Approved by Ac,council held on 2nd july 2010 effective from 2010 admission onwards

REGULATIONS FOR B.TECH DEGREE COURSE IN NAVAL ARCHITECTURE & SHIP BUILDINGS

(8 SEMESTER DURATION)

I. Admission to the course:

1. Candidate for admission to the B.Tech degree course in Naval Architecture and ship building shall be required to have passed the Higher secondary (10+2) examinations conducted in Kerala in First Class (ie. 60% aggregate), or the examination of any other University/Board accepted by the syndicate of this University as equivalent thereto with Mathematics, Physics and Chemistry as subjects of study. In the case of SC/ST candidates only a pass is required in the examination.

2. The candidate shall have secured a minimum of 50% marks for Mathematics as well as for Mathematics, Physics and Chemistry put together. In the case of candidates belonging to socially and educationally backward classes (referred to in G.O.(p) 208/66/Edn Dated 2.5.1966, as amended from time to time) the minimum marks requirements are 45% for Mathematics and 45% for Mathematics, Physics and Chemistry put together.

3. The candidates shall also satisfy the conditions regarding age and Physical fitness as may be prescribed by the University.

4. The admission will be based on the entrance examination conducted by the university.

II Course of Study:

1. The course for the B.Tech degree shall extend over a period of four academic years comprising eight semesters each of four months duration (approx.17 weeks) .
2. Between semesters, there will be an interval of four weeks, which will provide time for examination and its preparation.
3. The course of study shall follow credit system and will be in accordance with the scheme, course content and syllabus prescribed. The total credit for the entire course shall be 176.
4. The programme of instruction shall consist of the following:

- general core programme comprising of humanities (including technical communication, environment studies) and basic sciences.
- engineering core programme introducing the student to foundations in engineering
- professional core programme comprising of professional subjects in Naval Architecture and Shipbuilding.
- elective programme enabling the students to opt for specialised subjects related to the profession.
- workshop practice and laboratory works

5. Training and regular visits to industry will also form part of the course. Every academic year, except in the final year the students will undergo technical training for a period of 4 - 6 weeks duration in Shipyards, ship repair firms and related industries.

III Eligibility for the degree:

1. No candidate shall be eligible for the B.Tech Degree in Naval Architecture and Ship building unless he/she has undergone the prescribed course of study for a period not less than 4 academic years from the date of admission to the first semester and has passed the prescribed examinations in all the semesters.
2. A Student should complete the prescribed course of study within eight academic years from date of first admission to the course.

IV Rules regarding attendance:

1. Every candidate is required to secure a minimum of 75% attendance to be eligible for appearing for the University examinations.

2.Candidate having shortage of attendance upto a maximum of 10% are eligible to seek condonation by applying in the prescribed procedure.

3. A student cannot avail condonation for more than two times during the entire duration of the course.
4. It shall be open to the Vice-Chancellor to grant condonation of shortage in attendance upto 5% on the recommendation of the Head of the Department.
5. The percentage of attendance of a candidate for a semester shall be indicated by a letter code as given below:

Percentage of attendance	**Letter Code**
90% and above	H
75% and above but less than 90%	N
less than 75%	L

V Rules for examination:

1.Internal Assessment:- All sessional works shall be valued and marks shall be awarded on the basis of day-to day work, periodic tests and regular assignments based on the scheme of evaluation as decided by the department council.

2. The total sessional marks for theory and laboratory courses shall be made up of 50% for internal tests (minimum two tests), 40% for assignments/quizzes/seminars and 10% for attendance. However the teachers, depending upon the specific requirements of the subjects, can make changes in the distribution with the permission of the Head of the Department. Marks for attendance shall be awarded as follows:

% of attendance	**marks awarded**
96-100	5
91 – 95	4
86 – 90	3
81 – 85	2
76 – 80	1
below 76	0

3. A candidate shall be allowed to improve internal assessment marks in theory/laboratory courses subject to the following conditions:

- He / she shall not combine the course work with his/her regular course work
- He / she shall repeat the theory / practical in a particular course only once and satisfy the minimum attendance requirement of 75% in that particular course.
- He / she shall not be allowed to repeat the course work of any semester if he/she has already passed the semester examination in full.

4. External Assessment:- there shall be University Examination at the end of every semester in the subjects as prescribed under the course content.

5. To pass in a subject, a candidate has to score not less than 45% of the marks in the University examination and not less than 50% aggregate marks in the University examination and sessional marks put together.

6. In subjects where there are no University examinations, a candidate has to score not less than 50% sessional marks for a pass in that subject.

VI Rules for Promotion :

1. A candidate will be eligible to be promoted from one semester to the next semester only if he/she has secured a minimum of 75% attendance.
2. Each candidate shall register for the examination at the end of each semester.
3. A candidate shall not register for the n^{th} semester examination without registering for $(n-1)^{th}$ semester.
4. To get promotion from the n^{th} semester to the $(n+1)^{th}$ semester , a candidate has to pass the $(n-3)^{th}$ semester in full. This rule shall be applicable for promotion from fourth semester (ie. n = 4) onwards.

VII Rules for Readmission:

1. Students who are unable to attend classes on medical or other genuine grounds any be readmitted to the respective semesters along with the subsequent batch.
2. A student seeking readmission shall give a written application to the Head of the Department, Sixty days prior to the commencement of the semester to which readmission is sought.
3. Students who have been removed for the nominal rolls due to default in payment of the semester fees shall be readmitted subject to the following conditions.

-The Head of the Department can readmit the student within 10 days from the last date of payment of the semester fees.
-Thereafter the University may accord sanction for readmission
-Readmission can be given only if the student can secure a minimum of 75% attendance in each subject meeting the eligibility to register for the University examination of the respective semester.

VIII Grading:

1. Grades shall be awarded to the candidates in each course based on the total marks obtained in the internal and external assessments as follows:

Marks obtained (%)	Grade	Grade points
90 – 100	S	10
80 – 89	A	9
70 – 79	B	8
60 – 69	C	7
50 – 59	D	6
< 50	F	0

2. A student is considered to have credited a course or earned credits in respect of course if she/he secures a grade other than F for that course.
3. **Grade point average**: The academic performance of a student in a semester is indicated by Semester Grade Point Average (SGPA).

$$SGPA = \frac{G1C1+G2C2+.....+ GnCn}{C1+C2+...+Cn}$$

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

4. **Grade Card**: Grade card issued at the end of the semester to each student will contain the following:

- the code, title, number of credits of each course registered in the semester
- the letter grade obtained
- the attendance code
- total number of credits earned by the student upto the end of that semester and
- SGPA & CGPA.

5. Overall Classification:

a) ***First Class with Distinction***:- Candidates who qualify for the Degree passing all the examinations within 4 academic years after their commencement of the course of study and secure CGPA of 8 and above.

b***) First Class:-*** Candidates who qualify for the Degree passing all the examinations within 8 academic years after their commencement of the course of study and secure CGPA of 6.5 and above but less than 8.

c) ***Second Class:*** Candidates who qualify for the Degree passing all the examinations within 8 academic years after their commencement of the course of study and secure CGPA of 6 and above but less than 6.5.

IX Revision of Regulation and Curriculum:

The University may from time to time revise amend or change the Regulations, Curriculum, Scheme of Examination and Syllabus.

SCHEME FOR B.TECH DEGREE COURSE IN NAVAL ARCHITECTURE SHIP BUILDING
(8 SEMESTER DURATION)

Subject	Cr.
General core programme	
Technical Communication and Environment Studies	3
Mathematics	12
Applied Physics	3
Applied Chemistry	3
Computer Programming	2
Engineering Economics and Management	3
Engineering core programme	
Engineering Mechanics	7
Electrical Engineering & Electronics	3
Engineering Graphics	4
Machine Drawing	3
Fluid Mechanics	6
Mechanics of Solids	4
Instrumentation	3
Applied Thermodynamics	3
Design of Machine Elements	3
Analysis of Structures	3
Material Science	3
Production Management and Operation research	3
Computer Aided Design and Drafting	3
Professional core programme	
Introduction to ship Technology	4
Basic Ships Theory	3
Stability of Ships	3
Resistance of Ships	3
Propulsion of Ships	3
Controllability of Ships	3
Ship Motions in Seaway	3
Strength of Ships	6
Structural design of Ships	6
Ship Design	6
Ship Production	6
Marine Engineering	6
Electrical Systems on Ships and Shipyard	3
Joining Techniques in Shipbuilding Technology	3
Special problem and seminar	2
Project Work and Viva voce	15
Workshop practice and laboratory works	
Workshop Practice	4
Electrical Engineering Laboratory	1
Fluid Mechanics Laboratory	2
Material Testing Laboratory	1
Marine Hydrodynamics	1
Marine engineering Lab	1
Model Making Techniques	2
Vacation Training	3
Elective programme	
Electives I-IV	12

COURSE CONTENT

I SEMESTER

Code	Subject	Hrs/week				Marks			
		L	**T**	**P**	**Total**	**Credit**	**Int. Exam**	**Uty. Exam**	**Total**
ST 101	Technical Communications and Environment Studies	3	1	0	4	3	50	50	100
ST 102	Mathematics I	3	1	0	4	3	50	50	100
ST 103	Applied Physics	3	1	0	4	3	50	50	100
ST 104	Applied Chemistry	3	1	0	4	3	50	50	100
ST 105	Engg.Mechanics I	3	2	0	5	4	50	50	100
ST 106	Engg. Graphics	2	0	3	5	4	50	50	100
ST 107	Workshop Practice I	1	0	3	4	2	50	-	50
		18	**6**	**6**	**30**	**22**	**350**	**300**	**650**

II SEMESTER

Code	Subject	Hrs/week				Marks			
		L	**T**	**P**	**Total**	**Credit**	**Int. Exam**	**Uty. Exam**	**Total**
ST 201	Mathematics II	3	1	0	4	3	50	50	100
ST 202	Computer Programming	2	0	2	4	2	50	50	100
ST 203	Engg. Mechanics II	3	1	0	4	3	50	50	100
ST 204	Electrical Engg. & Electronics	3	1	0	4	3	50	50	100
ST 205	Machine Drawing	2	0	3	5	3	50	50	100
ST 206	Introduction to Ship Technology	3	0	1	4	4	50	50	100
ST 207	Workshop Practice II	1	0	2	3	2	50	-	50
ST 208	Electrical Engg. Lab	0	0	2	2	1	50	-	50
	Vacation Training	-	-	-	-	1	50	-	50
		17	**3**	**10**	**30**	**22**	**450**	**300**	**750**

III SEMESTER

Code	Subject	Hrs/week				Marks			
		L	**T**	**P**	**Total**	**Credit**	**Int. Exam**	**Uty. Exam**	**Total**
ST 301	Mathematics III	3	1	0	4	3	50	50	100
ST 302	Fluid Mechanics I	3	2	0	5	3	50	50	100
ST 303	Mechanics of Solids	4	1	0	5	4	50	50	100
ST 304	Instrumentation	3	1	0	4	3	50	50	100
ST 305	Applied Thermodynamics	4	1	0	5	3	50	50	100
ST 306	Basic Ship Theory	2	1	2	5	3	50	50	100
ST 307	Fluid mech. Lab	0	0	2	2	2	50	-	50
		19	**7**	**4**	**30**	**21**	**350**	**300**	**650**

IV SEMESTER

Code	Subject	Hrs/week				Marks			
		L	T	P	Total	Credit	Int. Exam	Uty. Exam	Total
ST 401	Mathematics IV	3	1	0	4	3	50	50	100
ST 402	Fluid Mechanics II	3	2	0	5	3	50	50	100
ST 403	Analysis of Structures	3	1	0	4	3	50	50	100
ST 404	Material Science	3	1	0	4	3	50	50	100
ST 405	Stability of Ships	2	2	1	5	3	50	50	100
ST 406	Marine Engineering I	3	1	0	4	3	50	50	100
ST 407	Material Testing Lab	1	0	1	2	1	50	-	50
ST 408	Model making Techniques	0	0	2	2	2	50	-	50
	Vacation Training	-	-	-	-	1	50	-	50
		18	**8**	**4**	**30**	**22**	**450**	**300**	**750**

V SEMESTER

Code	Subject	Hrs/week				Marks			
		L	T	P	Total	Credit	Int. Exam	Uty. Exam	Total
ST 501	Engg. Economics & Management	3	1	0	4	3	50	50	100
ST 502	Design of Machine Elements	2	0	3	5	3	50	50	100
ST 503	Resistance of Ships	2	1	1	4	3	50	50	100
ST 504	Propulsion of Ships	2	1	1	4	3	50	50	100
ST 505	Strength of Ships I	3	1	1	5	3	50	50	100
ST 506	Marine Engineering II	3	1	0	4	3	50	50	100
ST 507	Electrical Systems on Ships & Shipyards	2	1	1	4	3	50	50	100
		17	**6**	**7**	**30**	**21**	**350**	**350**	**700**

VI SEMESTER

Code	Subject	Hrs/week				Marks			
		L	T	P	Total	Credit	Int. Exam	Uty. Exam	Total
ST 601	Computer Aided Design & Drafting	2	1	1	4	3	50	50	100
ST 602	Controllability of Ships	2	1	1	4	3	50	50	100
ST 603	Ship Motions in Seaway	2	1	1	4	3	50	50	100
ST 604	Strength of Ships II	3	1	0	4	3	50	50	100
ST 605	Structural Design of Ships I	3	1	0	4	3	50	50	100
ST 606	Ship Design I	3	0	1	4	3	50	50	100
ST 607	Ship Production I	3	1	0	4	3	50	50	100
ST 608	Marine Hydrodynamics Lab	0	0	1	1	1	50	-	50
ST 609	Marine Engineering Lab	0	0	1	1	1	50	-	50
	Vacation Training	-	-	-	-	1	50	-	50
		1	**6**	**6**	**30**	**24**	**500**	**350**	**850**

