Department of Mechanical Engineering

About the Department: The Mechanical Engineering Department seeks to combine excellence in education and research with service to Defence. The goal of our academic programmes in mechanical engineering is to provide students with a balance of intellectual and practical experiences that enable them to address a variety of Defence needs. The Department is one of the largest departments.

The Department is known for research and projects in fluid dynamics, heat transfer, finite element methods, vibrations, experimental stress analysis, vehicle dynamics, CAD-CAM and other areas. Experimental and computational facilities are being continuously upgraded. The Department has established, over the years, a close interaction with the DRDO laboratories and industry. It has carried out a large number of consultancy and sponsored research projects, which have been successfully completed. A number of sponsored research projects are ongoing.

The Department has carried out significant curriculum development work in Mechanical Engineering. Apart from the regular courses the department offers, on a continual basis, a wide variety of short-term intensive programmes for personnel from DRDO laboratories, Armed Forces and industrial establishments. User-oriented M. Tech programmes on Armament/Combat Vehicles and Marine Engineering has been formulated as per the needs of the Defence sector. The Programmes offers a wide choice of specializations, electives and research areas. The department has laboratories in CAD/CAM, Vibration, Experimental Stress Analysis, Heat Transfer and Fluid Power.

M. Tech (*Marine Engineering*)

Brief Description: The aim of the programme is to impart advanced training and to update knowledge in the field of design, development, quality assurance and inspection of Marine equipments to engineering officers from Indian Navy, DRDO scientists and GATE qualified students. At the end of the programme the officer/student should be able to undertake R&D work and/or inspection, testing and evaluation of Marine Engineering Equipment systems.

Eligibility: Bachelor's Degree in Mechanical/Marine Engineering of a recognised Institute/University.

Organization: M. Tech Mechanical Engineering with specialisation Marine Engineering is a four-semester programme. In the first semester there are six courses along with lab. In second semester, there are six courses. In each of these semesters, there will be a mid semester examination and a final semester examination of every course. In third semester, one seminar/CAE lab in addition to the dissertation work whereas in fourth semester, only dissertation work is to be completed. Half yearly evaluation of the project takes place at the end of the third semester. At the end of the final semester, student submits a thesis and makes a presentation about the project, which is evaluated by the Internal and External examiners.

Visits to various DRDO labs like NSTL, ARDE, VRDE, Industry involved with Indian navy and naval technical facility are planned to enhance student's appreciation & understanding of the subject and provide them with opportunity to get hands on experience on various test equipment and procedures related to design, manufacturing and testing of Marine Engineering Equipments.

The details of the courses offered under the programme:

DEPARTMENT OF MECHANICAL ENGINEERING

M. Tech. in Mechanical Engineering [Marine Engg]

Semester I

Sl. No.	Course Code	Course	Contact Hours/week		Credits
			L	T/P	
1	ME 601	Mechanical Vibrations	3	0	3
2	ME 602	Advanced Mechanics of Materials	3	0	3
3	ME 603	Advanced Fluid & thermal Sciences	3	0	3
4	NW 608	Warship Transmission & Tribology	3	0	3
5	NW 611	Automatic Control Systems	3	0	3
6	AM 607	Mathematics for Engineers	3	0	3
7	NW 641	MATLAB and Vibration Lab	0	4	2
		Total	**18**	**4**	**20**

Semester II

Sl. No.	Course Code	Course	Contact hours/week		Credits
			L	T/P	
1	NW 605	Marine Diesel & Steam Engines	3	0	3
2	NW 606	Marine Gas Turbines	3	0	3
3	--	Elective I	3	0	3
4	--	Elective II	3	0	3
5	--	Elective III	3	0	3
6	--	Elective IV	3	0	3
7	TM 649	Scientific/Engg. Practices and Skills	3	0	3
		Total	**21**	**0**	**21**

Semester III

Sl. No.	Course Code	Course	Contact Hours /week		Credits
			L	T/P	
1	--	Elective – V	3	0	3
2	--	Elective – VI	3	0	3
3	ME 651	M.Tech. Dissertation Phase I	16		8
		Total	**22**		**14**

Semester IV

Sl. No.	Course Code	Course	Contact Hours /week		Credits
			L	T/P	
1	ME 652	M.Tech. Dissertation Phase II	28		14
		Total	**28**		**14**

