory of the slip line filed, two dimensional problems of steady and non steady motion, plastic anisotropy.

Suggested Assignment:
To refer ASME Series of *Journal of Tribology, Journal of Mechanical Design, Journal of Pressure Vessel Technology* for giving a seminar on any current topic of relevance.

REFERENCES:
1. Narayanasamy R, “Theory of Engineering Plasticity”, Ahuja Publications, 2000.
2. Johnson and Mellor, “Plasticity for Mechanical Engineers”, Ban Nostrand, 1973..
3. R.Hill , “The Mathematic theory of Plasticity”, Oxford Publication, 1982.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

ELECTRIC AND HYBRID VEHICLES

AIM :

OBJECTIVE: To understand working of different configurations of electric vehicles, and its components, hybrid vehicle configuration and performance analysis.

UNIT I

ELECTRIC VEHICLES

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNIT II

BATTERY

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT III

DC & AC ELECTRICAL MACHINES

Motor and Engine rating, Requirements, DC machines , Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV

ELECTRIC VEHICLE DRIVE TRAIN

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

UNIT V

HYBRID ELECTRIC VEHICLES

Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components

Suggested Assignment:

To refer SAE Transactions *International Journal of Engines, International Journal of Fuels and Lubricants, International Journal of Passenger Cars-Electronic & Electrical Systems* for giving a seminar on any current topic of relevance.

REFERENCES :

1. Iqbal Hussain, Electric & Hybrid Vechicles – Design Fundamentals, CRC Press.
2. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles.

DESIGN OF HEAT TRANSFER EQUIPMENT

UNIT I
DESIGN OF HEAT EXCHANGERS:
Exchangers-mean temperature differences for parallel and counter flow- effectiveness method(N.T.U)-keys and London charts.
DESIGN OF CONDENSERS:
Types overall heat transfer coefficients- temperature distribution and heat flow in a condenser-pressure drop in a condenser –extended fin surfaces-consideration of fouling factor-L.M.T.D. correction factor.

UNIT II
DESIGN OF EVAPORATORS TYPES:
Temperature distribution and heat flow in an evaporator-pressure drop- factor to be consider in the design of heat transfer equipment-types of heat consideration of fouling factor – correction factor
DESIGN OF COOLING ROWERS AND SPRAY PONDS:
Classification-performance of cooling towers – analysis of counter flow cooling towers-enthalpy- temperature diagram of air and water- cooling ponds- types of cooling ponds – cross flow cooling towers- procedure for calculation of outlet conditions.

UNIT III
DESIGN OF COMPRESSORS:
Types-equivalent shaft work-volumetric efficiency-factors affecting total volumetric efficiency –compound compression with inter cooling- rotary compressors-surging.

UNIT IV
DESIGN OF DUCTS:
Continuity equation-Bernoulli's equation-pressure losses-frictional charts- coefficient of resistance for fillings- duct sizing methods.

UNIT V
DESIGN OF FANS:
Standard air-fan horsepower-fan efficiency-similarity laws-fan laws-performance coefficients- theoretical expression for total pressure drop by a fan-centrifugal fan- axial flow fan-system resistance.
PIPING SYSTEM:
Requirements of a good piping system-pressure drop in pipes-moody chart-refrigerant piping-discharge line-liquid line-suction line-piping arrangement

Suggested Assignment:
To refer ASME Series of *Journal of Heat Transfer* for giving a seminar on any current topic of relevance.

REFERENCES:
1. Heat and mass transfer by Arora & Domkundwar.
2. Refrigeration & Air-Conditioning by P.L.Ballaney
3. .Refrigeration & Air-Conditioning by C.P.Arora.
4. .Refrigeration & Air-Conditioning by Stoecker

REFRIGERATION EQUIPMENT AND CONTROLS

UNIT I

Compressors - types - equivalent shaft work - Volumetric efficiency – factors affecting total volumetric efficiency - compound compression with inters cooling - rotary compressors - surging - screw compressors - lubricating oils. Condensers - types -Water cooled Condensers- Air cooled, Evaporative types - Economic water rate - Economic water velocity - over all heat transfer co-efficient - design - temperature distribution and heat flow in a condenser - pressure drop - fouling factor - LMTD correction factor.