		8							

VII SEMESTER

Code	**Subject**	**Hrs/week**				**Marks**			
		L	**T**	**P**	**Total**	**Credit**	**Int. Exam**	**Uty. Exam**	**Total**
ST 701	Production Management & Operation Research	3	1	0	4	3	50	50	100
ST 702	Structural Design of Ships II	3	1	0	4	3	50	50	100
ST 703	Ship Design II	3	1	1	5	3	50	50	100
ST 704	Ship Production II	3	2	0	5	3	50	50	100
ST 705	Joining Techniques in Shipbuilding Technology	3	1	0	4	3	50	50	100
ST 706	Elective I	3	1	0	4	3	50	50	100
ST 707	Elective II	3	1	0	4	3	50	50	100
		21	**8**	**1**	**30**	**21**	**350**	**350**	**700**

VIII SEMESTER

Code	**Subject**	**Hrs/week**				**Marks**			
		L	**T**	**P**	**Total**	**Credit**	**Int. Exam**	**Uty. Exam**	**Total**
ST 801	Special Problem & Seminar	0	0	2	2	2	50	-	50
ST 802	Elective III	3	1	0	4	3	50	50	100
ST 803	Elective IV	3	1	0	4	3	50	50	100
ST 804	Project Work& Viva voce	0	0	20	20	15	300	200	500
		6	**2**	**22**	**30**	**23**	**450**	**300**	**750**
						176			

SYLLABUS FOR B.TECH. DEGREE COURSE IN NAVAL ARCHITECTURE & SHIPBUILDING

(8 SEMESTER DURATION)

SEMESTER I

ST 101 TECHNICAL COMMUNICATIONS & ENVIRONMENT STUDIES

Module I

Written Communication : note making and note taking; summarizing; notes and memos, developing notes into text, organization of ideas, cohesion and coherence, paragraph writing, ordering information in space and time, short essays, description and argument, comparison and contrast, illustration, using graphics in writing, tables and charts, diagrams and flow – charts, maps, plans and graphs.

Spelling rules and tips, writing a rough draft, editing and proof reading, writing the final draft, styling text, filling in complex forms, standard letters, CV, writing a report, writing leaflets and brochures, writing references, essay writing expository writing, description of processes and products, classification , the instructional process, arguments and presentation of arguments, narrating events chronologically. (Emphasis should be given to the practice sessions for developing the oral and written communication skills of students).

Module II

Concept of an ecosystem – structure and function – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – structure and functions of forest ecosystems , aquatic eco systems, grass land ecosystems and desert ecosystems.
Definition of biodiversity – genetic, species and ecosystem diversity- biogeographical classification of India – Value – Hot spots of biodiversity – Threats of biodiversity – Conservation of biodiversity.

Module III

Environmental Pollution – causes effects and control measures of air pollution , water pollution, soil pollution, noise pollution, marine pollution, thermal pollution and nuclear hazards – causes, effects and control measures of urban and industrial solid wastes – Role of an individual in prevention of pollution - :Pollution case studies – An overview of the various environmental legislations in India – Issues involved in enforcement of environmental legislation – The concept of sustainable development . Disaster management : floods, earthquakes, cyclones, and landslides.

Module IV

Senses of Engineering Ethics- Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy Kohlberg's theory – Gilligan's theory – Consensys and Controversy – Professional ideals and vinues – Attributes of an ethical personality – Theories about right action – Self interest.
Responsibilities and Rights of engineers – Collegality and Loyalty – Respect for authority – Collective bargaining , Confidentiality – Conflicts of interest – Professional rights.

References

Rajagopalan. R, Environmental Studies : From Crisis to Cure, Oxford University Press, 2005
Erach Bharucha, Textboook of Environmental Studies, Universities Press 2005.
Odum E.P, Fundemental Chemistry , New Age International, 2000.
Meenambal T.,Uma R.M and K. Murali , Principles of Environmental Science and Engineering, S.Chand & Company Ltd., 2005
Jayashree Suresh and B.S.Raghavan, Professional Ethics, S.Chand & Company Ltd., 2005.
Edmund D.Seebaur & Robert L.Barry, Fundementals of Ethics for Scientists and Engineers, Oxford University Press, 2001.

ST 102 MATHEMATICS I

1. Hyperbolic functions: Definitions, properties including formulae for arguments A±B; Inverses expressed as logarithms. Series for Cos hx, Sin hx, Mutual conversion of hyperbolic and circular functions.
2. Leibnitz's rule for $D^n(uv)$. Simple problems. Taylor's and MacLauren's series
3. Standard curves in engineering practice such as conics, cycloids, hypocycloids, catenaries. lemniseates, cardioids and others. Curvature, centre of curvature of these. Tangents & normals,

4. Envelopes and evolutes. The latter viewed both as loci of centre of curvature and envelope of normals.
5. Partial derivatives. Total differentials. Euler's theorem on homogeneous functions. Errors and approximations.

Reference:

1) Kreyzig,E.; Advanced Engineering Mathematics, Wiley, New York.
2) Grewal,B.S.; Higher Engineering Mathematics, Khanna Publishers, New Delhi.

ST 103 APPLIED PHYSICS

1. Interference of Light: Interference on thin films, colours of thin films-Newton's rings (reflected system). Determination of wavelength and refractive index. Air wedge –diameter of thin wire-Testing of planeness of surfaces

   Production of X-rays-continuous and characteristic x-rays-Mosley's law-Diffraction of x-rays-Bragg's law-Bragg's x-ray spectrometer-Compton effect-expression for change in wavelength.
2. Diffraction-Fresenel and Fraunhofer diffraction-Zone place-plane diffraction grating-Measurement of wave length-dispersive power of grating. Resolving power-Raleigh's criterion-Resolving power of telescope and grating.

   Double refraction-Positive and negative crystals- Nicol prism-Huygen's theory of double refraction. Quarter wave and double wave plates. Production and analysis of plane polarised and circularly polarised light using crystal plates. Optical activity-Fresnel's theory-Specific rotation-Half shade polarimeter.
3. Coherence and Lasers: Spatial and temporal coherence-coherence length-spontaneous emission-stimulated emission- population inversion- CW & pulsed Laser, typical laser systems like Helium-Neon, Nd, YAG, Ruby, Semi-conductor lasers. Applications of lasers- Principle of holography-reflection and transmission type- Recording and reconstruction-Applications of holography-white light holograms.

   Ultra sound waves-Production, properties and application

   Recording and reproduction of sound- Magnetic tape recording-sound recording on cine films
4. Fibre optics and its applications: General ideas of optical fibre- NA of fibre-step index and graded index of fibres-multimode and single mode fibres-applications of optical fibres-fibre optic communication- optical fibre sensors-general ideas of integrated optics.
5. Crystallography and lattice planes: Crystallography-space lattice-unit cell-crystal systems-simple cubic-body centred and face centred cubes. Lattice planes and Miller indices-spacing between lattice planes-powder method for crystal study.

   Dielectrics: Types and applications

   Superconductivity: Transition temperature-Meissner effect-Isotope effect-Type I and type II-super conductors-B.C.S. theory (qualitative study)- High temperature super conductivity (General idea)- Josephson effect- SQUIDS.

Reference:

1) J.B. Rajan; Modern physics
2) Sathyaprakash; Optics and atomic physics
3) Thereja; Modern physics
4) Charles Kittel; Solid state physics
5) Agarwal; Optical fibre communication
6) Ajoy Ghatak; Optics
7) S.P. Nair & K.P. Jayaprakash; A text Book for Engg students

ST 104 APPLIED CHEMISTRY

1. Production of engineering materials – Production of steel – Bessemer converter process, open hearth process, electric furnaces, oxygen process, chemical additions to steels. Production of non-ferrous alloys – Production of aluminium and its alloys, Production of other non-ferrous alloys – bronze, brass, special reference to the requirements of shipbuilding (ships propellers etc). Plastics - formation of high polymers, thermoplastic and thermosetting resins, methods of fabrication of plastics, production of GRP-materials.
2. Electrochemistry – classification of conductors, electrolytes, conductance of electrolytes, specific and equivalent conductance, application of conductance measurements, Debye-Huckel model of electrolytic conductance and Onsager equation. Galvanic cells, EMF measurements, classification of electrodes, Nernst equation, electrode potentials, cell reactions. Relationship between cell potential and thermodynamic quantities. Electrochemical energy sources, lead acid battery, nickel cadmium battery. Fuel cells (H_2/O_2). Electrochemical corrosion and it application.

3. Fuels and Combustion – Solid, liquid and gaseous fuels, calorific value of fuels, calorific intensity, flue gas analysis. Coal – analysis of coal, carbonisation of coal, metallurgical coke and its manufacture, hydrogenation of coal. Petroleum – Origin and refining of petroleum, cracking and polymerisation, requisites of a good petrol. Diesel oil, Petrochemicals, Gaseous fuels – natural gas, LPG, Producer gas, combustion zone, reduction zone, water gas, coal gas, oil gas. Combustion calculations, explosives. Propellants, Nuclear fuels – nuclear fission and fusion.
4. Lubricants – Mechanisms of lubrication, boundary lubrication, extreme pressure lubrication. Classification of lubricants, synthetic lubricants, properties of lubricant.
5. Water and its Treatment – Source of water, hard and soft water, determination of hardness, softening water – lime soda process, ion exchange. Boiler feed water – removal of oil, blow down operation, caustic embrittlement, internal conditioning. Water for domestic purposes – sedimentation, coagulation, filtration and sterilisation, chlorination and its advantages and disadvantages. Disinfection with Ozone. Desalination
   Pollution – chemical characteristics, sewage treatment – biological oxygen demand (BOD), chemical oxygen demand (COD), total organic carbon (TOC). Solid wastes, Water pollution, Air pollution, their control.

Reference:

1) Balasubramanian M.R., Krishnamoorthy S. & Murugesan V. " Engineering Chemistry" Allied Publishers Ltd.
2) Uppal, M.M.; A Text Book of Engineering Chemistry, Khanna Publishers, New-Delhi.

ST 105 ENGINEERING MECHANICS I (Note SI Units should be followed)

1. Concurrent forces in a plane: Principles of statics, composition and resolution of forces, free body diagrams, equilibrium of concurrent forces in a plane, method of projections, equilibrium of three forces in a plane, method of moments, friction.
2. Parallel forces in a plane: Two parallel forces, general case of parallel forces in a plane, centre of parallel forces and centre of gravity, centroids of composite plane figures and curves, distributed force in a plane.
3. Properties of areas: Moment of inertia of plane figures with respect to an axis in its plane, moment of inertia with respect to an axis perpendicular to its plane, product of inertia, principal axis of three dimensional bodies.
4. General case of forces in a plane: Composition of forces in a plane, equilibrium of forces in a plane, plane trusses, method of joints and method of sections, plane frames, method of members, method of substitution and method of sections, funicular polygon, Maxwell diagrams, distributed force in a plane, flexible suspension cables.
5. Force system in space: Concurrent forces in space, method of projections and method of moments, couples in space, parallel forces in space, centre of parallel forces and centre of gravity, general cases of in space.
   Principle of virtual work: Equilibrium of ideal systems, efficiency of simple machines, stable and unstable equilibrium.

REFERENCES:

1) Timoshenko & Young: Engineering Mechanics
2) Beer F.P & Johnson E.R: Mechanics for Engines-Statics Dynamics
3) Shames I.H: Engineering Mechanics-Statics and Dynamics
4) Langhar H.L & Beresi A.P : Engineering Mechanics
5) Merriam J.L & Kraige L.G: Engineering Mechanics

ST 106 ENGINEERING GRAPHICS

1. Introduction to Engineering Graphics: - Drawing instruments and their use, different types of lines-lettering and dimensioning, familiarisation with current Indian Standard Code of Practice for general engineering drawing. Simple geometrical constructions-Conic Sections-Construction of ellipse, parabola, hyperbola and rectangular hyperbola, cycloidal curves, construction of Archimedian spiral and logarithmic spiral drawing tangents and normals to these curves.
2. Introduction to orthographic projections: - Plane of projection-principles of first angle and third angle projections. Projection of points in different quadrants. Orthographic projection of straight lines parallel to one plane and inclined to the other planes-straight lines inclined to both the planes-true length and inclination of lines with reference plane-traces of lines. Projection of plane laminae of geometrical shapes in oblique positions.
3. Projection of plane figures – projection on auxiliary planes; Projection of polyhedral and solids of revolution-Frustum projection of solids with axis parallel to one plane or parallel or perpendicular to the other plane-projection of solids with axis inclined to both the planes-projection of solids on auxiliary planes. Section of solids by planes inclined to horizontal or vertical planes shape of sections.
4. Development of surfaces of prisms, cylinders, pyramids and cones, intersection of surfaces of prisms. Cylinders and cones.

5. Introduction to isometric projection: -isometric scale, isometric views, isometric projections of prisms pyramids cylinders, cones and spheres. Introduction to perspective projections one point, two points and three points perspectives-visual ray method and vanishing point method-perspective of circles, perspective views of prisms and pyramids.