List of Electives

Sl. No.	Course Code	Course Name
Elective I, II, III, IV, V & VI		
1.	NW 607	Ship Dynamics & Marine Systems * (compulsory for all students)
2.	NW 619	Nuclear Reactor Engineering* (compulsory for IHQ MOD sponsored)
3.	ME 604	Advanced Materials and Processing
4.	ME 607	Computational Fluid Dynamics
5.	ME 608	Finite Element methods
6.	ME 609	Design of Machinery
7.	ME 618	Advanced Theory of Mechanisms
8.	ME 619	Advanced Composite Structures
9.	ME 620	Tribology
10.	ME 631	Compressible Fluid Flow
11.	ME 632	Fatigue and Fracture Mechanics
12.	AM 603	Operations Research
13.	AM 604	Advanced Statistical Techniques
14.	AM 624	Advanced Numerical Methods
15.	TM 602	R&D Management
16.	TM 603	Project Management
17.	TM 604	Strategic Management
18.	TM 609	System Engineering
19.	MS 601	Introduction to Materials
20.	MS 604	Design of Materials
21.	MS 606	Advanced Polymers, Ceramics and Composites
22.	MS 617	Non Destructive Evaluations
23.	MS 612	Advanced Functional Materials
24.	MS 613	Advanced Polymers and Composites
25.	AC 603	Thermodynamics and Combustion Process
26.	ME 650	Mini – Project

Notes:

1. Department has to decide which subjects should be offered as (i) Elective I, II, III & IV in Semester II and (ii) Elective V & VI in Semester III.

2. Core stands for compulsory subjects.
3. Practice school (Optional) of 4 weeks duration during Summer Vacation should be included.
4. As per Academic Council decision, the subject on **'Mini –Project of 3 – credits'** should be included in the list of electives and it should be offered in second Semester.

Department of Mechanical Engineering

ME 601: Mechanical Vibrations

Single Degree of Freedom Systems: Free and forced vibrations of damped and undamped systems; Simple harmonic excitation; steady state response; torsional vibrations.

Vibration of Systems with Two Degrees of Freedom: Free and forced vibration of spring-mass-damper systems; torsional vibrations; modal analysis of undamped and damped systems; numerical methods: Matrix iteration, Holzer's method, Dunkerley's lower and Rayleigh's upper bound approximations; Dynamic vibration absorbers

Vibration of Multi-degree of Freedom and Continuous Systems: Vibrating string; Longitudinal and torsional vibration of rods; Free and forced vibration of beams; Properties of vibrating systems: Flexibility and stiffness influence coefficients; Reciprocity theorem; Eigenvalue analysis; Orthogonality of eigenvectors; Modal matrix

Experimental methods in vibration analysis: Vibration instruments: exciters, transducers, analysers, measurement devices: vibrometers, velocity meters and accelerometers; Signal analysis techniques: time domain analysis, frequency domain analysis, amplitude and power spectra, coherence, auto and cross correlations, amplitude and frequency modulations; Tests for free and forced vibrations

Case studies: Vehicle dynamics: introduction to nonlinear and random vibrations, vehicle subjected to random vibrations (for example an uneven road); Fluid-structure interaction problems: vibration of suspension bridges

Text Books:

1. "Introductory Course on Theory and Practice of Mechanical Vibrations", J.S.Rao, K.Gupta, Revised second edition, New Age International Publishers
2. "Theory of Vibration with Applications", William T. Thomson, Marie Dillon Dahleh, Pearson Low Price Edition.
3. Mechanical Vibrations, J.B.K. Das & P.L.S.Murthy, Sapna book house.

Reference Books:

1. Principles and Techniques of Vibrations, Leonard Meirovich, Prentice Hall Inc.
2. Engineering Vibration, DJ Inman, Prentice Hall International Inc.

3. “Mechanical Vibration and Shock Measurements”, J.T.Broch, Bruel and Kjae Publication.
4. "Applications of Random Vibrations", N. C. Nigam, S. Narayanan, Narosa Publishers.

ME 602 : Advanced Mechanics of Materials

Theory of Elasticity: Introduction, stress. Differential equations of equilibrium, strain, compatibility conditions, plane problems of elasticity, stress strain relations, stress functions and applications in 2D problems. Pressurized cylinders & rotating disks, Governing equations, Stresses in thick walled cylinder under internal and external pressures. Introduction to experimental stress analysis.

Energy Methods: Work done by forces and strain energy, reciprocal relations, Castigliano’s theorems, Fictitious load method, statically indeterminate structures, theorem of virtual work, generalization of castigliano’s theorem.

