M. Tech Degree (Full Time) Course

in

MARINE ENGINEERING

SCHEME OF EXAMINATIONS & SYLLABUS

K. M. SCHOOL OF MARINE ENGINEERING
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
COCHIN– 682 022

JULY – 2018

REGULATIONS FOR THE M.TECH PROGRAMMES OFFERED BY THE UNIVERSITY DEPARTMENTS / SCHOOLS

The following regulations are made applicable to all the Full time and Part time M.Tech programmes offered by the Departments / Schools of the University with effect from 2016 admissions.

1. M.Tech Programme in Marine Engineering

The Full time M.Tech programmes offered by the Departments / Schools of the University shall be of four semesters duration spanning over a period of two academic years; wherein the first two semesters will include lectures, laboratory work,and seminars. The student will devote the third and fourth semesters on a project work related to a relevant area of the specialization either in the Department / School or in an industrial / research / academic institution outside the University.

1.2. Eligibility for admission M.Tech in Marine Engineering

Shall have passed B.Tech/BE/B.Sc.Degree in Marine Engineering or B.Tech/B.Sc.(Engg.) Degree in Mechanical Engineering or B.Tech Degree in Naval Architecture and Ship Building with a minimum of 60% marks or an examination of any other University/Institution accepted by this University as equivalent there to with 60% marks. Candidates who have passed sections A and B Examinations conducted by the Institution of Engineers (India) – AMIE or similar equivalent examinations in Mechanical Engineering with a minimum of 60 % of marks shall also be eligible.

Preference will be given to those who have passed MEO class IV examination or a minimum of 2 years professional experience in Ship Building/Ship Repair Yard/Ship Design Office/Indian Navy.

1.2.1 Four seats in the programme shall be reserved for Marine engineers and 3 seats shall be reserved for sponsored candidates satisfying the above mentioned eligibility requirements.

1.2.2 In the case of full time programmes, preference will be given to candidates having a valid GATE score in the concerned branch of study. In case such candidates are not available, candidates with GATE score in a related branch will be considered. In the absence of sufficient candidates with valid GATE score, admission will be made on the basis of a Departmental Admission Test (DAT).

1.2.3 Candidate for sponsored quota must have a minimum experience of three years in the relevant field and must be sponsored by University or Industry/Teaching/Research Organizations of Centre/State Government/or by Private Engineering Colleges approved by AICTE. Maximum age of sponsored candidates is fixed as 40 years as on 1st of August of the year of admission. Also, a special fee equivalent to the contingent grant received for GATE qualified candidates will be levied on the sponsored candidates.

1.3 Course Structure

1.3.1 The course content of M.Tech programmes shall consist of theory courses, practical courses, seminar, industrial training (optional) and project work.

1.3.2 The curriculum for the semesters 1,2 and 3shall generally consist of theory courses / practical courses and seminar. The students going outside for Industrial projects / Thesis during the third and fourth semesters can complete the course in the third semester through MOOC from the list of courses decided by the Department / Schools / Divisions in the same semester.

1.3.3 Each theory course will carry three or four credits and each practical course / seminar will have one or two credits.

1.3.4 The number of credits for the project work in third and fourth semesters shall be in the range of 15 – 18 each.

1.3.5 The minimum number of credits to be earned by a student for the award of the M.Tech degree shall be 72 subject to the condition that the candidate successfully completes all the core and elective courses prescribed by the Department / School.

1.4 Mode of Evaluation

1.4.1 A student would be considered to have progressed satisfactorily at the end of a semester if he/she has a minimum of 75 % attendance subject to the provision in clause (3) of the regulations. In the case of part-time students, the Vice-Chancellor shall have the power to condone shortage of attendance up to 10 percent on medical grounds on the recommendations of the Head of Division / Department. However such condonation for shortage of attendance shall be given only once during the entire course.

1.4.2The student shall be evaluated continuously throughout the semester and marks shall be awarded on the basis of tests / assignments as detailed below:

A maximum of 20 marks as awarded for the assignments given to the students by the concerned teacher.

There shall be two class tests and an end semester examination.

The first class test carries 20 marks and will be based on the portions of the syllabi covered till then.

The second class test also carries 20 marks and will be based on the portions covered till then after the first class test.

The end semester examination will be for 40 marks and shall contain questions from the entire syllabi of the course.

The duration of the end semester examination shall be three hours.

1.4.3The results of each subject in a semester shall be finalized by the concerned faculty member within 10 days from the last date of the end semester examination and the marks and grades obtained by the candidate in each subject shall be displayed on the notice board with the approval of the course-coordinator and head of the division/ department / school concerned.

1.4.4The pass minimum in a subject is 50 %. If a candidate fails tosecure 50% marks, he/she shall be deemed to have failed in the subject.

1.4.5 A makeup examination for the end semester examination shall be conducted for the failed candidates within 10 days from the date of display of the marks/grades. Such examination shall carry questions from the entire portions of the syllabus and the weightage shall be only 75%. It shall substitute one of the three tests that has fetched the least marks.

1.4.6 The final marks / grade of the candidate taking into account his/her performance in the makeup examination and periodic tests and assignments shall be finalized within 5 days from the date of the makeup examination. A candidate securing a minimum 50 percent marks shall be considered to have passed in that subject.

1.4.7 If the candidate fails to meet the minimum requirement for pass even after two attempts, he / she shall have to repeat the subject at the next available chance.

1.4.8 A pass in the course will entitle the student to acquire the number of credits allotted for that particular course. (for the details of number of credits, please refer to the course structure.)

1.4.9 A student shall acquire a minimum of 36 credits in the first two semesters before he/she registers for third semester. A student shall complete the M.Tech programme in 8 (eight) consecutive semesters in the case of full time programme and 10 (ten) consecutive semesters in the case of part time programme by acquiring the minimum total credit requirement of 72.

1.4.10A student who wishes to take up professional employment after completing the second semester shall obtain permission from the Head of the Department/School. The student will be permitted to carry out the project work in the institution / organisation where they are employed on production of a certificate from the Head of that institution/organisation to the effect that the student is permitted to carry out the project at the institution/organisation.

Such candidates shall carry out the project work under the joint supervision of a project guide from the Department/School and an external guide from the Institution/Organization concerned. The Department / School Council shall verify the academic/ research credentials of the proposed external guide before granting permission.

In the case of students who propose to carry out their project work in National Laboratories on full time basis, the provision regarding having a project guide from the Department/School concerned may be exempted by the Department / School Council, if the situation warrants.

This clause will be applicable to the sponsored candidates also if they wish to carry out their project work in their parent organisation.

1.4.11Project evaluation shall be done at the end of III and IV semesters in the case of full time programmes and at the end of V and VI semesters in the case of part time programmes.

The evaluation at the end of III Semester (Full time)/ V Semester (Part time) shall be conducted by an examination committee consisting of the head of the department / school / division, a senior teacher nominated by the head and the project guide.

At the end of IV or VI semester, the students will have to submit a dissertation on his / her project work. The dissertation shall have to be submitted as per the guidelines as advised.

Three bound copies along with a soft copy of the dissertation shall be submitted to the Head of the Department/School within the last date prescribed by the Department / School for the purpose

1.4.12The dissertation will be evaluated by an examination committee consisting of the head of the department / school / division, another senior teacher of the department/school /division concerned nominated by the Head of the Department / School,and theproject guide. However an external examiner may also be included in the examination committee with the approval of the Department / School Council.The candidate shall make an open defence of his/her dissertation which will be followed by a viva-voce examination.

1.4.13For the purpose of assessment, the performance of a student in theproject dissertation may be divided into the following sub components:

At the end of III semester (Full time)

Assessment by the project guide (based on periodic assessment of the work of the candidate) - 50 %

Assessment by the examination committee - 50 %

At the end of IV semester (Full time)

Assessment by the project guide (based on periodic assessment of the work of the candidate) – 50 %

Assessment by the examination committee - 50 %

1.5 Classification

The following grading system is adopted for all the courses. The following grades will be awarded based on the overall performance in each subject.

Range of Marks	Grades	Weightage
90 % and above	S- Outstanding	10
(80-89)	A- Excellent	9
(70-79)	B-Very Good	8
(60-69)	C- Good	7
(50-59)	D- Satisfactory	6
Below 50%	F- Failed	0

Overall performance at the end of the semester will be indicated byGrade Point Average (GPA) calculated as follows:

$$GPA = \frac{G1C1 + G2C2 + G3C3 + \text{----------} + GnCn}{C1 + C2 + C3 + \text{----------} + Cn}$$

Where 'G' refers to the grade weightage and 'C' refers to the credit value of corresponding course undergone by the student.

At the end of the final semester , Cumulative Grade Point Average (CGPA) will be calculated based on the above formula.