UNIT II

Cooling towers and spray ponds - classification - performance of cooling towers - analysis of counter flow cooling towers - enthalpy - temperature diagram of air and water - cooling ponds - types - cross flow cooling towers - procedure for calibration of outlet conditions.

UNIT III

Evaporators - types - Flooded and dry Evaporators, natural and forced convection type - shell and tube - shell and coil, plate type - secondary Evaporators – temperature distribution and heat flow in evaporator - pressure drop - fouling correction factor Defrosting - necessity - methods - manual, automatic, periodic defrosting, solid and liquid adsorbents, water defrosting, defrosting by reversing the cycle, automatic hot gas defrosting, thermo balance defrosting, electric control defrosting.

UNIT IV

Expansion devices - Capillary tube, thermostatic expansion valve - float valves, externally equalized valves - automatic expansion valves - solenoid control valve - location of piping and pump design consideration.

UNIT V

Performance of complete Vapour compression system-Performance of condensing unit-compressor -Evaporator-balancing of load in two stage compression. Installation of vapour compression refrigeration system - evaluation and dehydration testing for leakages - charging - adding oil.

Suggested Assignment:

To refer Elsevier Publishers *International Journal of Refrigeration* for giving a seminar on any current topic of relevance.

REFERENCES:

1.'Refrigeration and Air Conditioning'- by Stoecker – TMGH– International Edition
2. 'Refrigeration and Air Conditioning' - by Domkundwar – Dhanpat Rai & Co.
3. 'Refrigeration and Air Conditioning' - by - C.P.Arora – TMGH
4. ASHRAE Guide and Data book applications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

I.C. ENGINES AND ALTERNATE FUELS

UNIT I

ntroduction: Historical Review –Broad classification of fuels - Engine Types – Design and operating Parameters. Cycle Analysis: Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles – Real Engine cycles difference and Factors responsible for – Computer Modeling and simulation of combustion process.

UNIT II

Gas Exchange Processes: Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging. Exhaust gas recirculation system and their designing. Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre chamber Engine flows. Fuel supply systems for SI and CI engines to use gaseous fuels like LPG, CNG, and Hydrogen.

UNIT III

Engine Combustion: Combustion and Speed – Cyclic Variations – Ignition – Abnormal combustion Fuel factors. Combustion in CI engines: Essential Features – Types of Cylinders. Pr. Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and control:

UNIT IV

Pollutant Formation and Control: Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, Unburnt Hydrocarbon and particulate emission – Measurement – Exhaust Gas Treatment. Catalytic converter, 2 way type & 3 way type.

UNIT V

Modern Trends in IC Engines: Computer Simulation and Optimized Design –Lean Burning and Adiabatic concepts - Rotary Engines. Modification in IC Engines to suite Bio-Fuels.

Suggested Assignment:

To refer SAE Transactions *International Journal of Engines, International Journal of Fuels and Lubricants, International Journal of Passenger Cars-Electronic & Electrical Systems* for giving a seminar on any current topic of relevance.

REFERENCES:

1. I.C. Engines Fundamentals/Heywood/Mc Graw Hill
2. I.C. Engines /Ferguson
3. I.C. Engines / Maleev
4. IC Engines / V Ganesan
5. I.C. Engine in theory and Practice Vol. I and II / Taylor
6. I.C. Engines / Obert / Int.Text Book Co.
7. Combustion Engine Processes / Lichty
8. Scavenging of two stroke Cycle Engines / Switzer

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

THERMAL AND NUCLEAR POWER PLANTS

UNIT I

Energy scenario. Overview of steam power plant. Analysis of steam cycles. Feedwater heaters. De-aerator and drain cooler. Optimization of cycle parameters, reheat and regeneration. Analysis of multi-fluid coupled cycles. Cogeneration of power and process heat. Combined cycle power generation.

UNIT II

Fuels. Combustion mechanisms. Draft systems. Combustion control. Furnaces for burning coal in fluidized beds and in pulverized form. Coal handling installation.
Different types of boilers and their specific uses. Boiler mountings and accessories. Feedwater treatment.