Asymmetrical Bending of beams: Bending of prismatic bars and unsymmetrical bending. Concept of shear centre in symmetric and un-symmetric bending, Plate bending, bending of curved beams.

Torsion of non-circular sections: Introduction, torsion of general prismatic solid section like circular, elliptical, rectangular, triangular shafts, membrane analogy, torsion of thin walled tubes, torsion of thin walled multiple cell closed sections.

Text/References:

1. Theory of Elasticity, 1970, Timoshenko SN & GoodierJN, McGraw Hill.
2. Advanced Mechanics of Materials, 2nd Ed., 1998 Cook RD & Yound WC, Prentice Hall.
3. Advanced Mechanics of Materials, 5th Ed., 1995 Boresi AP, Sidebottom OM, John Wiley.
4. Experimental Stress Analysis, 3rd Ed., 2005, Dally JW & Riley WF, College House Enterprises.

ME 603: Advanced Fluid & Thermal Sciences

Review of concepts in kinematics of Fluid Motion, Vorticity, Circulation, Velocity potential and Stream function. Basic laws in Integral Form, Momentum Theorem, Applications in Propulsion, Energy equations, Applications. Dynamics of Ideal Fluid Motion, Applications, Integration of Euler’s equations of motion. Governing Equations of fluid flow in differential form, Navier-Stokes Equations and exact solutions, Energy Equation and solution of fluid flow with thermal effects. Dimensional Analysis. Prandtl’s Boundary Layer equations, Laminar Boundary Layer over a Flat Plate, Blausius solution. Turbulent flows in two-dimensional channels and pipes, Velocity field, Smooth and Rough pipes, Drag reduction in pipes, Turbulent Boundary Layer over a Flat Plate, Laws of wall over Flat Plates, Effect of Pressure gradient, Boundary Layer control.

Advanced topics in conduction and convection heat transfer, solution to laminar and turbulent convective heat transfer problems, external and internal flows, free and forced convection.

Text/References:

1. Viscous Fluid Flow, 2005, F. M. White, McGraw-Hill.
2. Convective Heat and Mass Transfer 4th Ed., 2004, W. M. Kays, M. E. Crawford and B. Weigand, McGraw-Hill.
3. Heat Transfer, 10th Ed., 2009, J P Holman, McGraw-Hill.
4. Boundary Layer Theory, 8th ed, 2000, Herrmann Schlichting, Springer.
5. Heat and Mass Transfer, 2nd ed 1963, Eckert ERG and Drake RM (translated by J P Gross), McGraw-Hill Inc. US.

NW 608 : Warship Transmission and Tribology

Warship Transmission Design

Specifications, design and design checks of Marine Gearboxes (Spur and helical gears, Gear Tooth loads, Bearing loads, Reaction torque, Causes and classification of gear failures, gear noise and stress analysis).

Shafting (NES requirements, torsional and bending strength calculations), Shaft-line Bearings (NES requirements, types, numbers and load distribution), Clutches and Couplings

Tribology

Theory of wear, its types and reduction, Theory of hydrodynamic lubrication, properties of marine lubricants, Bearings classification, selection, and performance. Theories of design of Journal Bearings and Rolling element bearings with performance and life estimation

Texts Books

1. Engineering Tribology, GW Stachowiak, AW Batchelor,Butterworth Heinman, 2001.
2. Shigley's Mechanical Engineering Design [In SI Units], Joseph Shigley, Charles Mischke, Richard Budynas, Keith Nisbett, Tata McGraw Hill, 2008.
3. Schaum's Outline of Machine Design, 3rd Ed, Tata McGraw Hill, 2010.
4. Gear Engineering, Pitman, Merritt HE, Latest edition.

NW 641: MATLAB and Vibration Lab

MATLAB: Get started with MATLAB. In these interactive tutorials, learn the basics of MATLAB with lessons, demonstrations, quizzes, and hands-on practice sessions.

Vibration Lab Experiments:

- Perform both free and forced natural vibration experiments without damping using wireless sensors.
- Validate theoretical predictions of natural frequencies, mode shapes, and frequency response as a function of frequency, boundary conditions, geometry and materials as given by Instructor.
- Learn to control vibration amplitude using tuned mass dampers and damping treatments.
- Learn vibration measurement transducers, signal processing, data acquisition and data analysis.