Classification for the Degree will be as follows :

Classification	**CGPA**
First class with distinction	8 and above
First class	7 and above
Second class	6 and above

2.0 Declaration of Results

An examination committee consisting of the Head of the Department (Chairperson), a senior teacher/Head of the Division concerned and the Course Coordinator shall scrutinise the marks and grades obtained by the candidates and finalise the results. The examination committee will be constituted by the Head of the department/school. The final marks will be reported to the University for Tabulation and declaration of results. The University shall issue mark lists at the end of each semester.

2.1 Review of Question Papers and Valuation of answer books

At the end of each semester, the question papers set for class tests and end semester examination will be reviewed by the Department / School Council. The review report may be placed in the Board of Studies concerned for scrutiny.

2.2 Grievance Cell

The Departmental / School Council or a subcommittee nominated by the Council will act as the grievance cell for the redress of complaints from the students on the conduct of the class test, semester exam, and the valuation methodology. The student shall make such complaints to the Head of the Department / School within a week of the display of the marks/grades for a particular course on the Notice board of the Department / Division.

3.0 Revision of Regulation and Curriculum

The University may from time to time, revise, amend or change the regulations, schemes of examinations and syllabus. In the case of students already undergoing the course, the change will take effect from the beginning of the following academic year after the changes are introduced and shall cover the part of the course that remains to be completed.

M. Tech Degree (Full Time) Programme in Marine Engineering

(Specialisation: Marine Engineering)

Semester – 1					
Course Code	Subject	Hours / week			No.of Credits
		L	**T**	**P**	
18-438-0101	Marine Diesel Engines- Design & Performance	3	1	0	4
18-438-0102	Ship Dynamics & Marine Machinery System Installation	3	1	0	4
18-438-01**	Elective - I	3	1	0	3
18-438-01**	Elective - II	3	1	0	3
18-438-0109	CAD/Computer Lab	0	0	3	1
18-438-0110	Seminar I	0	0	3	1
18-438-0111	Research Methodology and IPR	2	1	0	2
	TOTAL	14	5	6	**18**

Semester - II					
Course Code	Subject	Hours / week			No.of Credits
		L	**T**	**P**	
18-438-0201	Advanced Welding Technology	3	1	0	4
18-438-0202	Ship Design and Economics	3	1	0	4
18-438-02**	Elective -III	3	1	0	3
18-438-02**	Elective - IV	3	1	0	3
18-438-0209	Metallurgy Lab	0	0	3	1
18-438-0210	Seminar II	0	0	3	1
18-438-0211	Mini Project / Internship	0	0	3	2
	TOTAL	12	4	9	**18**

Semester - III					
Course Code	Subject	Hours / Week			No. of Credits
		L	**T**	**P**	
18-438-03**	Elective –V	3	1	0	3
18-438-03**	Elective – VI	3	1	0	3
18-438-0307	Dissertation (Phase –I)	0	0	20	12
	TOTAL	6	2	20	**18**

Semester IV					
	Subject	Hours / Week			No. of Credits
		L	**T**	**P**	
18-438-0401	Dissertation (Phase-II)	0	0	30	18
	TOTAL	0	0	30	**18**

***Electives must be selected from the following list for the corresponding semester*

Total Credits for the M.Techprogramme =72

ELECTIVES I & II (Semester I)

18-438-0103	Finite Element Analysis
18-438-0104	Maritime Safety and Environment
18-4380105	Computational Methods in Engineering
18-438-0106	Gas Turbines
18-438-0107	Port Logistics and Planning
18-438-0108	Optimization Techniques

ELECTIVES III & IV (Semester II)

18-438-0203	Combustion and Pollution
18-438-0204	Advanced Theory of Vibrations
18-438-0205	Energy Conservation & Management
18-438-0206	Quantitative techniques for managerial Decisions
18-438-0207	Numerical Methods in Thermal Engineering
18-438-0208	System Simulation and Modeling

ELECTIVES V & VI (Semester III)

18-438-0301	Marine Corrosion & Prevention
18-438-0302	Plant Maintenance &Safety
18-438-0303	CFD and its Application
18-438-0304	Marine Transportation and Economics
18-438-0305	Automatic Control Systems
18-438-0306	Diagnostic Methods in Combustion Systems

SYLLABUS FOR

M. TECH DEGREE COURSE IN MARINE ENGINEERING

SEMESTER – I

18-438-0101: MARINE DIESEL ENGINES –DESIGN& PERFORMANCE

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the combustion characteristics of reactive thermodynamics
2. Understand the design requirements of major parts of a marine diesel engine
3. Analyse various problems associated with engine components
4. Evaluate the suitability of an engine for intended purpose
5. Explore the means to reduce noise pollution and emission
6. Analyze the engine performance related information

Module I

Basic Concepts:Thermodynamics of reactive systems, chemistry of combustion and theoretical flame temperatures, complete and incomplete combustion, air requirements, combustion efficiency.

Module II

Design of Major Components/ Systems: Design requirements, materials, types, design procedures / checks and latest trends in respect of cylinder head, piston assembly, connecting rods and engine bearings. Supercharging and engine balancing.

Module III

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.

Module IV

Noise and Emission Reduction in marine engines:Regulations, constituents, control mechanisms for reduction of noise (silencing equipment) and exhaust emissions from marine diesel engines.

References:

1 .JB Woodward, “Diesel Engine to Drive a Ship”, Edition III, NA & ME Publications.

2. Charles Fayette Taylor, “Internal Combustion Engine Theory and Practices”, 2nd Edn, Vol I & 2,1999, Published by MIT.

3. SH Henshall, “Medium and High Speed Diesel Engines for Marine Use”, 1997, Published by Institute of Marine Engineers,U.K.

4. C.C.Pounder, “Review of Marine Diesel Engines and Gas Turbines”, 9th Edn.,2009, NewnesButterwoth publishers.

18-438-0102: SHIP DYNAMICS & MARINE MACHINERY SYSTEMS INSTALLATION

Course Outcomes:

1. On completion of this course the student will be able to:
2. Understand the basics of ship technology and stability
3. Understand the different Class and Statutory requirements for machinery selection
4. Analysis of power requirements of onboard machinery
5. Understand ship building process andassembly sequence planning
6. Plan and organise the test and trial of basin/dock trials and sea trials

Module I

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.

Module II

Choice & Selection of Propulsion System and Auxiliaries:General &Class requirements and guidance for design, manufacturing and installation of marine and machinery systems and equipment. Design for shock protection. Types of main propulsion and their evaluation.Selection of propulsion plant for specific applications. Requirement of shafting, power generation, air conditioning &refrigeration, ships auxiliary Systems, LSA,FFA&LSS requirements, marine controls and instrumentation.

Module III

Marine machinery systems outfitting/ installation:Outfitting processes in ship building- characteristics of outfitting process- requirements of various engineering information- interferences between yard and various subcontractors- outfitting planning- assembly sequence planning- detection of interferences between outfitting components- Installation of various systems- tests and trials of systems.

Module IV

Test and Trials of new builds:Shop trials, basin/dock trials and sea trials – their requirements and procedures.

References:

1. TC Gilmer, Brues Johnson “Introduction to Naval Architecture”, Naval Institute Press,1982.
2. Rawson & Tupper, “Basic Ship Theory”, Vol I & II, Saint Louis, Butterworth Heineman,1994.

3. “Principles of Naval Architecture”, Society of Naval Architects & Marine Engineers.
4. Rule books of IRS/LRS.
5. Manuals of Standard practices followed in ship yards.

ELECTIVES I & II (18-438-0103 to 18-438-0108)

18-438-0103 :ADVANCED THEORY OF VIBRATIONS

Course Outcomes:
On completion of this course the student will be able to:
1. Understand the basic principles of vibration and its effects
2. Analyse selected problems of stress, vibration and structural stability
3. Understand and use different methods of measurements of vibration
4. Analyse and solve different problems involving non-liner vibration
5. Solve vibration problems using approximate methods

Module I
Single degree of freedom systems, two degree of freedom systems**:** Spring coupled, mass coupled, vibration absorbers, and vibration isolation. Multi degree of freedom systems: Lagrange’s equation, close couples and far coupled systems, Dunker ley’s approximation method, Rayleigh method, matrix method, matrix iteration, orthogonality principle, orthogonality, expansion theorem and modal analysis, Stodola method, Holzer method, Galerkin method, Rayleigh- Ritz method, Myklested – Prohl method for far coupled systems,
transfer matrix method.

Module II
Experimental methods in vibration analysis: Vibration instruments, vibration exciters, transducers and measurement devices, analyzers, vibration tests:- free and forced vibration tests.

Module III
Vibration of continuous systems: Transverse, flexural, torsional vibration of beams, Timoshenko beam, Hamilton principle, vibration of plates, Collocation method, Myklested – Prohl method. Transient vibrations: Duhamel’s integral, method of step input, phase plane method, method of Laplace transformation, drop test spectra by Laplace transformations.

Module IV
Non linear vibrations: non linear vibrations and superposition principle, examples of non linear vibrations, method of dealing with non linear vibrations, phase plane trajectories, method of direct integration, perturbation method, iteration method, Fourier series.