UNIT III

Boiler maintenance. Circulation theory. Downcomers and risers. Drum and its internals. Economiser. Convective and radiant super heaters. Superheat temperature control. Recuperative and regenerative air preheaters. Dust and ash removal systems. Environmental aspects of power generation

UNIT IV

Basic concepts of reactor physics, radioactivity. Neutron Scattering. Thermal and fast reactors. Nuclear cross-sections. Neutron flux and reaction rates. Moderator criteria. Reactor core design. Conversion and breeding. Types of reactors. Characteristics of boiling water, pressurized water, pressurized heavy water, gas cooled and liquid metal cooled reactors.

UNIT V

Future trends in reactor design and operation. Thermal-hydraulics of reactors. Heavy water management. Containment system for nuclear reactor. Reactor safety radiation shields. Waste management. Indian nuclear power programme.

Suggested Assignment:

To refer Inderscience Publishers *International Journal of Nuclear Science and Technology,* ASME Series of *Journal of Thermal Science and Engineering Applications* for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1. M.M.EI. Wakil., *Nuclear Power Engineering'*, McGraw Hill Book Company, New York, 1987.
2. S. Glasstone and A. Setonske., *Nuclear Reactors, Engineering*', 3rd Ed., CBS Publishers and Distributors, 1992.

REFERENCES:

1. Loftness, *Nuclear Power Plants'*, D. Van Nostrand Company Inc, Princeton, 1964.
2. S. Sarg et al., *Physics of Nuclear Reactors'*, Tata McGraw Hill Publishing Company Ltd., 1985.
3. T. J. Connoly., *Fundamentals of Nuclear Energy'*, John Wiley, 1978.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

EXPERIMENTAL METHODS IN THERMAL ENGINEERING

UNIT I

Introduction: Basic concepts of measurement methods, single and multi point measurement Min space and time. Processing of experimental data, curve fitting and regression analysis. Data Acquisition systems: Fundamentals of digital signals and their transmission, A/D-and D/A converters, Basic components of data acquisition system. Computer interfacing of digital instrument and data acquisition systems; Digital multiplexes, Data acquisition board (DAQ), Digital image processing fundamentals.

UNIT II

Design and Construction of Experimental facilities: wind tunnel, general test rigs, Test cells for flow visualization and temperature mapping.

Modeling and Simulation of Measurement System: Lumped analysis, first order and second order systems: Frequency response and time constant calculation. Response of a generalized instrument to random data input, FFT analysis.

UNIT III

Temperature Measurement: Measurement Design, Construction and Analysis of liquid and gas thermometers, resistance thermometer with wheat stone bridge, Thermo-electric effect, Construction, testing and calibration of thermocouples and thermopiles, Analysis of effect of bead size and shielding on time constant and frequency response, characteristics of thermocouple, pyrometers, radiation thermometers.

Interferometry & Humidity measurement: interferometers, Humidity measurement: Conventional methods, electrical transducers, Dunmox humidity and microprocessor based dew point instrument, Calibration of humidity sensors.

UNIT IV

Flow and Velocity Measurement: industrial flow measuring devices, design, selection and calibration, velocity measurements, pitot tubes, yaw tubes, pitot static tubes; frequency response and time constant calculation. Hot-wire anemometer; 2d/3d flow measurement and turbulence measurement, Laser application in flow measurement, Flow visualization techniques, Combustion photography.

UNIT V

Measurement of Pressure, Force, and Torque: Analysis of liquid manometer, dynamics of variable area and inclined manometer, Pressure transducers, Speed and torque measurement: speed and torque measurement of rotating system.

Air Pollution sampling and measurement; Units for pollution measurement, gas sampling technique s, particulate sampling technique, gas chromatography.

Suggested Assignment:

To refer ASME Series of *Journal of Thermal Science and Engineering Applications, Journal of Fluids Engineering* and AIAA Transactions *Journal of Thermo physics and Heat Transfer, Journal of Energy* for giving a seminar on any current topic of relevance.