NW 611: Automatic Control Systems

Basic concepts of Automatic Control: Transfer Functions-Modeling of systems- Mechanical, Electrical, hydraulic system block diagram, signal flow graphs, closed and open loop systems. Feedback and Feed forward control system.

Static and Dynamic Characteristics of Control Systems: Transient Response and Steady state error analysis for First and second order systems. Frequency response. Experimental determination of transfer function. Stability Analysis. Root Locus Analysis. Nyquist Criteria.

Control Actions and Control System Components: Discrete action, Proportional, Integral and Differential Control Action, Composite action. Characteristics, working and limitations of different types of Comparators and actuators, amplifiers, Servo motors and Control valves.

Control System Implementations: Pneumatic Systems, Hydraulic Systems, Electrical Systems, Microprocessor Based Systems, Programmable Logic Controllers, Micro Controllers and Network Based Distributed Control Systems,

Case Studies (Internal Evaluation)

Marine Systems (for Naval Students)

Integrated Platform Management System / Battle Damage Control System, Ship board digital control, architecture and implementation of control of Marine systems in the latest Indian Naval Surface Warships.

Mechanical Systems (for Non - Naval Students)

Engine auto control warning system, NBC & fire fighting systems, Remote vehicles.

Texts Books

1. Measurement System, Application & Design, 4th Ed, E O Doebelin, Mc Graw Hill, 2003.
2. Modern Control Engineering, 4th Ed, Katushiko Ogata, Pearson, UK, 2001.
3. Modern Control Engineering, 4th Ed, Katushiko Ogata, Pearson, UK, 2001.

NW 605 : Marine Diesel & Steam Engines

Basic Concepts: Reactive Thermodynamics, complete and incomplete combustion, volumetric efficiency. Design Requirements, Materials, Types of Supercharging

Marine Diesel Engine rating, selection, engine-propeller matching: Terminology, Service Rating, Corrections for ambient conditions, Diesel engine Characteristics, Principles of matching, Modifications to allow for Service conditions, Towing Loads, Auxiliary Loads, CPP.

Noise and Emission Reduction in marine engines: Regulations, Constituents, Control Mechanisms for reduction of noise and exhaust emissions from marine diesel engines.

Boiler Design: Boiling process, heat transfer and fluid flow dynamics, boiler design considerations, procedure. Steam cycles analysis: Steam turbine thermodynamics, Simple Rankine

cycle, Power output and efficiency calculations, measures to improve cycle performance parameters.

Steam turbines: Impulse and reaction turbines, multistaging in turbines, compounding of turbines, design and part load performances, turbine losses. Steam turbine design procedure.

Texts Books (Diesel Engines):

1. Internal Combustion Engine Fundamentals, JB Heywood, McGraw Hill , 2003.
2. Internal Combustion Engine Theory and Practices, 2nd Ed, Vol I & 2, Charles Fayette Taylor, MIT Press, 1999.
3. Steam Turbines: Theory and Design, Shlyakhin P, Foreign Languages Publishing House, Moscow, 1995.

NW 606: Marine Gas Turbines

Gas Turbine theory and Performance: Gas dynamics, thermodynamic and fluid mechanics concepts, Gas Turbine Types and application, Cycle Analysis & Performance. Design & off-design point performance, Transient performance of single shaft, two shaft engine with FPT. Gas Turbine Simulation. Compressor turbine Matching. Propeller matching, displacing equilibrium running line.

Turbo Machinery Aerodynamics Design: Compressor design and Performance - Pressure losses separation & friction losses, Definition delta upon D, De Hallers no. Stage loading and flow parameters, degree of reaction, stall, Use of IGVs & VGVs, multi-spooling, variable temp rise distribution. Compressor design co-relations & example.

Mechanical Design and Performance of Turbine and Compressors: Blade shapes, methods of design. Velocity triangles, reaction, stage loading, flow coefficient. Design for maximum power. Stage efficiency, over-tip leakage. Design correlations & example. Centrifugal, Gas, Inertia Loads acting on turbo-machinery,

Creep design, Fatigue design, Requirements of naval application. Marine GT Combustors Design. Design & Materials for Marine GTs. Requirements, properties, Super-alloys, Manufacturing, Marine coatings, Types & Process. Marine GT Systems Design requirements & Integration with ships systems.