Reference:

1) P.S Gill : Geometrical Drawing, B.D Ketaria Ludhiana
2) N.D Bhat : Elementary Engineering Drawing, Charolar Publishing House, Anand
3) P.I Varghese & K.C John : Engineering Graphics

ST 107 WORKSHOP PRACTICE I

1. Fitting Shop
2. Carpentry Shop
3. Foundry Shop
4. Sheet Metal Shop
5. Lathe,
6. Shaping m/c, Planing m/c, Milling m/c, Drilling and Boring m/c

(Preliminary exercises for beginners in all shops. Specific models may be designed by the teachers)

SEMESTER II

ST 201 MATHEMATICS II

1. Applied Integral Calculus. Areas, arc-lengths, volumes and surface areas of solids of revolution. Multiple Integrals; Jacobians.
2. Vector calculus, Cartesian, Cylindrical and Spherical systems of co-ordinates. Expression for ds^2, gradient, divergence, curl in all the three systems. Gauss theorem. Stoke's theorem.
3. Ordinary Differential Equations of the second order with constant coefficients, Euler-Cauchy type. Simultaneous Linear Equations.
4. Fourier series. Full range and half-range series. Maxima and Minima of functions of two variables Saddle points. Legrangian Multipliers.
5. Sequences and infinite series: Convergence and divergence. Radius of convergence, comparison tests, Raabe's test. Solution of first order and second order differential equations at regular points (Singular points not included)

Reference:

1) Kreyzig,E.; Advanced Engineering Mathematics, Wiley, New York.
2) Grewal,B.S.; Higher Engineering Mathematics, Khanna Publishers, New Delhi.

ST 202 COMPUTER PROGRAMMING

1. Computer Fundamentals: Basic computer organisation, representation of information, secondary storage devices, systems and applications, software, operating system.
2. Overview of programming: Introduction to computer based problem solving, programs and algorithms, data organisation or data structures, construction of loops, use of procedures.
3. Fundamentals of C Programming: Data types – int, float, char, double and void, etc. Operators and expressions – Arithmetic operators, relational operators, logical operators and their expressions. Control constructs – if-then, for and while. Arrays – array declaration, one and two-dimensional arrays. Functions and subprograms – general form arguments and return values.
4. Advanced Programming techniques: Control constructs – do–while, switch statements, go to, label. Functions – parameter passing, call-by-value, call-by-reference, calling functions with arrays, argc and argv.
5. Dynamic Data structures: Pointers - & and * operators, pointer expression, pointer assignments. Structures – Basics of structures, referencing structure element, array of structures, passing structures to functions. File handling – file pointer, file accessing functions, fopen, fclose, putc, getc and fprint.

Reference:

1) Rajaraman; Introduction to Computers
2) Rajaraman; Computer Fundamentals
3) Kernighan, B.W.K. & Ritchi, D.M.; The C Programming Language; Prentice Hall of India, 1989.
4) Richard Johnson-baugh & Martin Kalin; Application Programming in C; Macmillan International Edition, 1990

5) Schildt, H.; C made easy; McGraw Hill Book Company, 1987.

ST 203 ENGINEERING MECHANICS II

1. Rectilinear translation: kinematics of rectilinear motion, principles of dynamics, differential equation of rectilinear motion, motion of a particle acted upon by a constant force as a function of time, force proportional to displacement, simple harmonic motion – damped oscillations, forced oscillations, damped oscillations and forced oscillations with single degree of freedom.
2. D'Alembert's principle, momentum and impulse, work and energy, law of conservation of energy, ideal systems, impact.
3. Curvilinear translation: Kinematics of curvilinear motion, differential equations of motion, motion of projectile, D'Alembert's principle in curvilinear motion, moment of momentum, work and energy in curvilinear motion.
4. Rotation of rigid body about a fixed axis: Kinematics of rotation, equation of motion of rigid bodies rotating about a fixed axis, rotation under the act of a constant moment, compounds pendulum, general case of moment proportional to the angle of rotation D'Alembert's principle resultant, inertia force in rotation, principle of angular moment in rotation, energy equation for rotating bodies.
5. Plane motion of a rigid body: Kinematics of plane motion, instantaneous centre, equations of plane motion, D'Alembert's principle in plane motion, principle of angular momentum in plane motion, energy equation for plane motion.

References:

a) Timoshenko & Young; Engineering Mechanics
b) Beer.F.P. & Johnson.E.R.; Mechanics for Engineering Statics
c) Shames.I.H.; Engineering Mechanics-Statics and
d) Langhar.H.L. & Boresi.A.P; Engineering Mechanics
e) Merriam H.L & Kraige L .G; Engineering Mechanics

ST 204 ELECTRICAL AND ELECTRONICS ENGINEERING

Module I

Transformers : principle and theory of an ideal transformer- Constructional features of single phase transformer-core type-shell-type- emf equation- turns ratio-no load vector diagram-transformer on load- equivalent circuit- impedance transformation- transformer losses- flux leakage, efficiency- open circuit and short circuit tests-estimation of equivalent circuit parameters. Auto transformer – working principle - basics of current transformer and potential transformer and three phase transformer.

Module II

Basic principles of electrical machines: D.C. generators-construction details-principle of operation-emf equation-methods of excitation-simple problems. D.C. motors-principle of operation-back e.m.f.-speed and torque equations-characteristics-losses-efficiency-applications of shunt, series and compound wound motors-simple problems.

Module III

Polyphase circuits: Generation of polyphase voltage-phase difference-vector representation-comparison between single phase and three phase systems-star and delta connection-current, voltage and power in three phase systems-balanced and unbalanced three phase circuits-power measurements in three phase circuits using single wattmeter and three wattmeter methods.

Module IV

AC Machines : Alternators- construction details-principle of operation-types-emf equation(winding factor need not be derived)-synchronous speed-Synchronous motors-principle of operation and method of starting-three phase induction motors-construction details of squirrel cage and slip ring motors-slip speed-single phase induction motors-principle of operation-types.

Module V

Electronics: Bipolar junction transistors-NPN, PNP-current components in transistors-commonbase, common emitter and common collector configurations-current gain-voltage gain and power gain-V-I characteristics- Active, saturation and cut off regions-R-C coupled amplifier - frequency response-feedback -Heartley and Colpitts oscillators.

References:

1. Reed's Advanced Electro technology for marine Engineers- *Edmund G.R. Kraal.*

2. A text book of Electrical Technology- Vol-I - *B.L.Theraja, A.K. Theraja*
3. A text book of Electrical Technology- Vol-II - B.L.Theraja, A.K. Theraja
4. Microelectronics. - Millman and Grabel

ST 205 MACHINE DRAWING

Introduction to theory of dimensioning, Types, size, location, functional and datum dimensions, principles for dimensioning (IS), dimension figures, notation of dimensioning.
Lines, symbols, figures, notes, arrow heads, etc., placing the dimensions, dimensioning angles, arrangement of dimensions, machining symbols and surface finish.
Simplifications and conventions-recommended abbreviations, use of symbols and abbreviations, conventions on machine drawing, conventional representation of threads, conventional lines.
Sectional views, section plane, section lining, full section, half section, partial or broken out section, off set section, removed or rolled section, auxiliary section, aligned section, disposition of successive sections, partial views, developed view, part located in front of a cutting plane, assembly sectioning, sectioning conventions.
Conversion of pictorial views into orthographic views, orthographic reading or interpretation of views
Sketching
Drawing of machine elements:- keys, cotters & pin joints, rivets & riveted joints welded joints, screw threads and screw fastening, bearing, brackets and hangers, pipes and pipe joints, gearing springs.
Production drawing (types and uses):- Final lay out drawings, general arrangement, assembly drawings, sub-assembly drawings, detail process drawings.
Information on drawings:- material list, modifications, jigs and fixtures, weight, general tolerances, order number, material specifications, heat treatment, surface finish, general comments.
Limits and tolerances

Reference:

a) N.D Bhat : Machine Drawing, Charolar Publishing House, Anand.
b) P.I Varghese & K.C John : Machine Drawing

ST 206 INTRODUCTION TO SHIP TECHNOLOGY

1. Historical review - ancient types of vessels (rafts, boats, and ships), the role of the ship in the ages of the great discoveries.
   Types of ships-terms and definitions, cargo ships (general cargo ships, bulk carriers, container ships, Ro-Ro ships, barge carriers, tankers), fishing vessels, factory ships, supply ships, Cable ships, ice breakers, research vessels, warships, hydrofoils, air cushion vehicles, small pleasure crafts (yachts, ketches, etc)
2. Some physical fundamentals-Archimedes principle, laws of floatation stability and trim, forces acting on a ship (static condition in waves and during launching)
   The ship's form-main dimensions, lines plan, coefficients and their meaning
3. The ship and her structural members-shipbuilding materials (properties, compositions), bottom structure, shell plating and framing, decks, hatches and hatch covers, superstructures, bulkheads, tanks, holds, fore and aft structure, stern and rudder.
4. Propulsion machinery-development of ship propulsion, general arrangement of propulsion plants, main engines (Diesel engines, steam engines & turbines, gas turbines, Diesel-electric drive, nuclear power plants)
   Auxiliary machinery-power supply (current, steam, water etc), auxiliary engines for ship systems operation, auxiliary engines for engine plant operation, steering gear.
5. Outfitting-anchor, mooring and towing equipment, cargo handling equipment, rigging, life saving appliances and fire fighting equipment, heating, ventilation and air-conditioning, refrigeration plants, painting, accommodations
   Bridge: The control centre of the ship-bridge arrangement and layout wheel house, navigation and communication equipments, methods of navigation, navigational lights

Reference:

a) Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
b) Rawson & Tupper; Basic Ship Theory
c) Tupper, E.C.;Introduction to Naval Architecture, Butterworth-Heinemann, UK, 1998.
d) Reed's Naval Architecture for Marine Engineers
e) Taggart; Ship Design and Construction, SNAME
f) D'Archangelo; Ship Design and Construction, SNAME.
g) Eyres, D.J.; Merchant Shipbuilding
h) Taylor, D.A.; Merchant Ship Construction, Butteworths, London

ST 207 Workshop Practice II

1. Introduction to Welding Technology (Theory) – Historical review, classification of welding process, Gas welding, Manual metal arc welding, Submerged arc welding, Electro slag welding, Inert gas welding, Plasma arc welding.
2. Welding Practice – Arc welding, Gas welding, Gas cutting.

ST 208 Electrical Engg. Lab.

1. Conduct the polarity test and ratio transformation of given single-phase transformer.
2. Conduct the open-circuit and short circuit tests on single-phase transformer.
3. Plot the following characteristics of DC series and Shunt motors:
    - Efficiency against output
    - Speed against torque
    - Current against torque

SEMESTER III

ST 301 MATHEMATICS III

1. Eigen values and Eigen vectors of a square matrix. Diagonalisation. Finding the n^{th} power of a square matrix using eigen values. Ortogonal and Hermitian matrix. Theorems on the eigenvalues of these.
2. Laplace Transforms. Unit step function- Dirac Delta functions. Periodic functions. Inverse transforms. Laplace transform methods of solving Ordinary Differential Equation
3. Analytic functions of a complex variable. Cauchy-Riemann conditions. Harmonic functions. . Euler's formula for $e^{i\theta}$ and its uses in summation of series
4. Expectation, Variance and n^{th} moments of the Binomial, Geometric, Poisson, Exponential and Normal variates. Moment generating functions
5. Partial Differential Equations of the form F(x,y,z,p,q)=0. Formation Complete, Singular and General Integrals. Clairaut's form. Charpit's Method

Reference:

a) Kreyzig,E.; Advanced Engineering Mathematics, Wiley, New York.
b) Grewal,B.S.; Higher Engineering Mathematics, Khanna Publishers, New Delhi.

ST 302 FLUID MECHANICS I

1. Properties of fluid-ideal fluid-actual fluids-fluid pressure
2. Statics of fluids-Euler's condition of equilibrium-pressure under the action of gravity-constant velocity rotation around a fixed axis-fluid under pressure neglecting gravity-forces on walls of container-surface tension-atmospheric equilibrium
3. Fluids in motion-One dimensional flow-equation of continuity-Euler's equation-Bernoulli's equation-stagnation and total pressure-energy equation for unsteady flow-impulse and equilibrium
4. Influence of viscosity-generalised Bernoulli's equation-Newton's law of fluid friction-laminar flow-Poiseuille's flow-turbulent flow-Reynold's number-Prandtl's mixing length and Karman's suggestion in regard to the relationship between mixing length and wall distance-velocity distribution in turbulant plane flow-friction co-efficient
5. Pumps:- Reciprocating pumps, Air vessels, Rotodyanamic pumps, Velocity diagram.
6. Turbines:- Impulse turbine- Pelton wheel, Reaction turbine, Francis turbine, Kaplan turbine.

References:

a) Walther Kaufmann; Fluid Mechanics, Tata McGraw-Hill Publishing Co, Ltd.
b) Douglas, Gasiorek, and Swaffield; Fluid Mechanics-Pitman.
c) Daugherty & Franzini; Fluid mechanics with engg. Applications, International students edition Mc Graw Hill.
d) Dr. Jagdish Lal; Hydraulic machines, Metropolitan book Co., Delhi-

e) N.S.Govind Rao; Fluid flow machines, Tata Mc Graw Hill.
f) Vallentine; Applied hydrodynamics, Butter Worths, London
g) Massey; Fluid Mechanics, ELRS
h) K.L.Kumar; Engineering fluid mechanics, Eurasia publishing house, New Delhi
i) Herbert Addison; A treatise on applied hydraulics
j) A.J.Stepan of; Centrifugal and axial flow pumps, Wiley, New York.
k) D.G.Shepherd; Principles of turbo machinery, Mac Millan Publishing Co.

ST 303 MECHANICS OF SOLIDS

1. Introduction-types of loads and stresses-definition of uniaxial, biaxial and triaxial state of stresses-displacements and deformations.

   Tension, compression and shear-uniaxial stresses-Hooke's law of material behaviour -deformation, in stress direction-lateral deformation, Poisson's ratio-differential equation of displacement, boundary conditions-strain energy for uniaxial loading.

2. Biaxial tension and compression-stresses in thin-walled pressure vessels (cylindrical and spherical)-analysis of biaxial stresses-Mohr's circle for biaxial stresses, principal stresses for triaxial state of stress

3. Torsion of circular shafts-shear stresses, shear deformation, differential equation of the rotational displacement, strain energy.