References:

1. W. T. Thomson, "Theory of vibration with applications",1993,Pretence Hall India.
2. J.S. Rao &K.Gupta, "Theory and practice of mechanical vibrations",2nd Edn.,Wiley Eastern.
3. S. S. Rao, "Mechanical vibration", 4th Edition, 2003, Addison Wesley.
4. KewalPujara, "Vibration and noise for Engineers", DhanpatRai and Co., 2004.
5. G. K. Grover and Nigam, "Mechanical vibrations" Nemchand and sons.
6. Steidel, "An introduction to mechanical vibrations" John Wiley.
7. Meirovitch, " Elements of vibration analysis" Tata Mac grow Hill.
8. V. Ramamurti, "Mechanical Vibration Practice",2000, Narosa Publications.
9. V.P. Singh, "Mechanical Vibrations",3rd Edition,2006, DhanpatRai& sons.

18-438-0104: MARITIME SAFETY AND ENVIRONMENT

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the safety issues onboard and provisions of SOLAS convention
2. Understand the importance of ISM code its implications
3. Evaluate the training requirements as per STCW convention
4. Understand the human element issues onboard and how they are addressed by provisions in MLC and STCW conventions
5. Evaluate the compliance of various statutory requirements and understand the role of Flag state and Port state controls
6. Understand the role of IMO and how the maritime industry is controlled and monitored for safe, secure, efficient and environmentally friendly operation

Module I

Basic Approach to Safety Issues:Introduction to the concepts of risk and safety- International Convention SOLAS- Issues related to ship's systems and equipments- Organizational issues in shipping- ISM code and ship and shore issues connected with ISM code.

Module II

Human Element Related Issues:Short presentation of human error, human factors and human element- STCW Code- Fraudulent certification - Safe Manning of shipping- Fatigue of seafarers- ILO Regulations- MLC- 2006- Coherence of safety- Importance of drills onboard.

Module III

Basic approach of Environmental issues:Introduction of environmental concerns & societies which are adverse to risk- Visibility of pollutions MARPOL 73/78 Convention- Annexes to MARPOL Convention- Waste management (ship and shore) – Ballast water Management & AFS convention- Environmental issues related to Ship recycling- Hongkong Convention & Basel Convention.

Module IV
Compliance monitoring and Enforcement: Compliance monitoring and Enforcement issues - Flag State Control and Port State Control inspections- Fining and detention of vessels- Various reporting systems to IMO – IMO audits.

References:
1. IMO Conventions-SOLAS, ISM Code, STCW Code, MARPOL, Ballast Water Management convention, AFS convention, Hongkong Convention.
2. Basel Convention.
3. ILO Conventions/ Recommendations on Labour Issues and MLC 2006.

18-438-0105:COMPUTATIONAL METHODS IN ENGINEERING

Course Outcomes:
On completion of this course the student will be able to:
1. Apply computational methods in Engineering and Technology using CAS (Computer Algebra Systems)
2. Understand errors and their propagation and the measures to control errors in the application of computational methods
3. Apply numerical methods to solve linear algebra problems
4. Apply numerical methods for interpolation, differentiation, integration, and integral transforms
5. Understand ordinary and partial differential equations and apply finite difference (FDM) method to solve them
6. Understand calculus of variations and Finite Element Method (FEM). Apply FEM to solve Ordinary Differential Equations (ODE)

Module I
Approximations: Accuracy and precision, definitions of round off and truncation errors, error propagation.
Introduction to CAS programs like Matlab/Mathematica/Maple/Python and their application to solve numerical examples of the topics included below.
Algebraic equations: Formulation and solution of linear algebraic equations, Gauss elimination, LU decomposition, iteration methods (Gauss – Siedel), convergence criteria, Eigen values and Eigen vectors.

Module II
Interpolation methods: Newton's divided difference, interpolation polynomials, Lagrange interpolation polynomials, Differentiation and Integration: High accuracy differentiation formulae, extrapolation, derivatives of unequally spaced data, Gauss quadrature and integration.
Transform techniques: Continuous Fourier series, frequency and time domains, Laplace transform, Fourier integral and transform, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT).

Module III

Differential equations: Initial and boundary value problems, Eigen value problems, Partial differential equations.

Numerical solutions differential equations: Formation of difference equations, types of difference equations and their solutions. Laplace and Poisson's equations.Iterative methods for solutions of parabolic, elliptic and hyperbolic types of Partial Differential Equations.

Module IV

Calculus of variations: Introduction to maxima and minima, variational notations, functional and Euler's equations, constraints and Lagrange multipliers, Hamiltonian
Principles.

Finite Element theory: Introduction to finite element theory, generalization of finite element concept, variational approaches, steady state field problems such as heat conduction, electrical and magnetic potential, fluid flow, failure mechanics, etc.

References:

1. Steven C Chapra, "Applied Numerical Method with Matlab for Engineers and Scientists", McGraw-Hill, 2017.
2. Schilling R.J and Harris S. L, "Applied Numerical Methods for Engineering using Matlab and C", Brooks/Cole Publishing Co., 2003.
3. S. S. Sastry, "Introduction to Numerical Methods", Prentice-Hall, 1999.
4. FonSneddon, "Introduction to Integral Transforms", McGraw Hill, 2016.
5. A. R. Forsythe, "Calculus of Variation", Cambridge University Press, 1927.
6. David V Hutton, "Fundamentals of Finite Element Analysis", McGraw- Hill, 2003.
7. Gerald and Wheatley, "Applied Numerical Analysis", Pearson Education, 1998.

18-438-0106: GAS TURBINES

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the combined cycles and cogeneration schemes in gas turbines
2. Analyse inter-cooled and reheat cycles with multi-spool arrangements
3. Describe factors affecting combustor design and performance
4. Calculate stage performance for axial flow and centrifugal compressors
5. Evaluate the overall performance of axial flow and radial flow turbines
6. Explore the blade cooling strategies in turbojet engines

Module I

Open and Closed Cycle Gas Turbines, Combined cycles and cogeneration schemes, thermodynamic analysis of gas turbine cycles, simple, inter-cooled and reheat cycles, multi-spool arrangements, gas turbine design procedure.

Module II
Performance of practical gas turbine cycles, P-V and T-S diagrams, Gas turbine combustion systems, Factors affecting combustor design, Combustion process, Combustion chamber performance, Gas turbine emissions.

Module III
Axial flow compressors, elementary theory, factors affecting stage pressure ratio, degree of reaction, design procedures, blade design, calculation of stage performance, centrifugal compressors, work done and pressure rise, compressor characteristics.

Module IV
Axial and radial flow turbines, vortex theory, choice of blade profile pitch and chord, estimation of stage performance, overall turbine performance, blade cooling, aircraft applications, performance evaluation of single spool turbo jet engine.

References:

1. Saravanamuttoo, Cohen and Rogers, "Gas Turbine Theory", Pearson Education, 2001.
2. Meherwan P. Boyce, "Gas Turbine Engineering Handbook", 3rd edition, Gulf Professional Publishing, 2006.
3. Hill and Peterson, "Mechanics & Thermodynamics of Propulsion", Addison-Wesley, 1992.
4. Lefebvre AH, "Gas turbine combustion", Taylor & Francis, 1999.
5. Norman Davey, "The gas turbine – Development and Engineering", Watchmaker publishing, 2003.

18-438-0107 :PORT LOGISTICS AND PLANNING

Course Outcomes:
On completion of this course the student will be able to:
1. Understand the concept of port logistics
2. Understand the factors affecting Proper Container Terminal Capacity
3. Analyse port transport systems and the transport chain
4. Model and analyse container terminal operations
5. Evaluate the handling capacity of container terminals and plan for future development

Module I
Concept of Port and Logistics and Port Logistics system and their meaning in terms of total transport chain – Need for Proper Container Terminal Capacity (PCTC) and the importance of PCTC for both a port and its customer.

Module II
Factors affecting PCTC - Factors for calculating the proper PCTC - analysis of port transport system in terms of total transport chain.

Module III
Development of Simulation Model for PCTC: General Description of Modeling - Analysis of Container Terminal Operation- Design of Simulation Model- Queuing theory. Questionnaire Survey for PCTC Indicators- analysis on the inputs for PCTC simulation.

Module IV
Analysis on the Handling Capacity of Major Container Terminals of India- implication of an improper container terminal capacity from the viewpoint of futuristic planning and development- Economic analysis of Port congestion.

References:
1. Khalid Bichou, "Port Operations, Planning and Logistics", 2010, Routledge Publication.
2. "Current Issues in Port logistics and intermodality", published by Institute of Transport and Maritime Management, Antwerp,2002.
3. Theo Notteboom, "Current issues in shipping. Ports and Logistics",Academic and Scientific publishers, Brussels, 2011.