REFERENCES:

1. **Experimental Methods for Engineers -** J.P. Holman, McGraw-Hill Publications.
2. **Mechanical Measurements -** Beckwith M.G., Marangoni R.D. and Lienhard J.H.,Pearson Education.
3. **Measurements systems-Application and Design -** E.O. Doebelin, Tata McGraw-Hill, Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

ELECTRONIC ENGINE MANAGEMENT SYSTEMS

AIM:

To teach the students about the various sensors and engine management systems used in petrol and diesel engines

OBJECTIVE :

- To give an in-depth knowledge of various sensors used in engine management
- To give an overview of different types of fuel injection and ignition systems
- To know the latest technological advancements in vehicle power plant

UNIT I

ELECTRONICS

Semiconducters , Transistors, Amplifiers – Integrated circuits – Analog and Digital, Logic Gastes, Microcontrollers –Analog Digital / Digital Analog Converters.

UNIT II

SENSORS

Sensors for Air flow, Pressure, Temperature, Speed, Exhaust Oxygen, Knock and Position in engine management systems – Principle of operation, construction and characteristics.

UNIT III

GASOLINE INJECTION SYSTEM

Open loop and closed loop systems, Mono point, Multi point, Direct injection systems and Air assisted systems – Principles and Features, examples of Bosch injection systems. Idle speed, lambda, knock and spark timing control. Three way catalytic converters, Lean NOx converters.

UNIT IV

DIESEL INJECTION SYSTEM

Heat release in the diesel engine and need for control of fuel injection. Inline injection pump - Rotary Pump and injector– Construction and principle of operation, Electronic control of these pumps. Common rail and unit injector system – Construction and principle of operation,

UNIT V

IGNITION SYSTEMS

Ignition fundamentals, solid state ignition systems, high energy ignition distributors, Electronic spark timing and control. Combined ignition and fuel management systems. Dwell angle calculation, Ignition timing calculation.

Suggested Assignment:

To refer SAE Transactions *International Journal of Engines, International Journal of Fuels and Lubricants, International Journal of Passenger Cars-Electronic & Electrical Systems* for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1. Robert N.Brady, Automotive Computers and Digital Instrumentation, Prentice Hall, 1988.
2. Bosch Technical Instruction Booklets.
3. Tom Denton, Automotive Electrical and Electronic Systems, Edward Amold, 1995.

REFERENCES:

1. Duffy Smith, Auto Fuel Systems, The Good Heart Willcox Company Inc., Publishers, 1987.
2. Gasoline Engine Management, Second Edition, Robert Bosch GmbH, 2004.
3. Engine Management, Second Edition, Robert Bosch GmbH, 1999.

4. Eric Chowaniety, Automobile Electronics, SAE Publications 1995.
5. William B. Ribbews, Understanding Automotive Electronics, Fifth Edition, SAE Publications1998.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

INTELLIGENT MANUFACTURING SYSTEMS

UNIT I

Computer Integrated Manufacturing Systems – Structure and functional areas of CIM system - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems – MAP/TOP, OSI Model, Data Redundancy, Top down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing – System Components, System Architecture and Data Flow, System Operation.

UNIT II

Components of Knowledge Based Systems – Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition. Machine Learning – Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

UNIT III

Automated Process Planning – Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning.

UNIT IV

Knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design, Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KBSES.

UNIT V

Group Technology: Models and Algorithms – Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation – Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System, Structure of Knowledge based system for group technology (KBSGT) – Data Baswe, Knowledge Base, Clustering Algorithm.

Suggested Assignment:

To refer ASME Series of *Journal of Manufacturing Science and Engineering,* Springer Publishers *International Journal of Advanced Manufacturing Technology* SAE Transactions *International Journal of Materials and Manufacturing* for giving a seminar on any current topic of relevance

TEXT BOOKS:

1. Intelligent Manufacturing Systems by Andre Kusaic.
2. Artificial Neural Networks by Yagna Narayana
3. Automation, Production Systems and CIM by Groover M.P.
4. Neural Networks by Wassarman.