Texts Books/References

1. Gas Turbine Theory, 5th Ed, Cohen, Rogers & Sarvamuttu, John Wiley & Sons, 2001.
2. Fluid Mechanics and Thermodynamics of Tubomachinery, SL Dixon, 6th Ed, Elsevier, 2010.
3. Gas Turbine 2nd Ed, V Ganeshan, Tata McGraaw Hill, 2010.
4. Fundamentals of Gas Turbines, 2nd Ed, Bathie WW, John Wiley, 2003.
5. The Design of Hi-efficiency Turbomachinery and Gas Turbine, DG Wilson & T Korakianitis, MIT Press, 2002.

NW 607: Ship Dynamics and Marine Systems

Introduction to Naval Architecture and Ship Dynamics: Categorization of ships, ships geometry and hydrostatics, Properties of ship building materials, Strength and structure of ship's hydrostatics and initial stability. Intact and Damage Stability. Ship Powering Calculations and Propeller design.

Staff Requirements for new ship design. Formulation of requirements, general role, speed, endurance, armament, logistic requirements, procedure for formulating outline, agreed and approved staff requirements, procedure for finalization of ship designs. Choice & Selection of Propulsion System and Auxiliaries

General requirements of marine machinery. Design for shock protection. Types of main propulsion and their evaluation. Selection of Distillation & Desalination Plants, Power Generation, Air conditioning & Refrigeration, Ships Systems, NBCD Requirements, Marine Controls and Instrumentation. Trials: Sea trials, their requirements and procedures.

Texts Books

1 Introduction to Naval Architecture, TC Gilmer, Bruce Johnson, Naval Institute Press, 1982.

2 Basic Ship Theory, Vol I & II, Rawson & Tupper, Saint Louis, Butterworth Heineman, 1994.

3 Warship Propulsion System Selection, CM Plumb, The Institute of Marine Engineers, 1987.

ME 607: Computational Fluid Dynamics (CFD)

Basic of Computational Fluid Dynamics. Governing Equations of fluid mechanics and heat transfer, physical boundary conditions, basic aspects of Discretization. Finite Difference and Finite Volume formulation of steady/transient one-dimensional conduction equation., Finite Volume formulation of steady one- dimensional convection and diffusion problems, Solution algorithms for pressure-velocity coupling in steady and unsteady flows. discretization equations for two dimensional convection and diffusion. Numerical methods for the Navier-Stokes equation. Turbulence models: mixing length model, Two equation (k-epsilon) models – Grid generation. Practical's on CFD software (FLUENT).

Text/References

1. An introduction to Computational Fluid Dynamics, 2nd edition, 2007, HK Versteeg & W Malalasekera, Pearson Education.
2. Introduction to Computational Fluid Dynamics, 2005, Anil W Date, Cambridge University Press, NY, USA.
3. Computational Fluid Dynamics & Heat Transfer, 1984, Anderson, Dale A, John C Tanehill and Richard H Pletcher, McGraw Hill.
4. Numerical Heat Transfer and Fluid Flow, 1980, Patankar SV, Hemisphere, New York.

ME 608: Finite Element Methods

Prerequisites to FEM

Application of FEM, Strain- displacement relations, Stress-strain relations, Differential equations of equilibrium, Co-ordinates, basic element shapes, interpolation function, Minimum potential energy. Properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics.

1-D structural problems

Analysis of axial Bar element - stiffness matrix, load vector, temperature effects, Quadratic shape function.

Analysis of Trusses- Plane Truss elements, Transformation matrix, stiffness matrix, load vector

Analysis of Beams - Hermite shape functions – beam stiffness matrix - Load vector - Problems

2-D stress analysis using CST

Plane stress, Plane strain, Force terms, Stiffness matrix and load vector, boundary conditions. Axisymmetric body subjected to axisymmetric loading-Numerical problems, Isoparametric element - quadrilateral element, linear shape functions.

Scalar field problems

1-D Heat conduction through composite walls, fins of uniform cross section,

2-D heat conduction problems, Torsional problems.

Dynamic considerations:

Dynamic equations - consistent mass matrix – Eigen values, Eigen vector, natural frequencies - mode shapes - modal analysis.

3-D problems:

Tetrahedron element - Jacobian matrix - Stiffness matrix, CAD softwares and its applications, Brief description to analysis of Plates & Shells.

