DEPARTMENT OF SHIP TECHNOLOGY

M TECH (CASAD) I SEMESTER SYLLABUS

DST 3101 ADVANCED ENGINERING MATHEMATICS

1. **FOURIER ANALYSIS:**
   Fourier series – Euler Formulae – Functions having arbitrary period – Even and odd functions – Half range expansions- The Fourier integral – Fourier transforms.

2. **PARTIAL DIFFERENTIAL EQUATIONS:-**
   Basic concepts vibrating string – One dimensional Wave equation – separation of variables – D'Alemberts' solution of the wave equation – one dimensional Heat equation – Heat flow in an infinite bar equation – Rectangular Membrane Laplacian in Polar Cordinates – Laplace's equation – Application of Laplace Transform to Partial Differential equations.

3. **COMPLEX ANALYSIS :-**
   Complex Analytic functions – Cauchy Riemann equations – Conformal Mapping – Line Integral Cauchy's integral theorem – Cauchy's integral formula – Derivatives of Analytic functions – Tayler's series – Laurent's series – Residues – the residue theorem – Evaluation of real integrals.

4. **SPECIAL FUNCTIONS:-**
   Bessel's equation – Bessel Function of the first kind – Legendr's equation – Legendre Polynomials – Orthogonality of Bessel"s function and Legendre Polynomials – Sturn – Liouville problem – Beta & Gamma functions.

5. **CALCULUS OF VARIATIONS:-**
   Euler's equation – Isoperimetric problems – Approximate solution of boundary value problems – Hamilton's principle –Lagrange's equation .

Reference:

1. Kreyszig . E, Advanced Engineering Mathematics, Wiley, Newyork (For sections 1,2,3,4)
2. Growal B.S,Higher Engineering Mathematics, Khanna Publishers, NewDelhi. (For sections 4,5)

DST 3102 COMPUTER –AIDED DESIGN IN OFFSHORE ENGINEERING

1. **INTRODUCTION TO COMPUTER PROGRAMMING & LANGUAGES.**

2. **BASICS OF COMPUTER GRAPHICS**
   Introduction to computer graphics technology – picture representation , graphic display devices, graphic input devices; Representation of points and lines, three- dimensional transformations and projections, representation of plane curves and space curves, surface description and generation.
3. **DATA BASE MANAGEMENT**

4. **Optimisation Techniques :-**
   Minimisation of unconstrained functions – gradient methods, Newton – Raphson method, Davidson's method. One –dimensional search method, direct search method, Minimisation of constrained functions, Lagrange multipliers, linear constrains(Gradient projection method and Reduced gradient method), nonlinear constraints (Method of feasible directions, Penalty function method).

5. **Offshore Engineering Applications.**
   Computer applications in offshore engineering – hydrodynamics and wave data analysis, geometric representation .

References:

1. Kernighan B.W and Ritchie D.M, The programming language, Prentice –Hall , NewDelhi.
2. Rojers D.F and Adams J.A, Mathematical Elements Computer Graphics, McGraw Hill , New York.
3. Newman W.N and Sproull R.F. Principles of Interactive Computer Graphics, MCGraw Hill , New Delhi.
4. Ammeral L, Interactive 30 Computer graphics, John Wiley, Singapore.
5. Aoki.M , Introduction to optimization Techniques, The Macmiliam Co., New York.
6. Rao S.S, Optimisation Theory and Practice.

DST 3103 ADVANCED STRUCTRAL ANALYSIS

Module I- Theory of Linear Elasticity :

Stress, Principal Stress and Strain. Concepts and definition of Strain – displacement relation, Equilibrium Constitutive and compatibility equations, St.Venant' principle, Plane stress , plane strain and axirymmetric conditions.

Module- II – Energy Principles:

Principle of virtual work, principle of minimum potential , Castigliano's theorem – Numerical examples from frame/truss analysis Ray-leigh Ritz method, Galerkin's method.

Module –III Matrix Methods in structural Analysis:

Stiffness method – direct Stiffness method derivation of stiffness matrix for truss, beam element flexibility method- derivation of flexibility matrix for truss and beam. Numerical examples frame and continuous beam analysis.

Module –IV Principles of Structural Stability

Methods of stability analysis – Column buckling – Euler equation, Frame instability – Energy approach Application of matrix method to beam column problems

Module V Structural Mechanics:

Theory of Beams – Analysis of Bernouli and Timoshenko Beams, Ritzmethod – Beam on elastic foundation.