18-438-0108: OPTIMISATION TECHNIQUES

Course Outcomes:
On completion of this course the student will be able to:
1. Understands and solve different linear programming problems
2. Solve multi objective optimization problems
3. Apply methods to solve optimization problems
4. Understand stochastic processes
5. Understand different queuing problems and the methods to solve them

Module I
Introduction to Various models and Methods: Theory of Simplex Method, Duality Theory, Duality theorems, Dual simplex method, Revised simplex method, Bounded variables algorithm, Sensitivity analysis, Parametric programming. Integer Programming: Cutting plane method, Branch and bound method. Network models and solutions: Shortest Route problems, Minimal spanning tree problems, Maximal flow problems.

Module II
Non-linear Programming Problems: General non-linear programming problems; convex, quasi-convex, concave and unimodal functions, theory of unconstrained optimization-necessary and sufficient conditions for extrema, Theory of constrained optimization-Lagrange multipliers and Lagrangian optimization, inequality constraints, Kuhn-Tucker conditions.

Module III

Algorithms for Unconstrained Optimization:Fibonacci search method, Golden section search method , Cauchy's (Steepest descent) method Algorithms for constrained optimization: Quadratic programming, separable convex programming. Multi-objective Decision Models: Introduction to multi-objective decision making, concept of pareto-optimality, goal programming formulation, the weighting method of solution, analytic hierarchy process.

Module IV

Sequential Decision Making (Stochastic Case): Stochastic processes, Markov processes, Markov chains, Markov decision problems, Algorithms for solving Markov decision problems, finite-stage models, infinite stage models. Metaheuristics: Nature of metaheuristics, Tabu search, simulated annealing, genetic algorithm. Complexity of algorithms: Complexity of algorithms for combinatorial optimization problems.

References:

1. Hillier, F.S. and Liberman, G.J., "Introduction to Operations Research", McGraw-Hill International edition, Eighth Edition 2009.
2. Rao, S.S, "Optimization: Theory and Applications", 2nd Edn, Wiley eastern, 1994.
3. Ravindran, A., Philips, D.T., and Solberg, J.J., "Operations Research: Principles and Practice", Second Edition, John Wiley & Sons, 1987.
3. Taha, H.A., "Operations Research: An Introduction", Sixth Edition, Prentice-Hall of India, New Delhi, 1999.
4. Deb, K., "Optimization in Engineering Design", Prentice-Hall of India, New Delhi, 1994.
5. Papadimitriou, C.H., and Steghtz, K., Combinatorial Optimization: Algorithms and Complexity, Prentice-Hall, New Jersey, 1982.
6. Simmons, D.M., Ravindran, A., "Non-linear Programming for Operations Research", Prentice-Hall, New Jersey, 1976.
7. Reklatis, G.V., Ravindran, A., and Ragsdell, K.M., "Engineering Optimization: Methods and applications", Wiley Interscience, New York, 1983.
8. Budnick F.S., McLeavey and R. Mojena, "Principles of Operations Research for Management", 2nd Edn., Richard D. Irwin Inc., Homewood, Illinois, 1991.

18-438-0109 :COMPUTER / CAD LABORATORY

Course Outcomes:
At the end of the course the students will be able to:
1. Acquire experience on the various design and drafting software
2. Get familiarisation of different ship design softwares.
3. Becapable of conducting the inclining experiment and preparation of stability booklet.
4. Become familiar with Class rules regarding design of a ship and to determine the structural requirements of a ship

Syllabus contents:
Introduction:
Familiarisation with various softwares used in ship design office- Use of ship design software to carry out various investigations illustrating technical design and economic aspects, together with simple optimisation studies.

Computer Aided Design:
Analysis of stress, strain, vibration, thermal stress, deflection through method of Finite Element Analysis by use of various softwares like MSC, NASTRAN, I-DEAS, AUTO-CAD, PRO-ENGINEER, NORAN etc.

Ship Design:
1. Using a proper ship design software, calculate required powering and propulsion device for a specified vessel and select a suitable engine.
2. Learn how to draw lines plan of a ship, calculations based on inclining experiment and preparation of a stability book.
3. Midship section/Longitudinal strength – Use of classification society rules to determine structural requirements of specified vessel. From experimental data and classification society rules determine rudder scantlings. Analyse structure using Finite Elementsoftware.
4. Use of Statutory Requirements to determine Freeboard and Tonnage of a given vessel and complete an entry for LRS/IRS.

18-438-0110: SEMINAR - I

Course Outcomes:
At the end of this course, students will be able to:
1. Improve communicative skills
2. Overcome performance anxiety in front of an audience
3. Widen the knowledge of thrust area
4. Develop the skill for preparing presentation material
5. Improve self confidence required for an engineer

Individual students are required to choose a topic of current relevance of their interest from Marine engineering related fields preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Marine engineering/Naval Architecture) shall assess the presentation of the seminar and award marks to the students based on style of presentation, technical content, adequacy of reference, depth of knowledge and overall quality of the seminar. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library.

References

1. David F. Griffiths, Desmond J. Higham, Learning LaTeX, Society for Industrial and Applied Mathematics, 2016.
2. LalitMali, Libre office 5.1 Impress, Draw, Base book, Vol. 2, Notion Press, 2017.

18-438-0111 RESEARCH METHODOLOGY AND IPR

Course Outcomes:

On completion of this course the student will be able to:

1. Demonstrate knowledge of research processes (reading, evaluating, and developing)
2. Perform literature reviews using print and online databases
3. Summarize and discuss important issues and trends within the actual research area.
4. Write a scientific article within a limited topic but with a quality such that the article could be accepted for presentation in a conference or workshop
5. Create a scientifically sound and reasonable and well documented plan for a Masters thesis project of excellent quality.
6. Understand the basics of the four primary forms of intellectual property rights.
7. Compare and contrast the different forms of intellectual property protection in terms of their key differences and similarities.

Module I

Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches to investigation of solutions for research problem - data collection, analysis, interpretation. Necessary instrumentation.

Module II

Effective literature review approaches, Plagiarism, Research ethics.

Effective technical writing. How to write a good report and a paper?

Developing a Research Proposal, Format of research proposal, Presentation and assessment by a review committee.

Module III

Nature of Intellectual Property: Patents, Industrial Designs, Trademark and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

International Scenario: International cooperation on Intellectual Property. Procedure for grant of patents, Patenting under Patent Cooperation Treaty (PCT).

Module IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indication of goods,.

New Developments in IPR: Administration of Patent System. IPR of Biological Systems, Computer Software etc. Traditional knowledge: Indigenous, medicinal and bioprospecting knowledge, Need for protection. Case Studies.

References:

1. Stuart Melville and Wayne Goddard, Research methodology: An introduction for Science & Engineering students, Juta& Co Ltd, 1996.
2. Ranjit Kumar, Research Methodology: A Step by Step Guide for beginners, 2nd Edition, Pearson, 2005.
3. Gopalakrishnan N S, and Agitha T G, Principles of Intellectual Property, 2nd Edition, Eastern Book Company, 2015.
4. Bansal K and Bansal P, Fundamentals of Intellectual Property for Engineers, BS Publications, 2013.
5. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 4th Edition, Cengage Learning, 2012.
6. Markel, Mike, Technical Communication. 11th Edition, Mac Millan, 2015.

SEMESTER - II

18-438-0201: ADVANCED WELDING TECHNOLOGY

Course Outcomes:

On completion of this course the student will be able to:

1. Understand different welding processes, their applications and limitations
2. Analyse the different weld defects and their causes
3. Apply general principles in selecting a suitable welding process
4. Prepare welding procedure specification and procedure qualification record
5. Explore thermal and metallurgical considerations in selecting welding process

Module I

Introduction and Brief Review of Conventional Welding Process:Importance and application of welding- classification of welding process. Selection of welding process.Gas tungsten arc (TIG) welding, Gas metal arc welding (MIG), Resistance welding. Electro slag welding processes, power sources and other characteristics for these individual processes, equipments and accessories, application and limitation of each process. Resistance welding processes-their principle-Types (spot, seam, projection, percussion, flash) - Equipments required for each application. Welding of MS, CI, Al, and Stainless steel & Maurer/Schaefflar Diagram. Soldering & Brazing.

Module II

Advanced welding Techniques:Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding, Diffusion bonding, cold welding, welding of dissimilar metals etc- equipments and accessories, application and limitation of each process.Principle and working and application of explosive welding /cladding.Underwater welding-Spray welding/ Metalizing- Hard facing.

Module III

Weld Design:Welding Machines/equipments and its characteristics and arc-stability. Weld defects and distortion and its remedies. Inspection(visual, liquid penetrant inspection and Magnetic particle inspection) / testing of welds (ultra sonic, radiography, eddy current and thermography)-principles, applications, advantages and limitations of each. Weld design- Welding of pipe lines and pressure vessels- Life predication.

Module IV

Thermal and Metallurgical consideration: Thermal considerations for welding, temperature, distribution. Analytical/Empirical analysis formulae- Heating and Cooling curves. Metallurgical consideration of weld. HAZ and Parent metal, micro and Macro structure. Solidification of weld and properties.