Text Books/References

1. "Introduction to Finite Elements in Engineering", Tirupathi R.Chandrupatla and Ashok D. Belagundu, Pearson Education (Singapore) Pte Ltd, 2006.
2. "An Introduction to Finite Element Methods", J.N. Reddy, Tata Mc Graw Hill, 2008.
3. A First Course in the Finite Element Method by Daryl L. Logan.
4. "Concepts and Applications of Finite Element Analysis", Robert Cook, Wiley India, Pvt., Ltd., 4th Edition-2007.
5. "An Introduction to Finite Element Methods", J.N. Reddy, Tata Mc Graw Hill, 2008.
6. "Finite Element Procedures", K.J. Bathe, PHI Learning, 2009.
7. The Finite Element Methods in Engineering / SS Rao / Pergamon.

ME 609: Design of Machinery

Manufacturing Considerations in Design: Design for manufacture, Tolerencing and tolerance analysis. Processing techniques and limitations for metals, polymers and ceramics. Influence of materials in processing and tooling on the design of components. Finishing, surface coatings and surface modifications of materials.

Engineering Design: Design of cast, forged, sheet metal parts and welded constructions. Design for assembly and dismantling, modular constructions. Erection, operation, inspection and maintenance considerations, Ergonomics.

Machining considerations: Design for accuracy, locating pins and registers, machining in assembly, adjustment. Backlash and clearance adjustment. Examples illustrating the various principles. Available design variants for some of the common basic functional requirements.

Text Books/References:

1 Ashby, M. F. "Materials Selection in Mechanical Design", Pergaman Press, 1992.

2 Bralla J., "Handbook of Product Design for Manufacture", McGraw Hill, 1988.

3 Levy S., and Dubois, L. H, "Plastics Production Design Engineering Handbook, Methuen Inc., 1985.

4 Dieter G E, Engineering Desing, McGraw-Hill, 1991.

5 Yotaro Hatamura, The Practice of Machine Design, Claredon Press Oxfor, 1999.

6 Ertas Atilia and Jones J C, The Engineering Design Process, John Wiley & Sons, 1996.

7 Waldron B M and Kenneth J W, Mechanical Design: Theory and Methodology, Spriinger, 1996.

ME 631: Compressible Fluid Flow

Introduction and Fundamental Physical Concepts -laws of thermodynamics, conservation of mass and momentum, Fundamental Physical Concepts: Speed of Sound, Bulk Modulus, Mach number, Mach angle, stagnation properties, Isentropic Flow: 1D flow with varying area. Isentropic Flow: Real Nozzles and Diffusers. Normal Shock Waves: Rankine-Hugoniot Relations, Steady shocks. Normal Shock Waves: Supersonic Diffusers, choking of diffusers. 1D Compressible Frictional Flow (Fanno Line Flow) and skin friction on external surfaces. 2D Oblique Shocks 2D Prandtl-Meyer expansion and compression fans, Airfoils in Supersonic Flow. Linearized Potential Flow, form drag of complex shapes in supersonic flow. Design of 2D Supersonic Inlets.

Text/References

1. Compressible Fluid Dynamics, Thompson, P. A., New York, NY: McGraw-Hill, 1972.

2. Elements of Gas Dynamics, Liepmann, H. W., and A. Roshko.Mineola, NY: Dover publications, 2001. Originally from Wiley, 1957.

3. Compressible Fluid Flow, Oosthuizen, P. H., and W. E. Carscallen, New York: McGraw-Hill, 1997.
4. Viscous Fluid Flow, 2nd ed., White, F. M., New York: McGraw-Hill, 1991.
5. Compressible Fluid Flow 1 and 2, Shapiro, A. H., Hoboken NJ: John Wiley & Sons, 1953.
6. Modern Compressible Flow with Historical Perspective, 2nd ed., Anderson, J. D. New York: McGraw-Hill, 1990.

NW 619: Nuclear Reactor Engineering

Nuclear Reactor Physics: Introduction to nuclear physics: nuclear fission, nuclear reactions and radiations. Reactor analysis, reactor kinetics and control

Nuclear Reactor Engineering: Thermal & hydraulic aspects of reactor design, energy removal. Core and Fuel design. Reactor process system, reactor fuel design. Design aspects of major reactor components, material selection, shielding design. Overview of nuclear fuel cycle. Different reactor systems

Nuclear Reactor Safety: Overview of nuclear safety philosophy, defense in depth principle, different safety systems

Health Safety: Effects of different types of radiation, dosage, radiation monitoring.

