INDIAN MARITIME UNIVERSITY

(A CENTRAL UNIVERSITY UNDER MINISTRY OF SHIPPING, GOVT. OF INDIA)

SCHOOL OF NAUTICAL STUDIES

Offers

SYLLABUS

FOR

BACHELOR OF SCIENCE (B.Sc.)

(NAUTICAL SCIENCE)

REGULATIONS AND SYLLABUS

(4TH REVISION)

2018

(With effect from the Academic Year 2018-19)

The Curriculum for the Three Year ***"B.Sc. (Nautical Science)"*** *include the requirement of STCW Convention, as amended, of IMO and that of the Directorate General of Shipping, Government of India for competencies required for "Officer In-charge of a Navigational watch".*

FOREWORD

The syllabus for 3 year B.Sc.(Nautical Science) Degree course has been tailored to suit the present need of the Industry.

The syllabus is drawn up keeping the objective of providing Maritime Education and Training including competencies that one would require to progress in the career from a cadet to Master Mariner.

The syllabus contents have been drawn up keeping in mind the country's sound education system at the 10 +2 level which is the entry level qualification for this programme.

Continuous interaction with the Industry experts have impressed upon us to revise on the present B.Sc. (Nautical Science) syllabus.

Now, the syllabus has been revised in such a way to keep the total hours in semester reduced from 600 hrs to the band of 520-540 hrs. Also the English syllabus has been revised to the demand of time and industry. The Hon'ble Supreme court guidelines and UGC directives on subject of ''Environmental studies'' have been introduced with this revision. All the semester subjects have been re-structured.

A Nautical Science career in non - academic areas, demands a very high level of discipline and overall growth of an officer to take up a highly demanding job of a Navigating Officer aboard a modern merchant ship. In view of this, a highly integrated Education and training schedule is drawn up to provide for development of the extracurricular activities of an individual. This includes the necessary regimental training in uniform for disciplined education.

The Hon'ble Vice Chancellor, School board members of Nautical studies, the Department of Controller of Examinations, IMU HQ and faculty of IMU Campuses and affiliated colleges have offered valuable direction and key inputs during revision of the syllabus. Last but not the least is the immense contribution put in by staff of IMU-Navi Mumbai Campus for compiling this revised version..

Syllabus Revision Committee, 2018

B.Sc. (Nautical Science) Syllabus 2018 has been revised in July 2018. Syllabus revision Committee under Chairmanship of Capt. Mihir Chandra, Convener School Board of Nautical Studies was constituted with following members:

1. Capt. K.N. Iyer (Dean Nautical, Tolani Maritime Institute, TMI)
2. Capt. Sureen Narag (Principal, Anglo Eastern Maritime Academy, AEMA)
3. Capt. Parag Mehrotra (Assitant Professor, IMU- Navi Mumbai Campus)
4. Subject Faculty of IMU- Navi Mumbai Campus, TMI Pune, AEMA Karjat,

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PROGRAMME REGULATIONS

1. About the University:

The Indian Maritime University (IMU) was established through an Act of Parliament (No. 22 of 2008) on 14th November 2008. As a Central University, it is poised to play a key role in the development of required human resources for the maritime sector. The IMU, being the first of its kind in the country cater to the educational requirement of the maritime fraternity. IMU has a panel of dedicated and experienced faculty members, state of the art infrastructure and efficient administration. IMU's strength and uniqueness lie in its ability to integrate theories and practices and its commitment to provide quality maritime education, training and consultancy. The headquarters of IMU is located at Chennai and regional campuses are at Chennai, Mumbai, Kolkata, Visakhapatnam and Cochin.

2. B.Sc. (Nautical Science) by School of Nautical Studies

The Indian Maritime University offers B.Sc. (Nautical Science) programme. The duration of the B.Sc. (Nautical Science) programme is of three academic years, consisting of six semesters. The odd semester functions from **August to December** each year and the even semester from **January to May.** There shall be not less than 90 working days in each semester.

3. Entry Requirements:

For entry into B.Sc. (Nautical Science) programme, the eligibility criteria are as follows:

i) Minimum 60 % marks in Physics, Chemistry & Mathematics at 10+2 / Equivalent Examination.

ii) Minimum 50 % marks in English at 10 + 2 Exam.

iii) Minimum Age 17 years & maximum Age 25 years
Relaxation of five years in the maximum age limit and 5% relaxation in eligibility marks (will not applicable for English) for SC / ST candidates

4. Attendance:
(As per IMU Ordinance 17 of 2015-Circular 1701 dt 06-01-2017)

All students must put in a minimum of 85% of attendance in order to appear in the end-semester examinations (Theory and Practical) of the Indian Maritime University.The cut-off date for the calculation of attendance shall be the date 15 days prior to the date of commencement of the end-semester theory paper examinations.

If any amendments take place to the above Ordinance in future the same would be applicable.

5. Condonation Fee:
(As per IMU Ordinance 17 of 2015 Circular 1701 dt 06-01-2017)

If a student has put in less than 85% but above or equal to 75% of attendance, owing to reasons such as medical, bereavement or any other, the Campus Director/Principal is empowered to condone the shortage of attendance subject to the collection of the prescribed Condonation Fee for Attendance.