References:

1. AWS Welding Handbook Vol. 1 to 4, 9th Edition.
2. Schwartz M. "Materials and Appplications- Metal Joining Manual", McGraw-Hill, 1979.
3. Nadkarni S.V.," Modern Arc Welding Technology" Oxford IBH Publishers, 2008.
4. Christopher Davis, "Laser Welding- A practical Guide", Jaico Publishing House, 1994.
5. Parmar R.S, "Welding Engineering and Technology", Khanna Publishers, 2013.
6. SaferianD.,"The Metallurgy of Welding", Chapman and Hall, 1985.
7. Cary, Howard, "Modern Welding Technology" prentice Hall,6th Edition, 2004.
8. Welding Codes-AWS DI.I Structural welding code, API 5L, API 1104, ASME Section VIII-Division 1, ASME section IX, ASME section II, Part A and C.
9. Baldev raj, "Practical Non-destructive Testing", Woodhead Publishing House, 2002.
10. B Hull and V. John, "Non-destructive testing", Macmillan, 1998.
11. Krautkramer, Josef and Hebert Krautkramer, "Ultrasonic Testing of materials", 3rd Edition, New York, Springer-Verlag, 1983.
12. Hertzberg RW, "Deformation and Fracture of Mechanics of Engineering Materials", John Wiley, 1996.
13. Omer W.B, "Design of Weldments", James F. Lincoln Arc Welding Foundation, 1991.
14. Bhattacharya M, " Weldment Design", Association of Engineers, 1991.

18-438-0202:SHIP DESIGN & ECONOMICS

Course Outcomes:

On completion of this course the student will be able to:
1. Understand the Ship design process
2. Understand the strength and stability calculations of a vessel
3. Prepare lines plan
4. Understand the safety requirements and use of formal safety assessment
5. Understand the economic aspects of ship operations
6. Apply sustainability concept and life cycle assessment procedure

Module I

Design basics: Considerations of overall ship design requirements. Basic requirements of a technical design- Development of specification- Derivation of displacement and principal ship dimensions: length, breadth, draught, depth, CB and capacity. Space determined designs: applications to cargo ships, passenger ships, ferries and container ships. Approximate formulae: derivation and applications to hydrostatics and stability. Metacentric height changes due to changes in dimensions. Use of approximate formulae at the preliminary design stage and limitations. Lightship mass estimates: methods of estimating hull, outfit and machinery masses and centre of gravity. The weight equation: description and applications.

Module II

Developments:Developments of overall technical design models, suitable for iterative procedures and the derivation of feasible technical designs. Introduction to computer models and optimisation. Design of ship's lines and modification to form: modifications to sectional area curves and preparation of body plans; application of standard series data. Computer aids to the preparation of lines: polynomial fits to S.A. and W.L. curves providing preliminary blocking off procedure for body plan; applications of cubic spline curves to the representation and fairing of ship's lines.

Module III

Safety- Introduction to ship safety and the use of formal safety assessment for operations and probabilistic approach for design. The need to integrate safety considerations with design spiral. Statutory requirements: stability, freeboard, subdivision and damaged stability, tonnage, outline discussion of L.S.A, crew, fire appliances and other regulations. The role of classification societies.

Module IV

Sustainability & Economics: Introduction to sustainability concepts and estimation of impacts- Life cycle assessment procedures- Cradle to grave concept. Introduction to the time value of money, capital investment and economic analysis.Principles of techno-economic analysis.Components of ship operating costs.Components of ship construction costs.Sources of cost information.Examples of techno-economic modeling, bringing together the derivation of feasible technical designs and their economic evaluation.

References:

1. K.J.Rawson, "Basic Ship Theory",5th Edition,2001, Butterworth-Hernemann Publication.
2. Ian Lyon Buxton, "Engineering Economics & Ship Design", British Research Association, 2nd Edition,1976.
3. D.G.M Watson, "Practical Ship Design", 2002, Elsevier Science Ltd., UK.
4. Harry Benford, "Fundamentals of Ship Design Economics: Lecture Notes", published by Dept. of Naval Architecture and Marine engineering, University of Michigan.

ELECTIVES III & IV (18-438-0203 to 18-438-0208)

18-438-0203: COMBUSTION AND POLLUTION

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the conservation of mass and energy in chemical reactions
2. Apply the fundamental laws of transport phenomena
3. Analyse chemical kinetics from the equation for rate of reactions
4. Model 1D laminar and turbulent premixed flames
5. Evaluate the characteristics of spray combustion
6. Explore the theory of formation of combustion generated pollutants

Module I

Principles of combustion, combustion chemistry, scope of combustion.

Thermodynamics of reactive systems**:** conservation of mass and energy in a chemical reaction. First and second law for reactive systems, Thermochemistry, adiabatic flame temperature, chemical equilibrium.

Chemistry of combustion: Chemical kinetics, elementary reactions, molarity and order of chemical reaction, general equation for rate of reaction, equation of Arrhenius, activation energy.

Physics of Combustion**:** Fundamental laws of transport phenomena, conservations equations, transport in turbulent Flow.

Module II

Premixed Flame: One dimensional combustion wave, laminar premixed flame, burning velocity measurement methods, effects of chemical and physical variables on burning velocity, flame extinction, ignition, flame stabilizations, turbulent premixed flame.

Module III

Diffusion Flame: Gaseous jet diffusion flame, liquid fuel combustion, fuel atomization, characteristics of spray combustion, solid fuel combustion.

Module IV

Combustion generated pollutants: constituents and types of emission, mechanisms of hydrocarbon and particulate emissions, and theories of soot and NOx formation, industrial furnace emissions. Quantification of emission, emission control methods, modelling of emissions. Emission standards.Instrumentation to measure pollutants.

References:

1. Law, C. K., "Combustion Physics", Cambridge, 2010.
2. Stephen R Turns, "An Introduction to Combustion", Mc-Graw Hill, 2nd edition, 2006.
3. Mishra, D.P, "Fundamentals of Combustion", Prentice Hall of India, New Delhi, 2008.
4. Kuo K.K, "Principles of Combustion", John Wiley and Sons, 2005.
5. Strehlow R. A. "Fundamentals of Combustion", McGraw Hill Book Company, 1984.
6. Thring, M.W, "The science of Flames and Furnace", Chapman & Hill Ltd, London 1962.
7. Trinks, W, "Indusrial Furnaces", Vol.1 4th edition, John wiley, New York 1951.
8. Irvin Glassman and R A Yetter, "Combustion", Academic press, 4th edition, 2008.

18-438-0204: FINITE ELEMENT ANALYSIS

Course Outcomes:

On completion of this course the student will be able to:

1. Understand variational and weighted residual approaches
2. Construct global stiffness matrix and load vector
3. Model two dimensional problems using constant strain triangle
4. Analyse selected problems of stress, vibration and structural stability
5. Model heat conduction and fluid flow problems
6. Explore the use of FEM codes in the evaluation of existing designs

Module I
Finite element modelling, variational and weighted residual approaches, potential energy approach, Galerkins approach, Shape functions, natural co-ordinates system, element and global stiffness matrix, assembly of global stiffness matrix and load vector.

Module II
Finite element equations, Treatment of boundary conditions, errors, convergence and patch test, higher order elements, application to solution of selected problems of stress analysis, dynamics and vibrations, structural stability, two dimensional problems using constant strain triangles.

Module III
Treatment of material and geometric nonlinearities, contact problems, heat conduction and selected fluid problems, mesh generation, modelling; numerical techniques, errors and convergence.

Module IV
Axi-symmetric formulation, Iso-parametric elements and numerical integration, use of commercial packages, finite element evaluation of existing complete designs, Comparison with conventional analysis, model revision.

References:

1.O. C. Zienkiewicz , R. L. Taylor , J.Z. Zhu, "The Finite Element Method: Its Basis and Fundamentals", Elsevier, 2005.
2.Reddy JN, "Introduction to finite element method", McGraw-Hill Higher Education, 1993.
3.Cook RD, Concepts & applications of finite element analysis, Wiley, 1976.
4.Chandrupatla&Belegundu, "An Introduction to Finite element method in Engineering", Pearson Education, 1996.
5.Chandrupala T, "Finite Element Analysis for engineering and technology", Universities Press, 1997.
6. C.S Krishnamoorthy, "Finite Element Analysis", Tata McGraw Hill, 1994.

18-438-0205: ENERGY CONSERVATON AND MANAGEMENT

Course Outcomes:
On completion of this course the student will be able to:
1. Understand the different principles of energy conservation management
2. Analyse different energy systems and the factors affecting efficiency
3. Conduct energy audit for thermal, electrical and other energy systems
4. Calculate the efficiencies of turbines, compressors and analyse the factors affecting efficiency
5. Evaluate the economic performance and do investment analysis

Module I

Energy conservation management:The relevance of energy management profession; general principles of energy management and energy management planning; application of Pareto's model for energy management; obtaining management support; establishing energy data base; conducting energy audit; identifying, evaluating and implementing feasible energy conservation opportunities; energy audit report; monitoring, evaluating and following up energy saving measures/ projects.