4. Symmetrical Bending of beams- Shear force and bending moment diagrams, assumption of the technical theory of bending, strain and stress distribution, linearised moment-curvature-relation, differential equation of deflection (2^{nd} & 4^{th} order), boundary conditions, strain energy, oblique bending.
   Transverse shear-shear stress-simplified deformations due to shear stresses-differential equation of the additional deflection caused by transverse shear-strain energy.

5. Combined loads-failures (fracture, yielding, loss of stability)-hypothesis of failure
   Stability of beams-types of equilibrium, Euler's theory of buckling, approx. determination of Cr. load.

Reference:

a) Timoshenko; Strength of Materials, East-West Publications.
b) Popov; Engineering Mechanics of Solids, Prentice-Hall Publications.
c) Krishna Raju & Gururaja; Advanced Mechanics of Solids and Structures, Narosa Publications.

ST 304 INSTRUMENTATION

1. Introduction

   Classification of instruments-Standards and calibration-Errors in instruments and measurements-gross errors-causes and corrective measures-static errors-static performance parameters Dynamic errors-Theoretical analysis of dynamic errors-simple case-I^{st} order system-Statistical analysis of data and errors- probable error- selection of the instrument.

2. Displacement –Velocity, Acceleration and Torque measurements

   Transducers-classification of transducers, selecting a transducer. Strain gauges- gauge factor-unbonded and bonded resistance strain gauges-resistance strain gauge bridges- temperature compensation balancing of bridges. Capacitive gauges. L.V.D.T. (Linear variable differential transformer) Piezo electric transducer-Measurement of torque-Dynamometers-Transmission type-Driving type-Absorption type. Measurement of velocity and acceleration-Siesmic transducers –spring mass type. Accelerometers-Potentiometer type-LVDT Type-Piezo electric type. Velocity transducers.

3. Pressure measurement
   Moderate pressure measurement-elastic transducers-electric mechanical instruments. High pressure measurement. Vacuum gauges-MC Leod gauge-Pirani gauge. Dynamic pressure measurement

4. Temperature measurement
   Non electrical methods. Solid rod thermometer, Bimetallic thermometer Liquid-in- galss thermometer. Electrical methods. Electrical resistance thermometer-Semi conductor resistance sensors (thermistors) Characteristics – applications-thermo-electric sensors (thermocouples) -Law of intermediate temperature-Law of intermediate

metals-Construction-Compensating circuits. Radiation methods. Total radiation pyrometer-selective radiation pyrometer optical pyrometer.

5. Measurement of humidity and flow
   Hygrometer-dew point methods-Industrial Psychrometer. Hot-wire anemometers-constant temperature and constant current methods-Laser doppler anemometer. Measurement of Liquid level-using Gamma rays, float, ultrasonic methods

6. Introduction to intelligent Instrumentation
   Logic circuits - ADC (Analog to digital converter) DAC (Digital to analog converter). Display devices-LED (Light emitting diodes), LCD (Liquid crystal display) and CRT (Cathod ray tube). Digital instruments (Functional diagram)

References:

a) B.C. Nakra, K.K.Chaudhary; Instrumentation measurement and Analysis.
b) A.K.Sawhney; Electrical and electronic Measurements and instrumentation.
c) William David cooper; Electronic Instrumentation and measurement techniques.
d) B.S.Sonde; Transducers and Display systems.
e) Ernest O Doebelin; Measurement Systems.
f) James.W.Dally, William.F. Riley, Kenneth G. McConnell; Instrumentation for Engg. Measurement.
g) E.B. Jones; Instrument Technology – Vol.2. – On line analysis of Instruments.

ST 305 APPLIED THERMODYNAMICS

1. Thermodynamics
   Introduction: Basic definitions (System, Control volume, work, heat property, process etc.); Zeroth law of thermodynamics; Ideal gas- equation of state.

   First law of thermodynamics

   Closed system undergoing a cycle; closed system undergoing a change of state; Internal energy of a system; Expansion work; Process using ideal gas - constant pressure, constant volume, isothermal; adiabatic and polytropic process -work done and heat added in different process; First law applied to one - dimensional steady flow process, flow energy, steady flow energy equation (ID).

   Second law of Thermodynamics

   Different statements; Reversible and irreversible process; Corollaries of second law - Absolute temperature scale; Carnot cycle - Carnot engine, refrigerator and heat pump. Clauscius inequality and definition of entropy, change of entropy of an ideal gas.

   Pure substance

   Equilibrium diagram - T-s, p-V, p-T, h-s, etc.

2. Gas power cycles and I.C.Engines

   Gas power cycles: Carnot cycle, Brayton cycle, Erricson cycle, Sterling cycle etc.; Air standard cycles- Otto- Diesel, Dual and Joule cycle; Evaluation of thermal efficiency and mean effective pressure

   Internal Combustion engine

   Classification of I.C. engines -Principle of operation of spark Ignition and Compression Ignition engines both two stroke and four stroke

   Stages of combustion in S.I. and C.I. engines

   Knocking and detonation-factors controlling knock and detonation, methods of preventing Knocking and detonation

3. Steady state Heat Transfer
   Modes of heat transfer and their mechanisms.

   Conduction- Fouriers law of heat conduction- Heat conduction through composite walls and cylinders

   Steady state heat convection

Free and forced convection- Definition of Nusselt, Reynolds, Praudlt and Grashoff's number and their significance.

Estimation of convective heat transfer coefficient using empirical formula for free convection over horizontal and vertical plates and cylinders, forced convection thorough pipes.

Heat exchangers

Different types- Log mean temperature difference for parallel flow and counter flow heat exchangers.

Radiative heat transfer

Emissive Power- Stephan Boltzman law- Definition of black body, grey body, Emmissivity, Absorptivity etc.,Kirchoff's law of radiation.

Estimation of heat transfer by radiation for sample cases like infinite parallel planes infinite concentric cylinders, and concentric spheres

4. Refrigeration

Definition and purpose

Principle of operation of Simple vapour compression system. Representation on T.S. AND p-h charts .Estimation of coefficient of performance and refrigerant flow rate. Factors affecting coefficient of performance.

Absorption refrigeration system

Comparison with vapour compression systems. Principle of operation of vapour absorption system like Aqua ammonia system, Electrolux system, Lethium bromide absorption refrigeration system etc.

Steam jet refrigeration system-working principle

Refrigerants

Classification and designation- properties and requirements- Important refrigerants like NH_3, CO_2, Methyl chloride, Methylene chloride, Freons etc. Factors influencing selection of refrigerants. Secondary refrigerants.

5. Air conditioning principles

Definition and purpose.

Psychrometry- psychrometric properties of air- Psychromentric chart- Adaibatic saturation.

Psychrometric process

Sensible heating and cooling, Humidification and dehumidification, Cooling and humidification, Cooling and dehumidification- Heating and humidification, Heating and dehumidification, Adiabatic mixing of air streams – cooling and heating load calculations

Summer and winter air conditioning – Estimation of the state of supply air to the conditioned space- Quantity of air supply etc for simple winter air conditioning systems.

Reference:

a) Nag, P.K.; Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.. 1998
b) Ballaney, P.L.; Thermal Engineering, Vol. I, Khanna Publishers, New-Delhi.
c) James P. Todd & Herbert B. Ellis; Applied Heat Transfer, Herper & Row Publishers, New York.
d) Holman, J.P.; Thermodynamics, McGraw-Hill-Internation Student Edition.

ST 306 BASIC SHIP THEORY

1. Lines Plan – fairing process – table of offsets
2. Integration rules – Trapezoidal rule; Simpson's rules (1-4-1, 1-3-3-1 and 5,8,-1 rule); 6 ordinate rule; Tchebycheff's rule; Areas, volumes and moments
3. Bonjean calculations and curves, sectional area curves.
4. Hydrostatic calculations and curves.
5. Buoyancy and weight of the ship
6. Watertight subdivision of ships – flooding calculation, Floodable length

Practicals:– Lines plan, Bonjean curves, Hydrostatic curves

Reference:

a) Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
b) Rawson & Tupper; Basic Ship Theory
c) Tupper, E.C.;Introduction to Naval Architecture, Butterworth-Heinemann, UK, 1998.

ST 307 Fluid Mechanics Lab

Pressure measurements, Velocity and rate of flow measurements, Calibration of Venturimenter, Determination of Friction factor, Critical velocity and Reynold's number at steady pipe flow, calibration of small orifices and mouthpieces.

Determination of metacentric height of a floating model.

SEMESTER IV

ST 401 MATHEMATICS IV

1. Solution of Linear Algebraic Equations by the methods of Gauss and Gauss-Jordan. Iteration methods of Jacobi and Gauss-Seidal. Relaxation methods
2. Regula-Falsi method and Newton-Raphson Method for non-linear equation in one variable. Horner's Method and Graeffe's Root squaring Method for polynomial equation.
3. Difference operators E,∇,Δ and their inter-relations. Newton's forward and backward interpolation formulae. Lagrangian Interpolation; Numerical differentiation, centre difference operators δ and μ., central difference formulae
4. Numerical Methods for Ordinary Differential Equations. Taylor Series Method. Picard's Method. Runge-Kutta Method of the fourth order. Orders of errors to be mentioned, Milno's predictor corrector method.
5. Harmonic Analysis. Estimation of Fourier coefficients given values of a function at specific values in its domain. Difference formulae for partial derivatives (only two dimensions need to be considered). Numerical methods for solving parabolic and elliptic partial differential equations in Cartesian co-ordinates only as in conduction of heat in infinitely long plates and steady state temperature distribution in finite rectangular plates.

Reference:
a) Kreyzig,E.; Advanced Engineering Mathematics, Wiley, New York.
b) Grewal,B.S.; Higher Engineering Mathematics, Khanna Publishers, New Delhi.

ST 402 FLUID MECHANICS II

1. General theory of two and three-dimensional flow:- Continuity equation, Euler's equation of motion, circulation, Stoke's integral theorem. Generalised Bernoulli's equation, sources, sinks, dipole, Flow with circulation, potential flow with rotational symmetry, hydrodynamical lift, Kutta-Joukowski theorem
2. Vortex motion- Fundamental concepts, vortex analogy to Biot-Savart's law, straight parallel vortex filaments, vortex sheets,
3. Viscous flow- Navier-Stoke's equations, Couette flow, Plane poiseuille flow.
4. Boundary layer theory- Prandtl's boudary layer equations, criterion for separation, Blasius solution, Skin friction, displacement thickness, momentum thickness, Turbulent boundary layer, Boundary layer control.
5. Airfoils- Lift, drag, circulation, pressure distribution-theory of thin airfoils, wings of infinite and finite span, circulation distribution. Cavitation

Reference:
a) Walther Kaufmann; Fluid Mechanics, Tata McGraw-Hill Publishing Co, Ltd.
b) Schlichting; Boundary Layer Theory.
c) Vallentine; Applied Hydrodynamics

ST 403 ANALYSIS OF STRUCTURES

1. Continuous beams - Clapeyron's three-moment equation, Moment distribution method, Torsion of non circular sections, shear center of simple cross sections.
2. Strain energy methods – principle of virtual work, flexibility method, stiffness method, strain energy and complementary energy, Castiglianos theorems.
   Introduction to theory of plasticity.

3. Matrix methods – flexibility and stiffness matrices – transformation matrices and its applications
4. Introduction to theory of thin plates, Pure bending of plates, Small deflection analysis of laterally loaded plates, Boundary conditions, Navier solution, Lavy's solution. Analysis of stiffened plates - orthotropic plate model and other methods.
5. Vibrations of continuous systems - vibration of strings and rods – vibration of beams – vibration of shafts.

Reference:

a) Timoshenko & Young; Theory of Structures, McGraw Hill Publications.
b) Reddy, C.S.; Basic Structural Analysis, Tata-McGraw Hill Publications.
c) Timoshenko & Young; Theory of plates, McGraw Hill Publications.
d) Krishna Raju & Gururaja; Advanced Mechanics of Solids and Structures, Narosa Publications.

ST 404 MATERIAL SCIENCE

1. Introduction:- Role of materials in Technology-Historical development-Economy of material usage-Classification of materials.
2. Structure of Solid

   Atomic structure –crystal structure-atomic packing in crystal-miller indices- Imperfections in crystals-Types of bonds-Bonding forces and energies - influence of bond type on Engineering properties-thermodynamics and kinetics in materials behaviour-diffusion-structure of metal, alloy, polymer and ceramic- strengthening mechanism in metal-metallography.
3. Phase transformation and Phase diagram

   Solidification-nucleation-crystallisation-single crystal and poly crystalline materials-Polymorphism-Thermodynamic reasoning of phase diagram-simple phase diagram-phase rule-lever rule-methods used to determine a phase diagram-Isomorphous system – Eutectic – Eutectoid, preitectic phase diagram- Iron- Carbon system-Martensite formation-TTT diagram- Hardenability - Tertiary system.
4. Heat Treatment

   Annealing-process annealing – Spheroidizing - Normalising-Quenching and Tempering process- Austempering – Martempering - Case hardening- Alteration of materials properties by casting, working, joining, sintering – Precipitation – Age hardening- recovery and recrystallisation.
5. Mechanical Properties of Materials and Testing

   Elastic, plastic, viscoelastic deformation- Tensile test for metals, polymers, ceramic- Strain aging-fracture- brittle fracture-Griffith's criterion of brittle fracture- fracture toughness-Ductile- brittle transition in fracture- Hardness-fatigue- creep- testing of mechanical properties- Failure analysis and prevention- wear of metal- NDT.
6. Structural Materials

   Classification of steel- different types of steel-Aluminium & Titanium alloys used in shipbuilding- Propeller materials- Selection of materials- Specification- classification society rules- National and International standards for different class of steels

Reference:

a) V. Raghavan-Material Science and Engineering , Prentice-Hall of India (P) ltd New Delhi.
b) Donald S Clark-Physical Metallurgy for Enginers, East West Press(P) ltd , New Delhi
c) A.G.Guy- Introduction to Materials science, McGraw Hill ltd, International Student Edition
d) Hanson-The Engineer's Guide to steel, Addision-wesley Pub. Company Inc.
e) Stephen .C.Dexter-Handbook of oceanographic engineering materials.