Nuclear Reactor Control & Instrumentation: General features of reactor control, control in reactor operation. Basics of reactor instrumentation, instrumentation range and wide range of detectors used.

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Texts Books

1 Nuclear Reactor Engineering: Reactor Design Basics, Volume – 1, Samuel Glasstone and Alexander Sesonske, CBS Publishers and Distributors, 2002.
2 Nuclear Reactor Engineering: Reactor systems engineering, Volume - 2, Samuel Glasstone and Alexander Sesonske, CBS Publishers and Distributors, 2002.
3 Introduction to Nuclear Engineering, John R. Lamarsh and Anthony J. Baratta. Prentice Hall; 3rd editions, 2001.

ME 632: Fatigue and Fracture Mechanics

Basic modes of fracture, Griffith theory of brittle fracture, Irwin's modifications for elastic-plastic materials, theories of linear elastic fracture mechanics, stress intensity factors, fracture toughness testing. Crack-tip plasticity and elasto-plastic fracture mechanics in metals. Mixed mode problems and evaluation of critical fracture parameters.

Classical theoretical analyses based on complex stress function approaches. Computational fracture mechanics: SERR evaluations, J-Integral methods. Fatigue damage theories, fatigue test,

endurance limit, fatigue fracture under combined loading, fatigue controlling factors, effect of stress concentrations, notch sensitivity, cumulative fatigue damage concepts.

Text/References:

1. Elementary engineering fracture mechanics By David Broek Noordhoff International 1974.
2. Popular Advanced Fracture Mechanics, M. F. Kanninen and C. H. Oxford, 1985.
3. Fracture Mechanics, Fundamentals and application, T. A. Anderson, CRC Press, 1994.

ME 619: Advanced Composite Structures

Introduction composite materials: Classification and characteristics, mechanical behavior of composite materials, basic terminology, and manufacture of laminated fiber-reinforced composite materials, current and potential advantages of fiber –reinforced composite materials, applications of composite materials.

Macromechanical behavior of lamina: Introduction, stress-strain relations for anisotropic materials, stiffnesses, compliances and engineering constants for orthotropic materials, restrictions on engineering constants, stress train relation for plane stress in an orthopic material, stress-train relations for lamina of arbitrary orientation, invariant properties of an orthotropic lamina, strengths of an orthographic lamina, biaxial strength criteria for an orthotropic lamina.

Micromechanica behavior of lamina: Introduction, mechanics of materials approach to stiffness, elasticity approach to stiffness, comparison of approaches to stiffness, mechanics of materials approach to strength.

Macromechanical behavior of laminates: Introduction, Classical Lamination Theory, Special Cases Of Laminate Stiffness, Theoretical Versus Measured Stiffness, Strength of Laminates, Inter-Laminar Stress.

Introduction to design of composites structures: Introduction to structural design, material selection, configuration selection, laminate joints design requirements and design failure criteria, optimization concepts, design analysis philosophy for composite structures.

Fabrication methods of composites structures: Introduction to various Fabrication Methods, VARTM And RFI Methods, Process Parameters In VARTM Method, Permeability Measurements, VARTM Process Model, Process Parameters Of RFI Method Film Casting And Characteristics, Concepts Of VARTM and RFI Process Optimisation.

Testing and characterisation of composites: Lamina strength characterization, tensile testing, compression testing, in-plane shear testing, short beam test, double cantilever beam test. Physical properties characteristion void content evaluation, fibre Volume Fraction Evaluation, DMA, DSC FOR Tg, Wet Properties Of Lamina, NDE Methods, Ultrasonic A-scan and CT-Scan Methods For Chracteristion Of Composites.

Text books

1. Mechanics of composite materials, by Robert. M. Jones, second sedition, Taylor and Francis,1999.
2. Experimental chracteristion of advanced composites materials, third edition, Donald f Adams, Lief A. Carlsson and R. Byron pipes. CRC press.

Reference books

1. Mechanics of fibrous composites by carl. T. Herakovich-john wiley and sons, 1997.
2. Advanced composite materials, Lalit Gupta, Himalayan books. New delhi, 1998.
3. Liquid moulding technologies, C D Rudd, A C Long, K N Kendall and C G E Mangin, Woodhead publishing limited, Cambridge England.
4. Process modeling in composites manufacturing, Suresh G advani, E. Murat sozer, Marcel Dekker, inc.

ME 651: M. Tech. Dissertation Phase– I

ME 652: M. Tech. Dissertation Phase- II