Reference

1. Timoshenko S.P and Goodier , Theory of elasticity , Mc Graw Hill , New Delhi.
2. Tauchert t, Energy Principles in Mechanics
3. Gere and Weaver – Matrix method of Structural Analysis
4. Reddy C.S, Basic Structural Analysis TMH, 1996
5. Iyengar NGR, Stability of beams and plates , TMH
6. Timoshenko SP and Kreegy, Elastic Stability, Mc Graw Hill , New Delhi

DST 3104 Marine Hydrodynamics

1. **Basic of hydrodynamics**
   Conservation of mass and momentum , Euler equation , Bernoulli's equation , potential flow, boundary conditions, fixed and moving bodies , Green's theorem and distributions of singularities.
2. **Waves**
   Classification of water waves , Two dimensional wave equation and wave characteristics, wave theories , small amplitude waves, finite amplitude wave, stokian , solitary and noidal wave theories, wave classification by relative water depth , water particle kinematics, pressure under progressive wave, wave energy power and wave group velocity , Wave deformation , reflections, diffraction and breaking of waves.
3. **Tides**
   Classification , long term effects, basin oscillations, tsunamis, storm.

4. **Currents**
   Classification , behavior, design criteria, scour and other effects of currents.

5. **Forces**
   Wave forces, current forces, wave – current – structure interaction, Morisson equation , wave loads on offshore structures and pipe lines, diffraction theory, wave slamming and slapping .

Reference:

1. Newman J.N, Marine Hydrodynamics, MIT Press, Cambridge, Massachussotts.
2. Beck R.P Cumins, W.E Dalzell J F, Mandel P and Webster, W C Motions in Waves, Principles of Naval architecture , Second revision (Ed) Lewis E.V, 1989, SNAME , JERSEY city , New Jersey.

DST 3105 Fracture Mechanics

1. **Introduction**
   Introduction to conventional approach and fracture mechanics approach to design , significance of defects in material behavior under static and fatigue loading, Brittle fracture experienced in the past, Behaviour of steels and high strength steels under different conditions in service; various test methods. Load extension diagrams, CVN energies , effect of welding, weld defects and its influence on strength under loading , service failure analysis, Non destructive test methods and its applications . Nucleation and formation of cracks in brittle, semi brittle and non- brittle solids, closure and healing of cracks, Short cracks and long cracks.
2. **Griffith's Approach**
   The effect of crack in a component or structure, Analysis of crack extension and crack tip stress field, LEFM concepts , The Griffith's energy balance concept, The criterion of crack growth, stress intensity factor and strain energy release rate, constant load and constant deflection cases, the crack tip plastic zone, Irwin's correction, Von Mises criterion, Tresca's criterion, Plastic zone shape, The thickness effect, strain energy densities – distortional and delational , Elastoplastic boundary around crack tip, Dynamics of crack arrest , the dynamic stress intensity factor branching , crack arrest.
3. **Fracture Toughness and Stress Intensity Factors**
   Plane strain fracture toughness determination , standard tests and procedures , size requirement for test specimens , correlation of fracture toughness data and CVN energy data; plane stress and transitional behavior; R-Curve concepts and plane stress testing; non linear crack tip yield, Elasto- plastic fracture, fracture beyond general yield, COD: Use of J integral. Measurement of JIC and JR, Nonlinear fracture toughness concepts, fracture under combined (mixed mode) loading; crack initiation angle and stress, mixed mode stress intensity factors, various criteria like maximum principal stress criterion strain energy density factor criterion, T-criterion etc..; Determination of stress intensity factors analytical and numerical methods, finite element methods and experimental methods; expressions available in literature for simple cases (through crack and elliptical cracks.).
4. **Fatigue Crack Growth**
   Fatigue crack propagation, crack propagation models; crack propagation equations for different materials such as steels and aluminium, constant aptitude and variable aptitude loading Retardation and closure concepts , Cyclic counting methods random loading , effective stress intensity factor range.
5. **Applications of Fracture Mechanics Concepts to Design**
   Applications to design of structural components; means to provide fail safety and damage tolerance, required information for fracture mechanics approach and collection of available information. Application to pressure vessels and pipe lines . ' Leak before break' criterion , Material selection , use of fatigue crack growth parameters and its application to design.

Reference

1. Lawn B R, and Wilshaw T r, fracture of Brittle solids, Cambridge University press.
2. Broek . D, Elementary Engineering Fracture Mechanics , Martinus Nijhoff Publishers.
3. Stress Intensity Factor Hand Book, Murakami (Edr)

DST 3201 DYNAMICS OF STRUCTURES

1. Free and forced vibration of SD of Systems , time and frequency domain approaches .
2. Formulation of equations of motion , Hamilton's Principle, Lagrange's equation of motion, continuous and discrete systems.
3. Study of MDO:- System Rayleigh – Ritz, Stodola and Holtzer methods, Matrix methods for dynamic analysis eigen solution and mode superposition.
4. Vibrations of structure involving fluid – structure – soil interaction, dynamic behavior of offshore structures.
5. Stochastic response of offshore structures, frequency domain response of linear systems, time domain response Narrow band systems, spectral fatigue analysis for offshore structures , Response to wave , wind and earth quake.