ST 405 STABILITY OF SHIPS

– Introduction :- Potential energy and equilibrium; Stability of ships - stable and unstable conditions (including submerged vessels); Stability terms; Equivolume inclinations - shift of C.O.B. due to inclinations, C.O.B curve in lateral plane, metacentre, pro-metacentre and metacentric radius, metacentric height, metacentric curve, surface of flotation, curve of flotation, righting moment and lever; Moments due to wind, shift of cargo, passengers, turning and non-symmetrical accumulation of ice; Effect of superstructure on stability

– Transverse stability: - Form and weight stability – stability functions

a) Initial stability – GM_0, GZ at small angles of inclinations, wall sided ships; Stability due to addition, removal and transference (horizontal, lateral and vertical) of weight, suspended weight and free surface of liquids; Stability while docking and grounding; Inclining experiment.

b) Large angle stability -Diagram of statical stability (GZ-curve), characteristic of GZ-curve, static equilibrium criteria; Methods for calculating the GZ-curve (Krylov, Prohaska, etc.); Cross curves of stability; Dynamical stability – diagram of dynamical stability, dynamical stability criteria.

– Longitudinal stability – trim, longitudinal metacentre, longitudinal centre of flotation, moment to change trim, trimming moment; trim calculations – addition, removal and transference of weight, change of density of water

– Damage stability – deterministic and probabilistic approach. Stability in waves.

– Recommendations of classification societies and governmental authorities – Intact and damage stability rules.

Practicals:– Cross curves of stability and Diagram of statical stability (Kryloff's method); Floodable length calculations

Reference:

6. Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
7. Dynamics of Marine Vehicles

ST 406 MARINE ENGINEERING I

– Ships and machinery – design and selection considerations; Marine diesel engines –general engine principles, Low speed and medium speed diesel engines, Constructional features. Fuels -, fuel oil system-Scavenging and turbo charging. Starting and revising systems, controls and safety devices, governing; Lubrication, Lubricants and lub. oil systems, cooling systems-torque and power measurement, fuel consumption's characteristics, engine lead tests and general characteristics-Heat balance, waste heat recovery system.

– Engine dynamics, torsional vibration of engine and shafting, axial shaft vibration, critical speeds engine rating, rating corrections, trial tests etc. Relationship of engine to the propeller classification society rules on engine construction. Engine room arrangement and engine-mounting study of different types of marine engines available in the world market.

– Marine boilers types, fire tube and water tube boilers, boiler arrangements-steam to steam boilers, double evaporation boilers, exhaust gas heat exchangers, auxiliary steam plant systems, exhaust gas boilers, composite boilers. Boiler mounting, combustion, feed system, feed water treatment. Feed pumps, condensers, air rejecters, deaerators, boiler operation, coal fired boilers.

– Marine Steam turbines –Types of turbines, compounding-reheat turbines, turbine construction, rotors, blades, casing, Gland scaling, diagrams, nozzles, bearings etc. Lubrication systems, expansion arrangements, control, gearing operating procedure.

– Marine gas turbines – fundamentals of G.T, Structure of gas turbines, gearing, operational features, controls, gearing, combined cycles.
Nuclear propulsion –physical principles of the operation of nuclear reactors – use of nuclear propulsion on seagoing vessels

Automation of ship propulsion plants

Maintenance requirements and reliability of propulsion plants.

Reference:

a) Harrington; Marine Engineering, SNAME Publications
b) Pounder,C.C.; Marine Diesel Engines, Newnen-Butterworths, London.
c) Reed's Marine Engineering for Naval Architect
d) Taylor, D.A.; Introduction to Marine Engineering

ST 407 MATERIAL TESTING LABORATORY

1. Standard tension test on UTM (Al or MS Rod)
2. Shear strength of MS rod on UTM
3. Deflection characteristic of open and closed springs
4. Determination of 'G' of wires using torsion pendulum
5. Hardness measurement – Brinell, Rockwell
6. Charpy and Izod impact tests
7. Maxwell's theorem and estimation of Young's modulus

8. Natural frequency and damping of cantilever beams
9. Stress concentration for a hole on a plate under tension using photo-elasticity

SEMESTER V

ST 501 ENGINEERING ECONOMICS AND MANAGEMENT

1. Definition – nature and scope of economic science –economic relation between economic decision and technical decision-economic efficiency and technical efficiency.
   Consumption-utility-diminishing marginal utility-indifferent map analysis
2. Production: Four factors of production and their peculiarities law of production-increasing-diminishing and constant return forms of business organisation-proprietorship - partnership joint stock company-division of labour-large scale production price mechanism: Demand and supply-elasticity of demand-different market structures-competition-monopoly –monopolist competition advertisement and product differentiation.
   Distribution: Marginal productivity theory of distribution-modern theory of distribution, gross and net profit-theories of profit Rich theory-Ucerlamy theory – Innovation theory profit.
3. Systems concept, management control: power, authority responsibility and accountability; managerial functions conventional structures and relationships, hierarchy; the hierarchy of objectives; management by objectives; different schools of thought in management.
4. Personnel Management: Recruitment, employment tests labour turnover; operator training; suggestion systems; industrial safety.
   Wages and Incentives; feature of wages; time and piece rate different incentive plans; profit sharing; job evaluation and ranking; factors of comparison and point rating.
5. Marketing Management: Concept of marketing in sales approach product design, pricing decisions, distribution, promotion marketing researches test marketing, marketing of services advertising management.
   Finance Management: Tasks, evolution of corporate management principles of accounting and finance statements.
   Long term financing: Equity, preference and debenture capitals term longs: dividends and share valuation: legal 21aspects of dividends: short term financing; working capital; influencing factors, cash budgeting, terms of liquidity, management of receivable and inventories.

References:

a) R.R Borthwalk; Industrial economics(An introductory text)
b) Paul A Samuel; Economics-An Introductory analysis
c) Alfred W.Stonier and Double C Hagum; A Text Book of Economic Theory
d) Bethel el. al.; Industrial organisation and management
e) Kootnz Donnel; Principles of industrial management
f) Prasanna Chandra; Financial management, Tata McGraw- Hill

ST 502 DESIGN OF MACHINE ELEMENTS

1. Fundamentals of machine design:-definitions, design process, design principles, design criteria; Stresses in machine parts-working stress, safe stress, factor of safety, endurance limits, fatigue factors
   Elastic springs-classification and uses of springs-allowable stresses and deflections-design for fluctuating loads
2. Joints:- Principles of force transmission; detachable joints (pins, keys, splines, and bolted joints), Non-detachable joints; welded, soldered and glued joints, riveted joints; strength of welded and riveted joints.
3. Drive elements:- Shafts - torsion and bending of shafts, design of shafts for strength and deflection, effect of key ways, crank shafts.
4. Shaft couplings:- Rigid coupling (flange and compression couplings)-couplings with kinematics flexibility-slip couplings fluid couplings.
5. Bearings:- Slide bearings-introduction to lubrication, hydrodynamic bearings, bearing materials, design of slide bearings.
   Roller bearings- types, static & dynamic load, capacity, bearing life and selection of Bearings.

6. Gears:- Types (spur and parallel helical gears) and function of gears, strength of gear teeth, stresses and stress concentration in gears-design of gears.

Practicals:- Design of a cast part, design and calculation of welded subassembly, design of a valve spring, design and calculation of a dynamically loaded screw joint, design and calculation of a shaft-boss joint (e.g. interference fit), design and drawing of a hydrodynamic slide bearing, design of gears on parallel axes.

Reference:

a) J.E.Shigley : Machanical Engineering Design, McGraw-Hill.
b) R.K.Jain, Machine Design, Khanna Publications, New Delhi.

ST 503 RESISTANCE OF SHIPS

1. Components of ship resistance, Dimensional analysis.
   Laws of comparison – geometrical, dynamical and kinematical similarity, Newton's, Froude's and Reynold's law, model-ship correlation

2. Viscous resistance – turbulent plate friction and plate resistance, viscous pressure resistance, separation and resistance due to separation, influence of curvature of the ship's hull, form factor, hull roughness and its influence on frictional resistance
   Wave making resistance – pressure resistance, ship wave system, interference effects, theoretical calculation of wave making resistance, wave breaking resistance, bulbous bows and their effects

3. Model testing – tank testing facilities, testing, prediction of resistance from model tests, extrapolation, Froude's concept, laminar influence and tank wall effect, comparison of resistance prediction with results of full scale trials
4. Determination of resistance from series test results – residuary resistance, effect of hull form on resistance, Taylor series, Series 60, B S R A series, S S P A series, etc.; statistical analysis of resistance data, Guldhammer-Harvald's and Danckwardt's method. Resistance of planing crafts multi-hull vessels, hovercrafts, hydrofoils, barges and convoy of barges.
5. Air and wind resistance, Resistance of appendages, Added resistance in waves; Resistance in restricted waterways – resistance in shallow water, resistance in canals.

Practicals:– resistance calculation using Guldhammer and Harvald series, shallow water resistance calculation, model – ship correlation.

References:

a) Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
b) Harvald S.A.; "Resistance and Propulsion of Ships", John Wiley & Sons.

ST 504 PROPULSION OF SHIPS

1. Propeller as a thrust producing mechanism; historical development; Screw propeller-screw propeller geometry, sections, propeller drawing, construction details.
   Propeller theories-Momentum theory, Blade element theory, Circulation theory

2. Interaction between Hull and propeller- Wake and wake fraction, Resistance augment and thrust deduction factor, propulsive efficiency in open water and behind conditions, hull efficiency, quasi propulsive coefficient, transmission efficiency; Powering.
   Cavitation-Types, Cavitation Number, Effects of cavitation, Prevention of cavitation, Design for minimum cavitation, Cavitation tests.

3. Design of propellers-Propeller families and series; Open water tests-Presentation of data, Kt-Kq diagrams, Design charts- Bp-δ, T-J, P-J charts, Use of charts in propeller design and performance study; Selection of engines-diesel engine characteristics.
4. Propeller strength- Materials and their qualities, strength calculation.

   Model testing of propellers-Test facilities, Laws of comparison, open water diagram self-propulsion tests-British and continental Methods.

5. Shrouded propellers-Action of propeller in a nozzle, wake fraction and thrust deduction fraction in nozzles, load factor of nozzles, design of propeller-nozzle system, design charts.
   Controllable Pitch propellers-Advantages, special features in geometry, design aspects.

   Super cavitating propellers-application.
   Other propulsion devices-Vertical axis propellers, Water jet propulsion, Sail, Paddle wheels, Electro magnetic propulsion etc.
   Ship standardisation trials.

Practicals: – Propeller design using series diagrams

Reference:

a) Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
b) Barnaby K.; Basic Naval Architecture,

ST 505 STRENGTH OF SHIPS I

1. Loads and Moments acting on ship structures in still water:-
   Loads, Weight and Weight distribution, Buoyancy and Buoyancy distribution. Load Curve, shear – force curve, bending moment curve, and deflection curve. Effect of thermal loads.
2. Loads in seaway:-
   Moments due to regular waves and oblique waves. Representation of irregular seaway. Short term and long term distribution of loads, Spectral approach to response of ship structures. Effect of slamming and shipping of green seas.
3. Longitudinal strength:-
   Application of beam theory and hull-girder section modulus calculation of shear stress distribution in cross section..
4. Transverse Strength:-
   Moment distribution method and matrix method for the analysis of transverse frames.
5. Miscellaneous topics of analysis
   Cargo handling system, Hatch- cover.

Practicals: - Longitudinal strength calculation, Transverse strength calculation

Reference:

a) Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), SNAME, New Jersey, U.S.A.
b) Owen Hughes; Ship Structural Design
c) Muckle,W.; Strength of Ships.

ST 506 MARINE ENGINEERING II

1. Marine and special duty pumps, Details of pumps for marine purposes viz. condenser circulating pumps, condensate and drain pumps, boiler feed pumps, bilge and ballast pumps – rotary pumps – ejectors: purpose of ejectors – details of construction.
   Marine piping – various types of piping system fitted in ships, Expansion arrangements for pipes, valves, types used in Marine Practice. Materials and corrosion in pipes, colour codes for pipes.
2. Aux. systems-Air compressors, boilers, heat exchangers, cooling, evaporators, distillers, waste heat recovery systems, hot water, drinking water, cooling water and sea water systems.
   Fuel systems, lubricating oil system-filters, coolers, centrifuges, purifiers and clarifiers.

Bilge and Ballast systems – Sewage disposal, Oily water separator, incinerator, galley equipment.

3. Deck machine and hull equipment – mooring, anchor handling, cargo handling-dry cargo handling equipment-winches, cranes, cargo gears, patent hatch covers, bulk heads, liquid cargo tanker cargo pipe layout systems-loading-unloading ventilation and cleaning of tankers, L.S.A. Boats & rafts, emergency equipment, water tight doors, stabilisers and bow thruster
4. Steering gears in marine use – different types – description construction, operation and maintenance.
   Shafting arrangements stern tubes and glands-soil lubricated stern tubes – shaft seals-shaft alignment. Thrust block-reduction gearing.
   Propulsion-types for marine propulsion, constructional details, fixing, maintenance and operation.
   Ship stabilisers; Engine room cranes, chain blocks, tackles; Anchors, anchor chains.
5. Safety systems-fire fighting equipment
   Instrumentation & control, watch keeping system UMS classes
   Air compressors, heat exchangers.