LOGISTICS AND SUPPLY CHAIN MANAGEMENT

UNIT I

Logistics and Competitive Strategy: Competitive advantage through logistic – Mission – Integrated supply chains – Models in Logistics Management – Logistics to supply Chain Management – Focus areas in supply Chain Management – performance Measures for SCM. Customer Service Dimension: The marketing and logistics interface – Customer service and customer retention - Service driven logistics systems – Basic service capability – Increasing customer expectations – Value added services – Customer satisfaction and success – Time based logistics.

UNIT II

Logistics System Design: Logistics positioning – Logistics reengineering – reengineering procedure – logistics environmental assessment – time based logistics – alternative logistics strategies – strategic integration – logistics time based control techniques. Measuring Logistics Costs and Performance: The concept of Total Cost analysis – Principles of logistics costing – Logistics and the bottom line – Impact of Logistics on Shareholder value – customer profitability analysis – direct product profitability – cost driver and activity based costing.

UNIT III

Logistics and Supply chain relationships: Benchmarking the logistics process and SCM operation – Mapping the supply chain processes – Supplier and distributor benchmarking – setting benchmarking priorities – identifying logistics performance indicators – Channel structure – Economics of distribution – channel relationship – logistic service alliances.

UNIT IV

Sourcing, transporting and pricing products: Sourcing decisions – transportation in the supply chain – basic transportation economics and pricing – transportation documentation – pricing and revenue management in the supply chain – pricing and revenue management in supply chains.

UNIT V

Coordination and Technology in Supply chain: Lack of coordination and Bullwhip Effect – obstacles to coordination – managerial levers to achieve coordination – Building strategic partners and trust within a supply chain. Role of IT in the supply chain – Ebusiness. Managing global logistics and global supply chains: Logistics in a global economy – global operating levels – interlink global economy – Global supply chain business processes – Global strategy, purchasing, logistics – Global alliances – Issues and Challenges.

Suggested Assignment:

To refer Elsevier Publishers *International Journal of Computers and Industrial Engineering* Springer Publishers *Journal of Industrial Engineering International* for giving a seminar on any current topic of relevance

REFERENCES:

1. Donald J. Bowersox and David J. Closs, Logistical Management: The Integrated Supply Chain Process, TMH.
2. Martin Christopher, Logistics Supply Chain Management, Pitman, London.
3. Sunil Chopra and Peter Meindl: Supply Chain Management: Strategy, Planning and Operation, Pearson Education, New Delhi.
4. B.S.Sahay, supply Chain Management for Global competitivesness, Macmillan.
5. Philip B.Schary, Tage Skjott – Larsen: Manageing the Global Supply Chain.
6. Arjun J Van Weele: Purchasing and Supply Chain Management- Analysis, Planning and Practice, Thomson Learning.
7. Ballou, Business Logistics/Supply chain management, Pearson Education.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

ADVANCES IN MANUFACTRURING TECHNOLOGY

AIM:

The aim of this course is to impart knowledge in various fields of advanced manufacturing technology

OBJECTIVE:

At the end of this course the students are expected to understand metal cutting and cutting tool materials, special machining processes, unconventional machining processes, micro machining process and rapid prototyping.

UNIT I

METAL CUTTING AND TOOL MATERIALS

Orthogonal and oblique cutting – types of tool wear, abrasion, diffusion, Oxidation. Fatigue and adhesive wear – Prediction of tool life – Monitoring of wear, Cutting forces and Vibration – tool Materials, Cemented Carbide, Coated Carbide, Cermets. Ceramic, CBN and PCD – Selection of Machining parameters and Tools.

UNIT II

SPECIAL MACHINING PROCESSES & EXPERIMENTAL TECHINIQUES

Deep hole drilling Honing – Lapping – Super finishing – Burnishing – Broaching High speed Machining, Measurement of cutting forces, temperature, Vibration and Tool wear in machining processes.

UNIT III

UNCONVENTIONAL MACHINING

Principles, Processes. Various influencing parameters and Applications of Ultrasonic Machining, Electro Discharge Machining, Electro Chemical Machining, Electron and Laser Beam Machining, Plasma Arc Machining and Water Jet Machining.

UNIT IV

MICRO MACHINING

Introduction to MEMS, principle, process capabilities, types, advantages, limitations and applications of bulk micro machining, surface micro machining and tool based micro machining processes.