Reference:

1. Meirovitch .L, elements of Vibration Analysis ,McGraw Hill , New Delhi.
2. Pen Hartog J.P, Mechanical vibration , McGraw Hill , Newyork.
3. Clough R.W, and Penzien J , Dynamics of structures, McGraw Hill, New York.

DST 3202 FINITE ELEMENT METHODS APPLIED TO OFFSHORE ENGINEERING

Module I

Introduction to fem, definitions, General Procedure of Finite Element Analysis – Variational formulations.

Module II

Shape functions, Convergence Criteria, derivation of property matrix for truss , beam , plane stress, plane strain axymmetric and solid elements.

Module III

Computer implementation of FEM, Organisation of computer code, Numerical methods for various property matrix calculation , Fundamentals of stability and dynamic analysis using fem.

Module IV

Soil Structure Interaction problem Fluid Structure Interaction Problem – Heat conduction problems.

Module V

Structural Application Multistory frames , Stiffened plated structure, Pressure vessels, Offshore Jackets.

References:

1. O.C.Zienkiewicz – Finite Element Method , Fourth edition, Mc Graw Hill
2. R.D.Cook " Concepts and Application of FE Analysis – John Wiley & Sons.
3. C.S.Krishnamoorthy, Finite Element Analysis TMH New Delhi.
4. S.Rajasekaran – Finite Element Analysis , Wheeler publishing Company .
5. K.J.Bathe – Finite Element Procedure in Engineering analysis , Prentice Hall

DST 3203 OCEAN WAVES AND EFFECT

1. **WAVES IN OPEN SEA**
   Origin and preparation , classification of sea state, elements of probability theory and random process, short-term model with constant amplitude components, generation theory of ocean waves, characteristics of point and directional spectoras, wave slope spectrum, encounter frequency spectrum, ocean wave data analysis, idealized spectral families.
2. **FORCES AND RESPONSE IN REGULAR WAVES**
   Formulation of diffraction and radiation problem for potential flow simplified head sea case, motion regular waves strip theory , panel method and finite element method to compute hydrodynamic forces and coefficients.
3. **FORCES AND RESPONSE IN A SEAWAY**
   Linear random theory , long-rested sea with without forward speed, short –crested sea case, statistics of maximum long-term performance predictions, local and relative motions, added resistance , wave loads.
4. **HYDRODYNAMIC EXCITING FORCES**
   Excitation forces due to steady flow, linerised wave forces inviscid fluid, influence of viscosity on wave excitation forces wave drift forces.
5. A minor project on determination of forces on Ocean Structures.

References:

1. Heoft J.P, Advanced dynamics of Marine Structure, Wiley – Interscience, Newyork.
2. Beck R.F, Cummins W.E, Dalzeli J F, Mandel P and Webster , W C " Motions in waves" Principles of Naval Architecture, Second Revision (ed), Lewis E V, SNAME ,Jersey City , New Jersey.
3. P:rice W.G, and Bishop, R E D Probablistic theory of ship Dynamics , Chapman and hall , London.

DST 3204 ANALYSIS OF SPECIAL STRUCTURES

Module –I

Plated Structures – Theory of thin plates , Buckling of plates. Analysis of stiffened plates , Buckling of Stiffened plates.

Module II

Thin walled Structures – Torsion of Thin walled Structures , Theory of restrained torsion.

Module –III

Sheanwalls Diaphragms grids and grillages

Module IV

Shells , Cylindrical shell roof, pressure vesels

Module V

Miscellaneous – Cranes , Industrial Structures , Suspension Bridges

References :

1. L.H.Donnel, Beam , Plates and Shells , Mc Graw Hill , New York
2. Timoshenko SP and Kruger . W .Theory of plates and Shells Mc Graw Hill
3. Srinath L.S – advanced Mechanics of Solids TMH , New Delhi
4. Kazmi – analysis of shear wall structures
5. G.S Ramaswami – Concrete shell roofs

DST 3205 DESIGN OF OFFSHORE STRUCTURE

1. Different types of offshore structure , loads on offshore structures, Design of platform derricks, mast helipads, etc.
2. Design principles of platform tower jackets , jack up legs, pressure chambers, Design specification of API, ABS, Lloyd's and pother classification societies .
3. Design of submarine pipelines.
4. Design of mooring cables.

References:

1. Dawson, Offshore structural Engineering
2. Teng H.Applied Offshore Structural Engineering
3. Berteaux H D , Buoy Engineering , John Wiley, Newyork.