Practical: Preparation of diagrams for various piping systems, steering gear, stern gear etc.

Reference:
a) Harrington; Marine Engineering, SNAME Publications
b) Pounder,C.C.; Marine Diesel Engines, Newnen-Butterworths, London.
c) Khetagurov, M.; Marine Auxiliary Machinery and Systems, Peace Publishers, Moscow.
d) Taylor, D.A.; Introduction to Marine Engineering
e) Reed's Marine Engineering for Naval Architect
f) Marine Pumps and Piping Systems,

ST 507 ELECTRICAL SYSTEMS ON SHIPS AND SHIPYARDS

1. Components of electrical system on board ships, Standard voltages, difference between marine and industrial circumstances. Safety and quality of supply. Electrical power generation on board ships- Diesel generating sets, shaft driven generators, Turbo alternators, Brushless generators, specification of generators. Capacity calculation of main power plant -Diversity factor, single line layout of the DA set, protection for generators of main power plant, preference tripping -Installation rules for main power plant-emergency plant-layout of IC engine- driven & battery driven E.P.P. Switch gear for electrical system Fuses-Switches-relays- contactors- circuit breakers
2. Distribution systems:- Ring and radial system. AC single phase & 3-phase system- DC systems- Components of distribution system. MSB, SSB and DB -single line layout. Rules governing the distribution system. Regulations governing the installation of MSB. Special rules for tankers and fighting crafts – earthed and insulated AC systems- Transformers for power and lighting-. Specification of transformers- Specification of motors-speed based and torque based motors -DOL starter. Special regulation for installation of electrical system in steering system –rectifiers. Cables- specification of cables- testing of cables –current rating-design and selection of cables. Installation rules.
3. Electric propulsion –advantages-single line layout –Control of propulsion motors.

   Light fittings- different sources of light-Types of light fittings- lighting arrangements in engine room, accommodation place, weather deck etc. Navigation lights -Installation rules for light fittings.

   Navigational equipments: Auto pilot, magnetic compass, Log, Echo sounder and radar -rules-satellite navigation –RDF, Gyro Compass, LORAN – Aerials fitted on board ships.

4. Communication equipments: Modulation –amplitude modulation, Frequency modulation, modulation index – superhetrodyne receiver- Internal and external communication equipment. Installation rules -Domestic equipment –Engine room automation-fire detection.

5. Electrical system in shipyards: power factor improvement- power tariff calculation -essential regulations -main loads.

Practical : Preparation of Ship electrical system diagrams.

Reference:
a) Harrington L.Roy; Marine Engineering, SNAME Publications

b) Watson, G.O.; Marine Electrical Practice
c) Starr, A.T.; Generation, Transmission and Utilisation of Electrical Power
d) Sonnenberg,G.J. & Newnen Butterworth; Radar Electronic Navigation

SEMESTER VI

ST 601 COMPUTER AIDED DESIGN & DRAFTING

1. Computer Aided Design and Drafting – An overview, Engineering design, designer vs computer; computer as a design medium- software tools, analytical tools, development of CAD software, programming language for CAD.

2. C++ and object oriented programming: Streamlining I/O with C++ - cin, cout, cerr, the >> extraction and << insertion operators. Reference variables – definitions, initialisation. Function overloading and default argument in functions. C++ structures – syntax rules. Object oriented programming – traditional structured programming, object oriented terminology, encapsulation and class hierarchy.

   Classes: Introduction – member variables and functions, interfaces and implementations, construction and destruction. Derived class – single inheritance, multiple inheritance, access control, abstract class and polymorphism. Operator overloading – operator functions, function call, increment and decrement.

Computer Graphics and Geometric Modelling:

3. Introduction: Representing, preparing and presenting pictures, interacting with the pictures - description of various graphics devices.

   Two Dimensional Transformations: Transformation of points and lines - scaling, reflection, shearing, rotation; Translation and Homogeneous co-ordinates; Combined transformations.

   Three Dimensional Transformations: Scaling, shearing, reflection, rotation, translation, multiple transformations; Projections - Orthographic, axonometric, oblique, perspective projections.

4. Curve representation: Nonparametric and parametric curves; Plane curves - circle, ellipse, hyperbola, parabola; Space curves - Cubic spline, Parabolic blending, Bezier and B-Spline curves.

5. Surface representation: Surface of revolution, sweep surfaces; Piecewise surface representation - bilinear surfaces, ruled and developable surfaces, Bezier and B-spline surfaces.

Practical: Preparation of computer programs to understand various concepts and techniques included in the syllabus.

a) Krishnamoorthy, C.S. & Rajeev, S.; Computer Aided Design- Software and Analytical Tools, Narosa Publishing House, New Delhi, 1995.
b) Bjarne Stroustrup; The C++ Programming Language, Addison-Wesley Publishing Company, 1995.
c) Chris H. Pappas & William H. Murray; The Visual C++ Handbook.
d) Rojers, D.F. & Adams, J.A., Mathematical Elements of Computer Graphics, McGraw Hill International Editions.
e) Vera B. Anand; Computer Graphics and Geometric Modelling for Engineers; John Wiley & Sons, Inc.
f) Steven Harrington; Computer Graphics - A Programming Approach; Second Edition, McGraw Hill International Edition.
g) Donald Hearn and M. Pauline Baker; Computer Graphics; Prentice Hall International Eastern Economy Edition.
h) William M. Newman & Robert F. Sproull; Principles of Interacting Computer Graphics; McGraw Hill International Editions.

ST 602 CONTROLLABILITY OF SHIPS

4. Manoeuvring Fundamentals – the control loop, path keeping, equations of motion, linearised equations and control fixed stability indexes, model tests.

5. Stability and control in the horizontal and vertical planes – definitive manoeuvres, turning trials.

6. Control surface hydrodynamics – geometry of control surface (rudder), flow around rudder, aspect ratio, influence of hull shape on aspect ratio, influence of fixed structures.

   Control surface design - specification of requirements and constraints on rudder design, rudder location and orientation, number of rudders, type of rudder, geometric properties of rudder, maximum rudder deflection angle

and deflection rate, rudder stock location.

7. Influence of ship features on controls fixed stability - fixed fin, propeller, hull, configuration

8. Experimental determination of hydrodynamic derivatives (rotating arm technique, planar motion mechanism).

Non-linear Manoeuvres, Simulation, IMO Rules and Recommendations

Practicals:- Calculation of free stream characteristics of rudder, Rudder design, Zigzag manoeuvre.

References:

a) Lewis,E.U.; "Principles of Naval Architecture", (2nd Rev.), 1989, SNAME, New Jersey, U.S.A.
b) Abkowitz,M.A.; "Lectures on Ship Hydrodynamics – Steering and Manoeuverability", 1964, Danish Technical Press, Copenhagen, Denmark.

ST 603 SHIP MOTIONS IN SEAWAY

1. Ocean Waves – Wind generated waves, regular wave theory, waves of Finite Height, Trochoidal Waves, Group Waves, Irregular Seaway, Point and Directional spectras, Wave Slope Spectra, Encounter Frequency Spectra, Idealised Spectral Families.

2. Ship in Regular Waves – Co-ordinate Systems, Equations of Motion (uncoupled Heave, Pitch and Roll; Coupled Heave and Pitch) Hydrodynamic Forces, Radiation Forces, Strip Theory.

3. Ship in Seaway and Dynamic effects – Linear Superposition, Response Amplitudes Operator, Pitch and Roll in Irregular Waves, Local and Relative Motions, shipping of green Water, Slamming, Yawing and Broading, Added Resistance, Powering in waves, Wave Loads.

4. Ship Motion Control – Control of Roll – Passive Stabilisers (Bilge Keel, Sails, Free Surface Tanks, U-tanks, Moving weight) Controlled – Passive Stabilisers, Active Stabilizers (fin, gyro, active-tank) Rudder Stabilisation, Control of Pitch.

5. Sea-keeping Performance and Design Aspects – Sea-keeping performance criteria and ship seaways responses, factors affecting pitching, heaving and rolling, guidelines for design, Sea-keeping features of high-performance ships (catamarans, SWATH, Planning Craft, Hydrofoil Craft, Air Cushion Vehicles and Surface and Surface Effect Ships, Submarines).

Practicals:- Estimation of Hydrodynamic coefficients, Heave, roll and pitch test in waves

References:

a) Lewis, E.U; 'Principles of Naval Architecture' (2nd Rev.) Vol. III, 1989, SNAME New York
b) Bhattacharyya..R; 'Dynamics of Marine vehicles', 1978, Wiley Inter Science, New York.
c) Lamb.H; 'Hydrodynamics', 1945, Cambridge University Press, UK
d) Newman J.N; 'Marine Hydrodynamics', 1977, MIT Press, USA
e) Newman J.N; 'Theory of Ship Motions', Advances in Applied Mechanics, Vol., 1980.
f) Price W.G & Bishop R.E.D; 'Probabilistic theory of Ship Dynamics', 1982, Chapman & Hall, London.

ST 604 STRENGTH OF SHIPS II

1. 3d modelling of ships structures and analysis-small deflection analysis of thin plates with transverse loads and combined loads – large deflection analysis – Buckling of thin plates – analysis of stiffened plates – Buckling of stiffened plates. Longitudinal Strength analysis during launching and docking, grounding and collision. Influence of super structure in longitudinal strength.
2. Analysis of submarine structure – Membrane and bending theory equations of cylindrical shells – Analysis of Stiffened cylindrical shells – analysis if frames and bulkheads – Buckling of Unstiffened and stiffened cylindrical shells, Introduction to classification society regulations.
3. Torsion of ship's hull:-
   Determination of Shear centre and shear flow calculation of thin-walled beams. St.Venant torsion and theory of restrained torsion. Modeling and torsion analysis of ship structure using fem. Influence of deck transverse and shipends.

4. Ultimate Strength analysis
   Application of Plastic theory to ship structures – Basics and definitions – Safety factors, damage and collapse of ship structures, application of fem for ultimate strength estimation.

5. Vibration analysis:-

   Sources of vibration and measures for control of vibration – Vibration analysis of beams, Methods to determine natural frequency of ships - Stodoliteration.

Reference:

a) O. Hughes - Ship Structural Design
b) Muckle - Strength of Ships.

ST 605 STRUCTURAL DESIGN OF SHIPS I

1. Introduction
   Shipbuilding materials – transition from wood to steel (historical review), shipbuilding quality steels (properties, steel grades); Joining techniques – riveting, welding (butt joints, fillet joints, lap joints, welding symbols, weld strength); Ship structural design concepts – specialisation of the structure, general considerations in structural design, external loads (review), structural analysis models, design criteria, steps in structural design procedure, design from first principles, design according to classification rules.

2. Ship structural systems
   Ship as stiffened plate structure – framing systems, common stiffener sections, corrugated construction, design of strakes (butts, seams), welding sequences, shell expansion; Structural subsystems – break up into bottom structure, side structure, deck structure, bulkhead structure, end structure, superstructure etc., general structural arrangements of different types of ships (historical review); subassembly, stiffened panels and volume sections.

3. Bottom structure and Side structure
   Bottom structure – framing system, functions, single bottom and double bottom construction, structural components and scantlings, openings, cut outs, connection details, bilge keel; Side structure – framing system, functions, structural components and scantlings.

4. Decks and Bulkheads
   Deck structure – functions, framing system, structural components and scantlings, hatch ways, pillars, bulwarks, guard rails, fenders; Bulkhead structure – type of bulkheads, functions, framing system, structural components and scantlings.

5. End structures
   Fore end structure – functions, structural arrangements (panting), structural components & scantlings; Aft end structure – functions, structural arrangements, structural components & scantlings;

   Structural connections – compatibility, bottom & side, side & deck, bulkhead with deck, side & bottom.

Practicals – Design of Bulk head, Midship section, Shell expansion

Reference:

a) Taggart; Ship Design and Construction, SNAME
b) D'Arcangelo; Ship Design and Construction, SNAME

ST 606 SHIP DESIGN I

1. Introduction – General aspects of Marine Activities, Transportation of cargoes, Marine services & Operations, Marine Industries; Engineering Economics in Ship Design – Economic criteria, Initial cost, Operating cost, RFR; Owners requirements

2. Methods of ship design – design using basic type ships, Design using coefficients, Design using iteration methods; design spiral; design categories (dead-weight carrier, capacity carrier, linear dimension ship).

   Ship parameters – displacement, displacement coefficient, displacement equation, volume equation, solution of the cubic equation

3. Ship dimension – length, breadth, depth, draught, form coefficients; Shape of the hull
   Mass estimation - lightship mass – steel mass, outfit mass, engine plant mass; dead weight.
   Design of hull form – conventional method of lines, distortion of existing forms; stem and stern contours, Bulbous Bow.

4. General arrangement - Subdivision of the ship's hull and erections, arrangement of spaces, arrangement of tanks, superstructure and deckhouses, arrangement of engine plants, Cargo handling capacity
   Hold capacity and stowage factor.