UNIT V

RAPID PROTOTYPING

Introduction – Classification – Principle advantages limitations and applications- Stereo lithography – laminated object manufacturing – Selective laser sintering –FDM, SGC, 3D Printing.

Suggested Assignment:

To refer ASME Series of *Journal of Manufacturing Science and Engineering,* Springer Publishers *International Journal of Advanced Manufacturing Technology* SAE Transactions *International Journal of Materials and Manufacturing* for giving a seminar on any current topic of relevance.

TEXT BOOKS:

1. Shaw Milton.C., “Metal Cutting Principles”, Second Edition, Oxford University, Press, 2005.
2. Armarego E.J.A. and Brown R.H., “The Machining of metals”, Prentice Hall, 1982.

REFERENCES:

1. Battacharya, “ theory of metal cutting”, NCB Agency, 1984.

2. HMT Manual, "Non – t5raditional Machining Methods", 1975.
3. Pandley P.S. and shah.N. "Modern Manufacturing Processes", 1980.
4. Sadasivan T.A., and Sarathy.D. "cutting Tools for Productive Machining", Widia (India) Limited 1999.
5. Rich F. and Knight'K., "Artificial Intelligence", McGraw Hill Inc, 1991.
6. Marc J. Madou, Fundamentals of Microfabrication: The Science of Miniaturization, Second Edition, CRC Press (ISBN: 0849308267), 2006.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

PRODUCTION AND OPERATIONS MANAGEMENT

UNIT I

Operation Management – Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management. Product design – Requirements of good product design – product development – approaches – concepts in product development – standardization - simplification – Speed to market – Introduction to concurrent engineering.

UNIT II

Value engineering – objective – types of values –function & cost – product life cycle – steps in value engineering – methodology in value engineers – FAST Diagram –Matrix Method. Location – Facility location and layout – Factors considerations in Plant location – Comparative Study of rural and urban sites – Methods of selection plant layout – objective of good layout – Principles – Types of layout – line balancing.

UNIT III

Aggregate Planning – definition – Different Strategies – Various models of Aggregate Planning-Transportation and graphical models Advance inventory control systems push systems –Material Requirement – Terminology – types of demands – inputs to MRP-techniques of MRP – Lot sizing methods – benefits and drawbacks of MRP – Manufacturing Resources Planning (MRP –II). Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System - Calculation of number of Kanbans Requirements for implementation JIT – JIT Production process – benefits of JIT.

UNIT IV

Scheduling – Policies – Types of scheduling- Forward and Backward Scheduling – Gantt Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – Job shop Scheduling – 2 jobs and n machines – Line of Balance.

UNIT V

Project Management – Programming Evaluation Review Techniques (PERT) – three times estimation – critical path – probability of completion of project – critical path method - crashing of simple nature.

Suggested Assignment:

To refer Elsevier Publishers *Journal of Operations Management, International Journal of Production Economics* for giving a seminar on any current topic of relevance

REFERENCES:

1. "Operations Management" by E.S. Buffs.
2. "Operations Management, Theory and Problems" by Joseph G. Monks.
3. "Production Systems Management" by James. L. Riggs.
4. "Production and Operations Management" by Chary.
5. "Operation Management" by Chase
6. "Production & Operation Management" by PannerSelvam
7. "Production & Operation Analysis" by Nahima

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination

Mechanical

ADVANCES IN CASTING AND WELDING PROCESSES

AIM:

To impart knowledge on basic concepts and advances in casting and welding processes.

OBJECTIVES:

- To study the metallurgical concepts and applications of casting and welding process.
- To acquire knowledge in CAD of casting and automation of welding process.

UNIT I

CASTING DESIGN

Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering

UNIT II

CASTING METALLURGY

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy.

UNIT III

RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT

Shell moulding, precision investment casting, CO_2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.

UNIT IV

WELDING METALLURGY AND DESIGN

Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.