Module II

Energy efficiency: Energy efficiency analysis; thermodynamics and energy; coefficient of performance; energy effectiveness; management of heating, ventilating and air-conditioning (HVAC) – principles, opportunities, case studies; management of process energy- principles, opportunities, case studies; management of electrical load and lighting - management opportunities with electric drives, lighting, heating and electrolytic systems; electrical load analysis; peak demand control; computer-aided energy management; cogeneration; forms of cogeneration; feasibility study for cogeneration.

Module III

Parameters affecting energy consumption:Energy efficiency of turbines, compressors and pumps; specific energy consumption; parameters affecting specific energy consumption; flexi targeting technique.

Module IV

Energy economics:Financial evaluation of energy projects; cash flow model; time value of money; evaluation of proposals - payback method, average rate of return method, internal rate of return method, present value method, profitability index, life cycle costing approach, investment decision and uncertainty; consideration of income taxes, depreciation and inflation in investment analysis.

References:

1. Charles M Gottschalk, "*Industrial energy conservation*'", John Wiley & Sons, 1996.
2. Craig B Smith, '*Energy management principles,*' Pergamon Press.
3. G GRajan, '*Optimizing energy efficiencies in industry*', Tata McGraw Hill, Pub. Co., 2001.
4. Paul O'Callaghan, '*Energy management*',1993, McGraw Hill Book Co.
5. Wayne C Turner, '*Energy management Hand Book*', The Fairmount Press, Inc.,2009.
6. S Rao and B BParulekar, '*Energy Technology*', Khanna Publishers, 2005.
7. IEEE recommended practice for energy management in industrial and commercial facilities, IEEE std 739 – 1995 (Bronze book).

18-438-0206: QUANTITATIVE TECHNIQUES FOR MANAGERIAL DECISIONS

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the strategic and tactical decisions making principles
2. Apply the basic concepts of network techniques
3. Analyse the inventory control systems and problems associated with that
4. Understand in depth various types of problems and solutions connected with decision making
5. Solve the various types of transportation problems and assignment problems

Module I

Decision Making Principles: Decision making- strategic and tactical decisions-strategy formulation-models of decision making-single stage decisions under risk-incremental analysis-multistage decision making-decision trees-decision making under uncertainty- Bayes decision theory. Network Techniques- basic concepts- network construction- CPM and PERT networks-algorithm for critical path-slacks and their significance-crashing-network flow problems-the shortest route problem-minimal spanning tree problem.

Module II

Inventory control: Inventory control-functions of inventory-structure of inventory problems-relevant cost-opposing costs-selective control techniques-dynamic inventory models under certainty-classical EOQ model with and without back logging-production lot size model-quantity discount- safety stock-probabilistic model-one time mode-P system and Q system.

Module III

Problems and Solutions:Statement of the LP problem- slack and surplus variables-basic feasible solutions- reduction of a feasible solution to basic feasible solution-artificial variable-optimality conditions- unbounded solutions- Charnes M method-two phase method-degeneracy-duality.

Module IV

Transportation Problem: Transportation problem- coefficient matrix and its properties-basic set of column vectors-linear combination of basic vectors-tableau format-stepping stone algorithm-UV method-inequality constraints-degeneracy in transportation problems - assignment problem-Hungarian method.

References:

1. Hadley.G, “Linear programming”, Addison Wesley Publishing Co.
2. Ravindran , Solberg, & Philips, “Operations Research”,2nd Edn.,2007, John Wiley.
3. Riggs, “Economic Decision models for Engineers and Managers” , McGraw Hill International Students Edition.

4. Weist& Levy, “A management Guide to PERT and CPM”, Prentice hall of India.
5. Starr& Miller, “Inventory control –Theory and Practice”, Prentice Hall of India.
6. Pearson, “Statistics for Management”,7th Edition,2013, Prentice Hall of India.
7. P.N.Aurora, “Comprehensive Statistical Methods”,S.Chand Publishing Co.
8. J.K.Sharma, “QT for Management Decisions”,2001, Mac Millan.
9. Sultan Chand,” New Age Fundamental of Statistics”,2007,New Age International.
10. Cengage/Thomson, “Quantitative Methods for Business”,11th Edn.,2009,Mac Millan.
11. N.D.Vohra,“Quantitative Techniques”, Tata Mac Graw Hill.
12. R.I.Levin&D.S.Rubin,”Statistical Method, Statistics for Management”, HPH

18-438-0207: NUMERICAL METHODS IN TERMINAL ENGINEERING

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the solution techniques for linear and non-linear algebraic equations
2. Apply the solution techniques in thermal radiation and chemical equilibrium calculations
3. Determine the nature of partial differential equations and time marching solutions
4. Evaluate finite difference applications in steady and transient conduction
5. Model convective heat transfer and diffusion
6. Explore incompressible and compressible flow simulations

Module I

Governing equations for thermal systems, solutions of linear and non-linear algebraic equations, LU decomposition, Bisection method, Newton-Raphson method, RungeKutta methods, applications in thermal radiation and chemical equilibrium calculations.

Module II

Time marching solutions, Equilibrium problems, elliptic equations, parabolic equations, hyperbolic equations, applications to reaction kinetics, discretization of derivatives, finite difference applications in steady conduction, simulation of transient conduction by finite difference.

Module III

Introduction to gradient method, Steepest descent method, Congugate gradient method, Finite volume method, applications in heat conduction, transient one dimensional conduction, two dimensional steady heat conduction, applications in convective heat transfer, modelling of convective diffusion.

Module IV

Incompressible flow simulation, modelling of compressible flows, Simulation of reacting systems, Introduction to FEM, Incompressible flow simulation by FE, Turbulent flow modelling, grid generation techniques.

References:

1. Chung, "Computational Fluid dynamics", Cambridge university press, 2002.
2. JH Ferziger and M Peric,"Computational methods for fluid dynamics", Springer, 1999.
3. K Muralidhar and T Sundarajan, "Computational fluid flow & heat transfer", Narosa Publishing house, 2001.
4. Suhas V Patankar, "Numerical heat transfer and Fluid flow", Hemisphere Publishing Corporation, 1980.

18-438-0208: SYSTEM SIMULATION AND MODELING

Course Outcomes:

On completion of this course the student will be able to:

1. Understand system concepts, systems and system environment, components of a system
2. Learn the system design and system modeling, techniques of simulations and event scheduling
3. Learn the techniques for generating random numbers, various types of tests for random numbers
4. Study the verification, calibration and validation of simulation models and types of regressions
5. Learn simulation modeling and analysis of manufacturing systems and inventory systems and PERT networks

Module I

Introduction:System Concept- Systems and system environment, components of a system, discrete and continuous systems, systems approach to problem solving, types of system study, system analysis, system design and system postulation, system modeling, types of models. System Simulation: Technique of simulation, comparison of simulation and analytical methods, types of system simulation, steps in simulation study, Monte Carlo simulation. Concepts in Discrete Event Simulation: Event scheduling/Time advance algorithm, modeling world views, simulation programming tasks, Comparison and selection of simulation languages.

Module II

Random Number Generation:Techniques for generating random numbers, linear congruential method, test for random numbers, frequency tests, run tests, tests for autocorrelation, gap test, and Poker test. Random variategeneration: Inverse transformation technique, exponential, uniform, Weibull, triangular, Empirical-Discrete and continuous distributions. Convolution method, Acceptance-Rejection technique.InputModelling for simulation: Data collection, identifying the distribution with data, parameter estimation, goodness of fit test, Chi square, Klomogrov and Smirnov tests, selecting input model when data are not available.

Module III

Verification and Validation of Simulation Models:Verification of simulation models, calibration and validation of models, face validity, validation of model assumption, validating input-output transformation, input-output validation using historical input data. Output Analysis for a single model: Measures of performance and their estimation, point estimation, interval estimation, output analysis for terminating simulations and steady state simulations. Meta modelling: Simple linear regression, testing for significance of regression, multiple linear regression.

Module IV

Simulation Modeling and Analysis of Manufacturing Systems**:** Objectives, performance measures, issues in simulation of manufacturing systems, simulation software for manufacturing applications, simulation of job shop manufacturing systems, simulation modelling and analysis of single server and single queue systems, inventory systems and PERT networks.

References:

1. Deo, N., "System Simulation with Digital Computer", Prentice Hall of India, 2004.
2. Askin R.G. and Standridge, C.R., "Modelling and Analysis of Manufacturing Systems", John Wiley & Sons, 1993.
3. Gordon, G., "System Simulation", 2nd Edn, Prentice Hall of India, 1995.
4. Law, A.W. and Kelton, W.D., "Simulation Modelling and Analysis", Third Edition, McGraw Hill International, 2000.
5. Fishman, G.S., "Concepts and Methods in discrete Event Digital Simulations", Wiley, New York, 1973.
6. Carrie, A., "Simulation of Manufacturing Systems", John Wiley & Sons Ltd., 1988.
7. Banks, J., Carson, J.S., Nelson, B.L., and Nicol, D.M., "Discrete-Event System Simulation", 4th Edition, Pearson Education, Inc., 2005.