5. Effect of from on Ship's performance: Freeboard and load line regulation; Stability – stability booklet, IMO Regulations, Checks on stability, trim.
   Watertight integrity; damage stability, Tonnage measurement – international, Suez, Panama.
   Behaviour of ships in sea
   Resistance, Powering, Propulsion

Reference:

a) Lewis, E.U; 'Principles of Naval Architecture' (2nd Rev.) Vol. III, 1989, SNAME New York
b) Schneekluth, H; Ship Design for Efficiency and Economy, Butterworths, 1987
c) Taggart; Ship Design and Construction, SNAME

ST 607 SHIP PRODUCTION I

1. Introduction to shipbuilding:– Structure of the shipbuilding process, special aspects of transport in shipbuilding, principles of flow line production in shipbuilding – mechanisation, automation, numerical control, computer control, trends of future development; Relations with supply industry, pattern of the shipbuilding, location and layout of shipyards, area, labour and other sources, coastline etc.
   Data generation for shipbuilding process – generation of hull forms, generation of frame plan, shell plate development, generation of hull components, lofting, nesting.
   Storage and preparation of material – Introduction, material handling and storage, transport system in steel stockyard, material preparation (straightening of plates and rolled sections, shot blasting, prepainting), material preparation flow line devices and their control systems

2. Fabrication of component parts:– the cutting process – tools, physical-chemical background of the cutting process, mechanical cutting, devices for thermal cutting, general description of the various machines, photoelectric and NC-control devices, edge preparation, problems of accuracy; Bending of rolled and built up sections - general description of bending, control of the bending process, automation of bending; Plate bending, uniaxial bending, biaxial bending (devices, cold bending, heat-line bending), possibilities of automated plate bending.

3. Assembly of Ship's Structures: Prefabrication – general remarks, basic problems of prefabrication, pattern of prefabrication, welding in prefabrication
   Sub-assemblies: built up T-bars, web frames, machine foundations etc.; welding deformation and straightening; Prefabrication of flat sections – panels, panel production line, preassembly of biaxial stiffened panels – welding procedures. Assembly of flat and corrugated sections, flat sections with curvature – assembly jigs, welding process, its nature, theoretical background, strengthening of flat sections. Preassembly of volume units – Preassembly of double bottom sections – different structural arrangements, variants of the assembly process, welding problems; Preassembly of side tank units – structural arrangement; Special assembly systems (ROTAS, GAMMA-Systems, etc.); Preassembly of the fore and aft end structure; Preassembly and outfit of superstructures.

4. Erection of ship's hull – General assembly methods, handling of preassembled units in the erection area – cranes, heavy-duty truck; Preassembly of blocks – special types, advantages and disadvantages; Hull assembly – different methods of hull assembly, auxiliary devices; Welding in ship's hull assembly – welding methods applied, welding defects, welding deformation of the ship's hull; Quality control (X-ray tests etc),; Scaffolds

5. Launching – General methods, Launching by floating off (building dock, launching dock, floating dock), Mechanical launching methods (slip, lift), Launching from inclined building berths – stern launching, side launching; Launching calculations, model and large scale-experiments.

Practicals – Calculation of the process of frame 4bending, Subdivision of a ship into preassembled units, Erection

sequence of a ship.

Reference:

a) Taggart; Ship Design and Construction, SNAME
b) Storch R. Lee, Hammon C.P. & Bunch H.M.; Ship Production, Cornell Maritime Press, Maryland, USA, 1988
c) Dormidontov V.K. & et.al.; Shipbuilding Technology, Mir Publishers, Moscow.
d) Eyres D.J.; Ship Construction William Heinemann Ltd, London, 1982

ST 608 MARINE HYDRODYNAMICS LAB

1. Model test to predict ship resistance, flow line test, shallow water resistance test.
2. Open water test, self-propulsion test, bollard pull test.
3. Seakeeping tests

ST 609 MARINE ENGINEERING LAB

1. Energy balance of a Diesel engine
2. Determination of the characteristics of diesel engine.
3. Determination of the characteristic curves of compressors.
4. Determination of the characteristic curves of pumps and pipings.

SEMESTER VII

ST 701 PRODUCTION MANAGEMENT AND OPERATION RESEARCH

1. Production system-The systems approach-subsystems, comprehensive system model – the firm as a system
2. Managerial decision making-decision theory under certainty and uncertainty-models as decision aids-the decision process-problems, types and decision approaches
3. Decision of productive systems-product line determination, product planning, demand forecasting, steps and techniques-capital planning-demand and supply of capitals-capital allocation methods-investment criteria-value analysis and break even analysis-plant location and layout-factors-site selection-process and product layout-material handling systems-types, equipments, operating effectiveness in the productive system.
4. Operation planning and control-production inventory system-the inventory problem-functions of inventory-inventory costs-inventory concepts, models-production planning and control-pre-production activities-planning-scheduling-network models (PERT,CPM)-quality control-maintenance analysis
5. Some analytical techniques of operation research-introduction-basic concepts of OR types of mathematical models-linear programming-formulation of linear optimisation models-distribution methods-simple method-waiting line theory-models-examples

Practicals:-Linear programming applied to a problem of the production process-Application of network models with critical path scheduling-distribution problem-waiting line problem.

Reference:

a) Elwood S.Buffa; Modern Production/Operations Management, Wiley Eastern Ltd.
b) Richard J. Hopeman; Production – Concepts, Analysis, Control, 3rd Edition, Charles E. Merril Publishing Co.
c) Arthur C.Laufer; Operations Management, South-Western Publishing Co.
d) Khanna, O.P.; Industrial Engineering and Management, Dhanpat Rai Publication.
e) Richard I. Levin, et.al.; Production/Operations Management: Contemporary Policy for Managing Operating Systems, Tata-McGraw Hill Publishing Co. Ltd.

ST 702 STRUCTURAL DESIGN OF SHIPS II

1. Engine Room – functions, general arrangement, engine casing, foundations, structural design of engine rooms.
2. Superstructure and Deckhouses - functions, structural arrangement, effectiveness of superstructure & deckhouse, structural design, opening and expansion joints.
3. Cargo handling equipment – different cargo handling system, mast derrick system, loads on mast derrick system, design of mast derrick system, deck cranes.

4. Hatch Covers – functions, load on hatch covers, statutory requirements, types of hatch covers, cleating & sealing arrangements, structural design of pontoon covers.
5. Miscellaneous topics – construction of life boats, submarine structure, chain locker, hawse pipe, rudder types & their construction, nozzles, stern tube & shaft bossing.

Practicals – Design of fore or aft end structure, Structural design of a rudder, Design of machine foundations, superstructures etc.

Reference:

a) Taggart; Ship Design and Construction, SNAME
b) D'Arcangelo; Ship Design and Construction, SNAME

ST 703 SHIP DESIGN II

1. Standardisation – Process and product standard; Rules and regulation.
2. Cargo handling equipments, cargo hatches, lifting devices; Anchor installations – types of anchors, anchor handling system, anchor chain & storage; Mooring systems – deck fittings & structural arrangement, mooring machinery, mooring operations.
3. Accommodation – crew size, accommodation standards, space allocation, habitability, access, materials, standardisation and modular arrangement; Access equipments –hatches, manholes, doors, other closing & opening devices, load line rules, gang ways and ladders
4. Steering gear – Types, design aspects, connections; Mast & riggings; Railings & awnings; Sound and light signals.
5. Equipments in tanks & holds – Air vents, sounding tubes, cleaning devices, fire protection devices
   Life saving system – life saving equipments, IMS international rules
   Fire fighting systems – Rules and regulations, equipments, fire fighting

   Ventilation, Panelling & deck covering, Painting.

Reference:

6. Taggart; Ship Design and Construction, SNAME
7. Cargo Handling Systems in Ships
8. Rules & Regulations – IMO, SOLAS, IMS
9. Venugopal K.; Maritime Law of India, Law Publishers, India
10. ISO 9000 Series
11. BSI – Indian Codes

ST 704 SHIP PRODUCTION II

1. Outfitting of ships:– workshops –piping shop, fitters shop, Carpenters shop (wood, plastics), Mechanical workshop, Machine shop (preassembly of blocks), Other workshops (electrical installation, painting, insulation, etc.); Technological process in the hull installation work –Technological process in installing the main machinery, installation of shafting and propeller, installation of the main machinery, installing of auxiliary machinery and boilers, installation of piping systems, electrical installation, hull installation work; Pre and advanced outfitting.

   Trial trip

PRODUCTION PLANNING AND CONTROL IN SHIPBUILDING

2. Production design – application of the principles of design for production in shipbuilding – joining of parts, relations between structural design and prefabrication, simplifications in structural design (design for welding), quality control.

   Problems of accuracy – tolerances, standards, measuring techniques (theodoilite laser, etc); quality control

3. Process planning in shipbuilding:- Planning for operations – interconnection between production design and process planning, production and process analysis, assembly charts, operation process charts, flow process charts; Process selection. Application of models for process planning, scheduling and control – Gantt charts, CPM & PERT, transportation models etc.; Special aspects of application of these in shipbuilding process.
4. Capacity planning – estimation of future capacity of a shipyard methods, strategies for modifying capacity, models for capacity planning under the special conditions of shipbuilding.
5. Production Standards – production standards in several parts of the ship production process, work measurement systems, methods of man-hour determination, use of computers, correlation between size of series and needed man-hours.

   Systems of maintenance and quality control.

Practicals – Launching calculation, Shell plate development & Nesting, Application of Gantt-charts and network techniques, Design of a panel-line and capacity calculation, Design of a special part of a shipyard layout (e.g. steel stockyard, dry-dock)

Reference:

a) Taggart; Ship Design and Construction, SNAME
b) Storch R. Lee, Hammon C.P. & Bunch H.M.; Ship Production, Cornell Maritime Press, Maryland, USA, 1988
c) Dormidontov V.K. & et.al.; Shipbuilding Technology, Mir Publishers, Moscow.
d) Eyres D.J.; Ship Construction William Heinemann Ltd, London, 1982

ST 705 JOINING TECHNIQUES IN SHIPBUILDING TECHNOLOGY

1. Definition, Historical Background, Electric arc welding, Development in Welding, Science of Welding

   Welding Metallurgy: Introduction, Structure of metals, Crystallisation of a pure metal, Equilibrium of constitutional dig., Phase transformation in Iron - Carbon diagram, Weldability of steel, Presence of alloy elements, Effect of welding process & nature of base metal, Preheating, HAZ.
2. Gas metal arc welding – Process, different metal transfers, power source, electrodes, shielding gas, uses of Gas in metal arc welding

   Mechanised system in shipbuilding - Introduction, philosophy of automation in welding, different welding systems in shipyards, Welding in production shop – SAW, Gravity welding, Auto contact, CO_2 Welding
3. Panel line production - One-sided welding – SAW, MIG welding, welding of stiffeners

   Welding in building berth - External welding on the berth, Electro-slag welding, Electro-gas welding, One-sided welding (Flux Asbestos backing, Ceramic backing etc); Internal welding on the berth.
   Comparison of European, Japanese & Indian Welding Process
4. Welding problems - Weld defects, Distortion, Accuracy control; Non destructive tests.

   Welding quality control - Welding standards, Welding procedure qualification, Effect of variables on qualification of tests, Performance qualification of Welders & operators, Test reports, Acceptance standards, Quality assurance and audit, Consumable classification & coding.

   Introduction to Robotic Welding.
5. Structural Adhesive Bonding as a joining technique – Adhesives and adherands, bonding methods and joint design, analysis of joints for strength, surface preparation for steel, aluminium and other materials used for marine structures.

Reference:

2. Davies, A.C.; Welding, Cambridge University Press, Low Price Edition, 1996.
3. Richard, Little; Welding Technology, McGraw Hill Publications, New Delhi.
4. Joe Lawrance; Welding Principles for Engineers, Prentice-Hall Inc. Englewood Cliffs, N.J.
5. Welding Handbook – Vol.:1,2,3; American Welding Society
6. O.P. Khanna; A Textbook of Welding Technology, Dhanpat Rai & Sons.

ST 706 ELECTIVE I

ST 707 ELECTIVE II

SEMESTER VIII

ST 801 SPECIAL PROBLEM AND SEMINAR

Students can be given small projects that are relevant to Naval architecture, Marine Engineering and other Engineering fields and accordingly a seminar can be conducted.

ST 802 ELECTIVE III

ST 803 ELECTIVE IV

ST 804 PROJECT WORK

Students shall do independent Ship Design Project work. After completing the project, a project report shall to be prepared and submitted by each student.

VIVA VOCE

List of Elective Subjects for the 7th and 8th Semester

Group A: ST 706/707 NEA n (7th Semester)

(*The first elective from this group shall be coded* ***ST 706 NEAn*** *and second paper as* ***ST 707 NEAn*** *where 'n' represents the serial number of the elective)*

1) Ship building Materials, Corrosion, prevention and protection
2) Design of Fishing Vessels
3) Refrigeration & Air conditioning of Ships
4) Offshore Structure Design
5) Ship Recycling
6) Computer Aided Ship Design
7) Experimental Stress Analysis
8) Cargo Handling
9) Inland Water Transport
10) Design of small crafts
11) Marine Pollution , Control and Recovery Systems
12) Maritime Law and Shipping Management.

Group B:ST 802/803 NEB n (8th Semester)

(*The first elective from this group shall be coded* ***ST 802 NEBn*** *and second paper as* ***ST 803 NEBn*** *where 'n' represents the serial number of the elective)*

1) Experimental Techniques on ships and models
2) Finite element method
3) Ship Repairing and Surveying
4) Advanced Computer Techniques
5) Computer Application in Shipbuilding Technology
6) Design of fishing systems

7) Design of Submarines and Deep Submersibles

8) Design of High speed crafts

9) Quality Assurance and Management in Shipbuilding

10) Numerical techniques in Marine Hydrodynamics

11) Probabilistic Theory applied to ship in seaway

12) Remote sensing Applications in Ocean Wave Data Analysis

13) Underwater Explosions and Acoustics

14) Design of warships

15) Fracture Mechanics

Syllabi for Elective Subjects – 7th Semester

NEA1 Ship building materials, corrosion prevention and protection

1.**Introduction**- Corrosion in nature, Corrosion losses, importance of corrosion protection, theories of – corrosion- electrochemical series- types of corrosion - its identification-remedies-factors affecting corrosion-fouling-effect of fouling on ships-factors affecting growth and settlement.