UNIT V

RECENT TRENDS IN WELDING

Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

Suggested Assignment:

To refer Springer Publishers *Welding International,* American Foundry Society Publishers *International Journal of Metal Casting* for giving a seminar on any current topic of relevance

REFERENCES:

1. ASM Handbook, Vol 15, Casting, 2004
2. ASM Handbook vol.6, welding Brazing & Soldering, 2003
3. Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002
4. Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002
5. HEINELOPER & ROSENTHAL, Principles of Metal Casting, Tata McGraw Hill, 2000.
6. Jain P.L., Principles of Foundry Technology,Tata McGrawHill Publishers, 2003

7. Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002
8. IOTROWSKI – Robotic welding – A guide to selection and application – Society of mechanical Engineers, 1987.
9. SCHWARIZ, M.M. – Source book on innovative welding processes – American Society for Metals (OHIO), 1981
10. CORNU.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.
11. LANCASTER.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1980

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
Mechanical

MATERIALS TECHNOLOGY

UNIT I
Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material.

UNIT II
Griffth's Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson : Miller Parameter, Deformation and Fracture mechanism maps. Fatigue, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and Paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non:metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis.

UNIT III
Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep. Selection for Surface durability, Corrosion and Wear resistance, Relationship between Materials Selection and Processing, Case studies in Materials Selection with relevance to Aero, Auto, Marine, Machinery and Nuclear Applications.

UNIT IV
MODERN METALLIC MATERIALS : Dual Phase Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Intermetallics, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass, Quasi Crystal and Nano Crystalline Materials.

UNIT V
NONMETALLIC MATERIALS : Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, Structure, Propertiesand Applications of engineering Polymers, Advanced Structural Ceramics WC, TiC, TaC, Al2 O3, SiC, Si3 N4 , CBN and Diamond : properties, Processing and applications.

Suggested Assignment:
To refer ASME Series of *Journal of Engineering Materials and Technology,* SAE Transactions *International Journal of Materials and Manufacturing* for giving a seminar on any current topic of relevance.

TEXT BOOKS:
1. Mechanical Behaviour of Materials / Thomas H. Courtney, McGraw Hill.
2. Mechanical Metallurgy / George E. Dieter / McGraw Hill.
3. Selection and use of Engineering Materials /Charles J.A/ Butterworth Heiremann.

STATISTICAL QUALITY CONTROL

OBJECTIVE:

This course is concerned with the applications of statistical tools in measuring and controlling the quality of products/processes.

UNIT I

QUALITY FUNDAMENTALS

Importance of quality, meaning of quality, quality dimensions, quality planning, quality control, SQC, Quality assurance, quality costs, economics of quality, quality and productivity, quality and reliability, quality loss function.

UNIT II

CONTROL CHARTS FOR VARIABLES

Process variation,– Statistical basis, 3 – sigma control limits, Rational sub-grouping, X ,R and S charts, Interpretation of charts, warning and modified control limits, operating characteristic curve for X – chart, SPC -process capability analysis – Cp, CPK, Cpm, Machine capability, Gauge capability.

UNIT III

CONTROL CHARTS FOR ATTRIBUTES

P, np, C, U and ku charts, demerits control chart, Multi – variable chart, individual measurement charts – moving average and moving range charts, quality control in service sector.

UNIT IV

ACCEPTANCE SAMPLING

Need for Acceptance sampling, economics of sampling, sample selection, single and Double sampling – O.C. curves, Average outgoing quality (AOQ), Average sample Number (ASN), Average total inspection (ATI), Multiple and sequential sampling, sampling plans – military standards, Dodge – Roming, IS 2500.

UNIT V

METROLOGY & INSPECTION

Fundamental methods of measurement, precision & accuracy, measurement devices - Linear and Angular - Coordinate Measuring Machine, Destructive and Non- Destructive Testing methods.

Suggested Assignment:

To refer Springer Publishers *Journal of Industrial Engineering International,* Elsevier Publishers *Computers and Industrial Engineering* for giving a seminar on any current topic of relevance.

TEXT BOOK :

1. Douglus C.Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, 2004.

REFERENCES :

1. Statistical Quality Control, Eugene L.Grant and Richard S.Leaven Worth, TMH, Seventh Edition, 2000.
2. Quality Control. Dale H.Besterfield, Pearson Education Asia, Seventh Edition,2004.