18-438-0209: METALLURGY LABORATORY

Course Outcomes:

At the end of the course the students will be able to:

1. Acquire hands on experience on sample preparation and microscopicexamination of weld coupons.
2. To identify and analyse weld defects.
3. To carry out other NDT methods commonly used in ship building and ship repair industry
4. Understand the microstructural observation of weldments of various materials
5. Become conversant with the preparation of welding procedure specifications and various records to be maintained

Syllabus contents:

1. Study of metallurgical microscope and sample preparation.
2. Microscopic examination of plain carbon steels, stainless steels, maraging steels and tool Steels.
3. Microscopic examination of cast irons
4. Microscopic examination of Magnesium alloys, Aluminum alloys, Titanium alloys, Copper alloys.

5. Demonstration of hardness measurements - micro and macro, and evaluation of tensile Properties.
6. Effect of welding parameters on weld bead by GTA welding, GMA welding, Submerged arc welding.
7. Microstructural observation of weldments of Carbon steel, Stainless steel, Aluminum Alloy, Titanium alloy, Dissimilar joints.
8. Analysis of weld defects.
9. Practice for preparation of welding procedure specification.
10.Practice for preparation of procedure qualification record.

18-438-0210:SEMINAR - II

Course Outcomes:
At the end of this course, students will be able to:
1. Improve communicative skills
2. Overcome performance anxiety in front of an audience
3. Widen the knowledge of thrust area
4. Develop the skill for preparing presentation material
5. Improve self confidence required for an engineer

Individual students are required to choose a topic of current relevance of their interest from Marine engineering related fields preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Marine engineering/Naval Architecture) shall assess the presentation of the seminar and award marks to the students based on style of presentation, technical content, adequacy of reference, depth of knowledge and overall quality of the seminar. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library.

References

1. David F. Griffiths, Desmond J. Higham, Learning LaTeX, Society for Industrial and Applied Mathematics, 2016.
2. LalitMali, Libre office 5.1 Impress, Draw, Base book, Vol. 2, Notion Press, 2017.

18-438-0211: MINI PROJECT / INTERNSHIP

Course Outcomes:
At the end of the course the student will be able to:
1. Get an opportunity to work in an actual industrial environment if they opt for internship.
2. Solve a live problem using software/analytical/computational toolsin the case of mini project.
3. Learn to write technical reports.
4. Develop skills to present and defend their work in front of technically qualified audience.

Students can take up small problems in the field of Marine engineering / Navalarchitecturetopicsas mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on related engineering subjects, studying a software tool for the solution of an engineering problem etc.

SEMESTER- III

ELECTIVES V& VI (18-438-0301 to 18-438-0306)

18-438-0301: MARINE CORROSION AND PREVENTION

Course Outcomes:
On completion of this course the student will be able to:
1.Identify the impact of corrosion and problems faced in marine environment
2. Distinguish between different modes of corrosion and means to control them
3. Familiar with various corrosion monitoring methods and equipments
4. Determine the corrosion rate
5. Suggest solutions to control the corrosion problems and related environmental issues
6. Explore the effectiveness of use of alternate control measures

Module I
Introduction:Definition of corrosion- corrosion Engineering- environments - corrosion damage-classification of corrosion - the nature and diagnosis of marine corrosion problem - environmental factors in corrosion of metals in sea water - nature of corrosion processes - corrosion in offshore structures.

Module II
Corrosion Principles:Factor influencing corrosion-types of corrosion- electrochemical aspects-environmental effects-metallurgical effects- mechanism of corrosion-galvanic or two metal corrosion - crevice corrosion-corrosion atmospheric corrosion-pitting-inter granular corrosion-selective leaching -erosion corrosion-stress corrosion-hydrogen damage - fatigue corrosion - corrosion due to biofouling- microbial corrosion-corrosion rate expressions - corrosion rate measurements.

Module III
Corrosion Monitoring and Testing:On-stream monitoring equipments-electrical resistance principle- linear polarisation principles-hydrogen test probe-ultrasonic testing--radiography-PH instruments infrared thermography-corrosion coupon-off-stream monitoring equipments-acoustic emission testing-eddy currents inspection-magnetic particle inspection-liquid penetrants inspection-miscellaneous equipments. Corrosion testing- Simple immersion test - tests at high and moderate flow velocity-spinning disc test-cavitation erosion tests galvanic corrosion testing-stress

corrosion test -corrosion fatigue test - special purpose tests - atmospheric corrosion tests - salt spray tests -- test for stainless steel - paint test and Incotest.

Module IV

Corrosion Control and Prevention:Materials selection-alteration of environments - design for cathodic and anodic protection -- comparison of cathodic and anodic protection- protective coating - metallic coating and other inorganic coat inorganic coating- coating system selection-paint system-protection by means of paints-antifouling paints-corrosion protection system of hull structure-corrosion control by GRP- biofouling control- corrosion inhibitors-anodic inhibitor-marine coating -corrosion resistant materials for propellers, pumps, system, heat exchangers, hulls, wire ropes.

References:

1. Fontana and Greene, "Corrosion Engineering", Mcgraw Hill-book company.
2. Philip A Schwetzer, "Corrosion and corrosion protection hand book",2nd Edn.,CRC Press.
3. R.N. Arkins, "Corrosion processes", Applied Science publishers, London.
4. Francis L. Lague, "Marine Corrosion", John Wiley and Sons Publication, London.
5. Kenneth A. Chandler, "Marine and Offshore Corrosion", Butterworth.

18-438-0302: PLANT MAINTENANCE & SAFETY

Course Outcomes:

On completion of this course the student will be able to:

1.Understand different maintenance practices and methods used for condition monitoring of machineries
2. Conduct fault tree analysis and predict the reliability
3. Apply general principles in selecting methods to improve the reliability of systems
4. Understand the provisions in factory act and industrial safety act
5. Comment on safety performance
6. Understand the relevance and implications of provisions in EMS and OSHAS

Module I

Plant Maintenance: Types of Maintenance – Break down, Routine, Planned, Preventive, Diagnostic Maintenance. Condition Monitoring – Principles and methods . Contaminant monitoring, Spectral Oil Analysis Procedure, Ferrography. Vibration Monitoring and Analysis – Transducer selection, Frequency analysis. Condition Monitoring of Rolling Element Bearing - Selection of lubricants for various purposes.

Module II

Reliability: Reliability, availability, maintainability. Failure Data Analysis. Mean Time to Failures (MTTF), Mean Time to Repair (MTTR), Fault Tree Analysis, Failure Mode Effects Analysis (FMEA), Failure Mode Effects & Critical Analysis (FMECA). Reliability estimation.

Module III

Industrial safety: Introduction to the concept of safety- safety provisions in the factory Act-Laws related to the industrial safety-Measurement of safety performance, Safety Audit, Work permit system, injury and accidents and reporting systems to concerned authorities. Statutory test certificates from various competent authorities to be obtained and maintained.

Module IV

Environmental & Occupational Health and Safety:Hazards- types of industrial hazards (Environmental and OSHAS) -nature, causes and control measures, Threshold limit values, Logics of consequence analysis- Estimation- Toxic release and Fire hazard, Emergency planning and preparedness- Medical and other statutory records to be maintained. Requirement of Quality, EMS and OSHAS certifications and conducting mandatory training programmes for the various categories of personnel.

References:

1. R.A.Collacot – "Mechanical Fault Diagnosis and Condition Monitoring",Chapman& Hall, London.
2. Mars G. Fontana – "Corrosion Engineering",3rd Edition, 2005, McGraw-Hill.
3. L.S.Srinath – "Reliability Engineering"4th Edition,2005, Affiliated East West Press.
4. Thomas J. Anton, "Occupational Safety and Health Management", McGraw Hill,1989.
5. IanT.Cameron& Raghu Raman, "Process Systems Risk Management", ELSEVIER Academic press, 2005.
6. Lees F.P, "Loss Prevention in Process Industries", Butterworths, New Delhi, 2005.
7. ILO Codes, "Safety & Health in Ship Building and Ship Repairing".
8. The Factory Act,1948 and Factory Rules1950 with amendments.
9. The Explosive Act,1884 and Explosive Rules, 2008.

18-438-0303: CFD AND ITS APPLICATION

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the equations of mass, momentum, energy and species balance
2. Apply turbulent flow models in log-law, outer and viscous sub layer
3. Model partial differential equations based on explicit, implicit and semi implicit schemes
4. Analyse criteria for numerical stability and convergence
5. Solve one and two dimensional heat equations using finite volume method
6. Explore the application of CFD codes in modelling compressible and incompressible flows

Module I
Review of fluid dynamic processes in flows, equations of mass, momentum, energy and species balance, specification of boundary conditions, turbulent flow models, turbulence kinetic energy, free turbulent flows, viscous sub layer, Log-law layer, outer layer.