2.**Corrosion control**-Weathering steel-stainless steel-Titanium and Nickel alloys-copper and copper based alloys-Zinc-Aluminum and its alloys-corrosion control by Design, corrosion inhibitors-corrosion monitoring-corrosion management in ships.

3.**Surface preparation**-Degreasing-weathering-mechanical surface cleaning-pickling-blast cleaning-flame cleaning-rust converters-chemical pretreatment-comparison of pretreatment methods.

4.**Marine paints**-Role of constituents of paints-classification of paints-mechanism of anticorrosive paint-paint types-selection of paint-paint scheme-antifouling paints-principles of antifouling paints -coating failure.

5.**Cathodic protection**-Mechanism of cathodic protection, sacrificial anode, design of sacrificial anode system for ship, impressed current system, advantages and disadvantages of cathodic protection.

REFERENCES:

Fontana M. G, Greene N. D, 'Corrosion Engineering', McGraw Hill, 2nd Edition, 1978
Raj Narayan, 'An Introduction to Metallic Corrosion and its Prevention', Oxford and IBH,1983
Jones D. A, 'Principles and Prevention of Corrosion', 2nd Edition, Prentice-Hall, 1965
T. Howard Rogers "Marine Corrosion" first Edition, George Newnes Ltd London, 1968

NEA 2 Design of Fishing Vessels

1. Introduction

- definitions of fishing vessel
- special features of fishing vessels
- regulations for the safety of fishing vessels

- classification of fishing vessels
- fish production in India
- organizational setup and shore facilities
- fisheries organizations and activities
- administrative systems on fishing vessels

2. Fishery

- Characteristics of fish ground
- Fishing gear and methods
  drift net, long line, drag net, siene net, dredging, with electric light
  harpoon/whale catching
  trawling (side and stern trawlers, single and pair trawling, pelagic & bottom trawling)
- Dressing, processing and freezing

3. Design Procedure
- Owner's specifications
- Economy, fuel efficiency, hull form, investment cost
operating revenues and costs
- Design of Main Dimensions and form
  parent vessel data analysis, space requirement (capacity) of the whole ship
  estimation of main dimensions, estimation of form coefficients
  estimation of light ship weight, estimation of dead weight, design of lines

3.1 General arrangement
engine room, fish holds, erections, deck machinery arrangement
crew accommodation, fuel, fresh-water, ballast tanks, bulkhead positions

3.2 Resistance, powering and propeller selection
- friction resistance, wave making resistance, eddy resistance, net resistance
- powering calculations, propeller selection

3.3 Propulsion Systems and other machinery/equipment
- different propulsion systems and selection of main engine
- selection of equipments/instruments for fish finding, navigation, communication, fire fighting, life saving and net monitoring

3.4 Seakeeping and maneuvering considerations.

4. Material and construction methods
- mechanical properties of materials
- comparison of hulls of different material
- type of construction
- details of steel construction
- construction methods in FRP/GRP, Aluminium, Ferro-cement

5. Fish holds and preservation facilities
- insulation materials and properties
- methods fish preservation

NEA3: Refrigeration and Air conditioning of Ships:

1. Refrigeration at Sea

1.1. Cargoes and carrying conditions

1.2. Thermodynamical principles

… vapour, compression cycles (CARNOT, superheating, subcooling, multistage operation)

… Absorption cycles

1.3 Refrigerating machinery, principal components

… compressors, condensers, evaporators, regulators

1.4 Refrigenrants

… demands, properties, choice

1.5 Methods of cooling the cargo chambers in conventional refers

1.6 Methods of cooling containers

1.7 Insulations

1.8 Heat Leakage Estimation

1.9 Total load on the refrigeration plant

2. Air Conditioning

2.1. Fundementals

… definitions

… psychrometric chart

2.2 Airconditioning (Heating)

… heat sources, heat exchangers

… heat pump

2.3 Airconditioning (Cooling)

… principal arrangement, equipment

2.4 Standards for marine airconditioning systems

2.5 Air flow & airconditioning capacity calculations

2.6 Airconditioning Systems

Ref: 1) Marine Air Conditioning – Srivastava. S. S.

2) Refrigeration at Sea - Munton & Stot

NEA 4 Offshore Structure Design

Module I

Introduction to offshore structures , Classification of offshore structures. Description, details and features of Jacket, Gravity, Jack up, Guyed towers, TLP , Spar,Semi submersible, FPSO. Design Principles, WSD and LRFD.

Modelue II

Loads .Description of environmental loads, dead loads and operational load , calculation of wave, wind, current loads.

Module III

Steel structural design of members subjected to axial compression and bending , Design of deck structures. Design of mooring lines, Design of offshore pipelines

Module IV

Design of Jacket structures, Combined axial compression and bending , Design of Joints- Punching shear load and determination of stress concentration , Design for fatigue strength.

Module V

Design of Jackup structures, Description of the structural components, Design of hull structures, leg, lifting components.

Reference:

1. Dawson, Offshore Structural Engineering
2. Teng. H, Applied Offshore Structural Engineering.
3. Berteaux H.D, Buoy Engineering , John Wiley, New York.
4. S.K.Chakrabarti, Handbook of Offshore Engineering (Vol I & II)
5. W.J.Graff, Introduction to Offshore Structures- Design, Fabrication, Installation

NEA 5 :Ship Recycling

1. Introduction

Definition of Ship Recycling

Relevance of Ship Recycling

Concept of sustainable development of the world

Factors contributing to the sustainable development **,** Role of maritime industrial sector **,** Statistics of global shipping and ship building

2. Ship life cycle stages -

Various stages of life cycle of ships, Operations in life stages and effective management of the stages.,

Importance of ship recycling in life cycle stage management

3. Recycling Methods

Decision on decommissioning of ships

Preparations for transferring obsole vessels to Recycling Yards

Planning, Commercial matters, Transportation methods, Survey before positioning , Legal matters

Positioning of obsolete ships

Beaching ,Buoy and Dock methods

4. Operation in Ship Recycling

Ship dismantling process ,

Access, Cleaning, Marking, cutting, handling, lifting, sorting, stacking, storing, marshall

Concept of recycling

Reuse and Land-filling in ship recycling

Design for ship recycling

Vessel specific dismantling : Safety Issues.

5. Rules and regulations in ship recycling

Rule of various international and national agencies , IMO, UNEP (BASEL CONVENTION), EPACUSA), GMB (GUJARATH), ILO, DNV , Statutory Certificates for Ship Recycling , Green passport and Green ship

Role of NGOs (Green Peace foundation ,Ban Asbestos Network)

Inventory list

Safety matters/ requirements

Chances of Environmental pollution ,effect on life / organisms at sea.

6. Ship Recycling Yards

Model layout of Ship Recycling yard , ISO recommendations , Application of Information Technology in Ship Recycling.

References:

1) Purnen Misra, Anjana Mukharjee, Ship Recycling , A Hand book for mariners, Narosa Publicating, House, New Delhi, 2009.

2) A guide for ship scrappers, tips for regulatory compliance, United States Environmental Protection Agency, Summer 2000.

3) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 8 October, 2005.

4) IMO guidelines on ship Recycling, Resolution A.962(23),2004.

5) Industry code of practice on ship Recycling, Marisec, London, August 2001.

6) Safety and health in ship-breaking guidelines for Asian countries and Turkey, International Labour Office, 2004.

7) U.K ship recyling strategy Department for Environment Food and Rural Affairs, February 2007.

8) United Nations Environment Programme, Conference of the parties to the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal, UNEP/CHW.6/23.

NEA 6: Computer Aided Ship Design

1. Numerical Techniques in Computer Aided Ship Design:

   Numerical Interpolation: Differences, Newton's Forward Difference interpolation formula, Lagrangian Interpolation formula

   Numerical Integration: Integration formulas,

   Curve Fitting: Fitting of Polynomials, Least Square curve fitting technique, Choosing the degree of the polynomial, Ill-conditioning difficulties, Orthogonal Polynomial fitting

2. Lines Design and Fairing:

   Manual Graphical method

   Computer Aided Curve fitting Techniques

   Fairing Principles

   Spline Fitting: Cubic Spline curve, Bezier Curve, B-Spline Curve.

3. Preliminary Ship Design

   Design Stages and methods

   Preliminary Parameter Estimation: Displacement, Length, Breadth, Depth, Draught, Block Coefficient; Check on Transverse & longitudinal Stability, Freeboard, etc., Estimation of Power, Capacity; Basic Ship Method

   Computer Aided Preliminary Ship Design: Preliminary Parameter Selection, Ship Lines fairing

4. Database Systems

   Introduction

   Architecture of a Database system

   Data Models: Relational, Hierarchical, Network

   Application to Ship Design

5. Optimisation Methods in Ship Design

   Introduction

   Modelling of Design as Optimisation

Different Optimisation Methods; Linear and Non-liner optimisation

Application to Ship Design

Practical: Development of relevant Computer Programs based on the syllabus

Reference:

g) L.R Reheja, et.al.; Computer Aided Ship Design, Code No. 77, Update for Working Professionals, AICTE, Continuing Education Programme

h) Chengi Kuo; Computer Methods for Ship Surface Design, Longman, 1971

i) Chengi Kuo; Computer Applications in Ship Technology, Heyden & Son Ltd. 1977

j) H. Nowacki, et.al.;Computational Geometry for Ships, World Scientific Publishing Co. Pvt. Ltd., 1995

k) David F. Rogers & J Alan Adams; Mathematical Elements for Computer Graphics, McGraw-Hill International Editions, 1990.

8th Semester

NEB 1 Experimental Techniques on Ships and Models

1. Ship Resistance tests, Total resistance, Resistance diagrams, Resistance Coefficients, Ship Models, Laws of comparisons and Similarity, Extension of Model results to Ships, Towing Tank, Instrumentation, Method of measurements.

2. Open water tests, Objectives, Fecilities, Test set up, principles, procedure, Analysis and conclusions.

3. Cavitation, Cause of Cavitations, Cavitation number, Classification of Cavitation, Law of similarities, Cavitations tests, facilities, prevention of Cavitation.

4. Self Propulsion experiments, Objectives, Instruments and equipments, Test arrangements, basic principles, experiment, Results.

5 Sea trials, Shop tests, various sea trials, manoeuvering trials, Dock trials, Speed Trials, Observations, Data presentation and uses.

6. Shallow water resistance tests

Wake measurements, Sea keeping tests

Model Tests for Determination of Hydro dynamic derivatives of Ships and submerged vehicles.

Paint erosion tests, Smoke disposal tests, Redder tests, Tuft tests

NEB 2 Finite Element Method

Module I.

Scope of finite element method as a solution strategy for engineering problems, historical development of fem, General steps in finite element analysis, variational formulations and weighted residual methods.

Module II

Shape functions, Convergence criteria , General equations for calculation of stiffness matrix in the form $\int B^T DBdvol.$ Derivation of stiffness matrix for truss beam, Plane stress , plane strain, axisymmetric elements.

Module III

Computer Implementation of fem- organization of computer program, Numerical methods for various property matrix calculations, fundamentals of stability and Dynamic analysis.

Module IV

Ship Structural Analysis using fem- formulation of plate finite elements, issues associated with plate formulation of finite elements. Numerical examples on simple plate analysis. One dimensional and two dimensional finite element modeling of ship structure .

Module V

Analysis of offshore jacket structures using fem – static and free vibration analysis – including foundation . Analysis of Jackup structures using stick model. Numerical examples of simplified structures.

Reference:

1. O.C.Zienkiewicz – Finite Element Method, Fourth edition , Mc Graw Hill.
2. R.D.Cooke " 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.

NEB 3 : SHIP REPAIRING AND SURVEYING

Module I:

Repair of ship hull – Introduction; cause of wear and damage in ships hull: Comparison between different types of repair activities (Afloat, berthed, etc.); Repair of hull and other parts while afloat; docking plan-replacement of hull plates and stiffeners, decks and bulkheads; repair of stem and stern frames and shaft bracket; NDT and X-ray tests; Testing for water-tightness and hull continuity etc;

Module II:

Underwater welding – welding equipment; quality control and standards; degree of automation;
Safety during repair – various operations involving risk; safety devices and plans; problems during docking;
Ship repair facilities in a modern repair yard-repair docks, machine shop, scaffolding; Subcontracting policies by shipyard in repair project, layout of repair yard.

Module III:

Various types of marine surveys.
Roles and responsibilities of marine surveying agencies;
Historical development of ship classification societies; Major activities of classification societies; rules and class notation; IACS and joint projects;
Comparison of ship class rules by LRS and ABS;

Module IV :

International Ship classification societies and UN agencies involved in marine and offshore activities.
Activities of classification societies and surveying agencies bodies;
Classification society – Design approval; construction survey; survey on operation, repair conversion.
Industrial surveys, third party accreditation.

Module V:

Statutory surveys – role of MMD. Activities of statutory bodies – MMD, Inspectorate of boats – design approval; construction inclination experiment, keel sighting, registration, surveys during – repair conversion and operation.

Activities of other bodies – port authority; IWAI; Local bodies; canals etc;
Warship construction warship overseeing team, inspection during construction; lineout inspection;
Introduction of Marine Insurance
Marine Cargo Survey
Survey dry, liquid and container, cargoes

References

7. Witherby (IACS) General Cargo Ships, Guide lines for surveys Assessment and Repair fir Hull Structures
8. Witherby (IACS) Surveyors Guidence
   Bulk Carriers, Guide lines for Surveys, Assessment and Repair of Hull structurers,
   2nd edition.

9. Lashing and securing of deck cargoes, Nautical Institute
10. Millard Norman – Lloyds Survey handbook, The Nautical Mind- Toronto Canada