Module II
Application of Finite Difference Methods, discretization, Taylor series method, central differencing, forward and backward differencing, estimation of truncation and discretization errors, explicit, implicit and semi-implicit techniques, Crank Nicolson scheme, criteria for numerical stability, convergence analysis.

Module III
Flux formulation for Finite Volume Method, transient one dimensional conduction, two dimensional steady heat conduction, convective diffusion, incorporation of variable properties, upwinding and artificial diffusion, QUICK and SIMPLE algorithms, solution of discretized equation, Tri Diagonal Matrix Algorithm.

Module IV
Modelling of flow problems; simulation of incompressible and compressible flows; implementation of boundary conditions, inlet and outlet boundary conditions, wall boundary condition, symmetry and periodic boundary conditions, fundamentals of grid generation; structured and unstructured grids, introduction to the use of commercial software; use of commercial CFD software in simulation, case studies.

References:
1.Muralidhar K and Sundarajan T, "Computational fluid flow & heat transfer", Narosa Publishing House, 1995.
2. Suhas V Patankar, "Numerical heat transfer and Fluid flow", Hemisphere Publishing Corporation, 1980.
3.H.K. Versteeg& W. Malalasekera, "An Introduction to Computational Fluid Dynamics", Pearson, 1995.
4.John D Anderson, "Computational fluid dynamics", McGraw Hill,1995.
5. TuJiyuan, Yeoh Guan Heng and Liu Chaoqun, "Computational Fluid Dynamics: A Practical Approach", Elsevier, 2012.

18-438-0304: MARINE TRANSPORTATION AND ECONOMICS

Course Outcomes:
On completion of this course the student will be able to:
1. Understand the international transport system, demand of the sea transport, major shipping routes and types and problems of major ports
2. Analyse the shipping market model, supply and demand for seatransport and freight rates
3. Undrestand the impact of financial pressures on ship owners' decisions and cost, revenue and financial performance
4. Do the voyage cash flow analysis and annual cash flow analysis and internal rate of return
5. Study in depth the shipping markets and commodities and logistics management of shipping and ports

Module I

The economic organization of the shipping Market: The economic role of the shipping industry- The international Transport system- The demand for sea transport – The world merchant fleet- The role of ports in the transport system. Major Shipping Routes- Ports- types, Problems, factors for good port. Major ports of India and World.

Module II

Supply, Demand and Freight rates: The shipping market model- The supply of sea transport- The demand for sea transport- The freight rate mechanism-Factors influencing in determining various equilibrium.

Module III

Cost, Revenue and Financial Performance: The impact of financial pressures on ship owners' decisions – Financial performance and investment strategy – the cost of running ships – various revenue receipts – Voyage cash flow analysis and annual cash flow analysis- the internal rate of return. Regular and irregular cash flow patterns; criteria – NPV, RFR, AAC, PBR, etc. Depreciation and tax, profit and loss accounts- Cost breakdown and voyage analysis - Annual and discount cash flow analysis.

Module IV

Shipping markets and commodities: The tanker market (freight rates and contracts, WORLDSCALE index; equivalency and behaviour of freight rates; characteristics and structure of the market; FOB and CIF prices, optimisation theory and Lagrange multipliers; oil transportation network, minimisation of transportation cost); Dry bulk markets, Liner market (status; operation of conferences; characteristics and structure; determination of freight rates)- International trade and sea transport- Logistics management of shipping and ports.

References:

1. Martin Stopford, "Maritime Economics",3rd Edition,2009,Routledge, Abington, Oxon.
2. James McConville, "Economics of Marine Transport: Theory and Practice", Witherby& Co. Ltd.,1999.
3. Heather Leggate, James McConville, Alfonso Morvillo, "International Maritime Transport: Perspectives"2004, Routledge Abington, Oxon.

18-438-0305: AUTOMATIC CONTROL SYSTEMS

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the basic concepts of automatic control systems
2. Analyse static and dynamic characteristics of control systems
3. Understand control actions and control system components
4. Demonstrate control system implementations
5. Apply various types of control systems employed onboard ships.

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

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

Module III
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.

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

References:
1. E O Doebelin, " Measurement System, Application and Design", 5th Edn.,2004,Mac GrawHill.
2. C S Rangan, G R Sharma, V S V Mani, "Instrumentation Devices and Systems",1997, Tata Me Graw Hill, New Delhi.
3. D Patranabis, "Telemetry Principles", 2000, Tata Mac Graw Hill.
4. Katushiko Ogata, "Modern Control Engineering", 2001, 4thInternationalEdn., Pearson, UK.
5. Palgrave Jacqueline Wilkie and Michael Johnson, " Control Engineering", 2001, Mac Millan.
6. Smith, "Automated Continuous Process Control", John Wiley & Sons, 2002.

18-438-0306: DIAGNOSTIC METHODS IN COMBUSTION SYSTEMS

Course Outcomes:
On completion of this course the student will be able to:
1. Understand the measurements techniques for flow rates and turbulence of gas streams
2. Illustrate the flow and flame visualization techniques
3. Describe velocity measurements using hot wire anemometers and velocimeters
4. Explore particle image velocimetry for spray diagnostics
5. Demonstrate measurement of species concentration, temperature and emissions

Module I
Measurements of static pressure, temperature, flow rates, flow velocity and turbulence of gas streams.

Module II

Flow and Flame Visualization, Shadowgraph and Schlieren methods. Flame photography and the measurements of burning velocity, velocity measurement using hot-wire and Laser Doppler velocimeter, particle image velocimetry,particle sizing methods.

Module III

Malvern particle Analyzer, Phase-Doppler Anemometer and its application to spray diagnostics, PIV techniques.

Module IV

Measurement of species concentration and temperature; Raleigh scattering, Coherent Anti-Roman Stokes technique, Planar Laser Induced Fluorescence.Measurement of combustion emissions.

References:

1.Kohse-hoinghaus Katharina, Jeffries, "Applied combustion diagnostics", Taylor & Francis, 2002.

2. Eckbreth A C., "Laser diagnostics for combustion temperature & species", Gordon Breach Publishers, 1996.

3. Stephen R Turns, "An Introduction to Combustion", Edition 3, McGraw Hill, 2011.

References:

1. Steven C Chapra, "Applied Numerical Method with Matlab for Engineers and Scientists", McGraw-Hill, 2017.
2. Schilling R.J and Harris S. L, "Applied Numerical Methods for Engineering using Matlab and C", Brooks/Cole Publishing Co., 2003.
3. S. S. Sastry, "Introduction to Numerical Methods", Prentice-Hall, 1999.
4. FonSneddon, "Introduction to Integral Transforms", McGraw Hill, 2016.
5. A. R. Forsythe, "Calculus of Variation", Cambridge University Press, 1927.
6. David V Hutton, "Fundamentals of Finite Element Analysis", McGraw- Hill, 2003.
7. Gerald and Wheatley, "Applied Numerical Analysis", Pearson Education, 1998.

18-438-0307: DISSERTATIONPHASE - I

Course Outcomes:

At the end of the course the student will be able to:

1. Get exposed to self-learning various topics.
2. Learn to survey the literature such as books, national/international refereed journalsandcontact resource persons for the selected topic of research.
3. Learn to write technical reports.
4. Develop oral and written communication skills to present and defend their work in front of technically qualified audience.

Guidelines:

The Project work will start in the 3rd semester and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solutions and must preferably bring out the individual's contribution.The project work can be a design/ experimental /computer simulation on any of the topics related to Marine engineering/Ship construction/Ship design etc. The Project seminar conducted should be based on the area in which the candidate has undertaken the dissertation work. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by the Head and PG course coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.Each student shall individually carry out a project in an Industry / R&D institution / University department. The project work shall be reviewed and evaluated periodically during the 3rd semester and continued in the 4th semester. The evaluation shall be based on the technical content and presentation of the work.

SEMESTER - IV

18-438-0401: DISSERTATION PHASE - II

Course Outcomes:

At the end of the coursethe student will be able to:

1. Use different experimental techniques.
2. Use different software/ computational/analytical tools.
3. Design and develop an experimental set up/ equipment/test rig.
4. Conduct tests on existing set ups/equipments and draw logical conclusions from the results after analysing them.
5. Either work in a research environment or in an industrial environment.
6. Become conversant with technical report writing.
7. Present and convince their topic of study to the engineering community.

Guidelines:

It is a continuation of Project work started in the 3rd semester. He/she has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report

consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solutions and results and discussion. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, internal examiner and project guide as decided by the Head and PG course coordinator. The candidate has to be in regular contact with his guide. The project work shall be reviewed and evaluated periodically during the semester. A detailed project dissertation in the prescribed format shall be submitted at the end of the semester. All the test results, relevant design and engineering documentation shall be included in the dissertation. The evaluation shall be based on (i) Presentation of the work, (ii) Quality and content of the dissertation and (iii) Viva Voce