If any amendments take place to the above Ordinance in future the same would be applicable.

6. Break-in-Studies: (As per IMU Ordinance 17 of 2015)

There will be no Condonation of attendance below 75% under any circumstances whatsoever. A student who has put in less than 75% attendance will not be permitted to write the university's end-semester examination and will not be permitted to move to the next semester. It will be treated as a case of 'Break-in-Studies' and he will be required to repeat the incomplete semester in the next academic year. Before rejoining the Programme, he must pay (i) the Condonation Fee for Break in Studies as prescribed by the University, (ii) pay the Semester Fees for the concerned semester once again where he is repeating an incomplete semester, and (iii) obtain prior permission from the Vice Chancellor.

If any amendments take place to the above Ordinance in future the same would be applicable.

7. Procedure for awarding Internal Assessment (IA) Marks:

1. There will be no minimum pass mark for Internal Assessment for all programmes.
   a. The maximum marks for each theory paper will be 100 marks, out of which 30 marks will be for Internal Assessment and 70 marks for University Examination.

   b. The maximum marks for each practical paper will be 100 marks, out of which 50 marks will be for Internal Assessment and 50 marks for University Examination.

2. The above break-up will not apply to Project Work, Dissertation, Summer Internship and Shipboard Structured Training Programme (SSTP).

3. The component-wise breakup of the 'Internal Assessment' for the Theory papers is given:

S No	Component	Marks
1	Teachers Assessment which may include parameters such assignments/behavior in class, responses/attentiveness in class etc.	10
2	Class Tests - 2 per semester	20
	Total	30

4. The component-wise breakup of the 'Internal Assessment' for the Practical papers of UG and PG Programmes shall be as follows:

UG Programmes

S No	Component	Marks
1	Teachers Assessment which may include parameters such assignments/behavior in class, responses/attentiveness in class etc.	10
2	Lab work records	40
	Total	50

(a) Attendance: A cadet having attendance of 90 % and above shall be awarded full 5 marks. Attendance calculation shall be as per IMU Circular No 1701 dated 06.01.2017.

(b) Assignment (Homework): Two Assignments, in the form of Homework, for a maximum of 5 marks each shall be given. 1st Assignment in the 4th week and 2nd Assignment in the 8th week of the semester. Average mark of the two assignments shall be taken as the Assignment marks.

(c) Class Test: Two Tests of 45 minutes duration, for a maximum of 20 marks each, shall be conducted. 1st Class Test in the 6th week and 2nd Class Test in the 12th week of the semester. Average marks of the two tests shall be taken as the Class Test marks.

(d) Practical (Lab Work / Record Keeping): Every completed Practical (Lab Work / Record Keeping) shall be evaluated for a maximum of 15 marks. Average mark of all the prescribed experiments / exercises done during the entire semester shall be taken as Practical (Lab Work/ Record Keeping) marks.

Note: There shall be NO minimum pass mark for the Internal Assessment (IA) for Theory and Practical subjects.

(e) Circular 1749 dealing with " Internal Assessment of Practical and Theory papers for the various programmes conducted by IMU" is applicable for this section.

If any amendments take place to the above Ordinance in future the same would be applicable.

8. Procedure for awarding End Semester University Exam (UE) Marks :

a) Theory Papers: Examination of 3 hours duration shall be conducted and evaluated for a maximum of 70 marks.

b) Practical Papers: Examination of 3 hours duration shall be conducted and evaluated maximum of 30 marks.

Note: There shall be a common minimum pass mark 50% in the External (Theory and Practical) Examinations and 50 % overall.

Pass Mark percentage for all subjects shall be as per Circular No.1749 dated 06-03-2017

If any amendments take place to the above Ordinance in future the same would be applicable.

9. Evaluation of Answer Scripts

Answer scripts of the University examination will be subjected to two valuations by a Panel of Examiners constituted by a competent authority. Where there is variation of more than 15% of marks between the first and second valuation, the paper shall be sent for third valuation. The final marks shall be the "average of the third valuation and the nearest among the first and second valuation". However, Guidelines for valuation and 'Declaration of Results' framed by the competent authority from time to time will apply.

10. Arrear paper

A student with arrears can repeat the papers along with the subsequent semester examinations as and when the same can be conducted by IMU (Please refer IMU Circular No.1743). In such cases, the internal marks obtained by the student will be carried over for computation of total marks.

11. Classification of Marks

The classification of marks will be as follows:

- 75% of the marks and above in first attempt – **Distinction**
- 60% and above but below 75% -should have passed all the papers within the stipulated period of the programme - I **class**
- 50% and above but below 60% - **II class**
- Below 50 % - **Fail**

12. Consolidated Mark Statement

The consolidated marks statement indicating marks scored in all the subjects will be issued when the students pass all the subjects of the B.Sc. (Nautical Science) programme. The fee for consolidated marks statement is to be remitted along with the examination fee while registering for the VI semester examination.

13. Provisional Certificate

For those who are declared qualified for the B.Sc. (Nautical Science) programme, Provisional Degree certificate will be issued in person or sent by post after publication of the results. All the students have to pay the fee for the provisional certificate along with sixth semester examination fee.

14. Award of Degree

Students who have successfully completed the programme within the stipulated period will be awarded the degree of Bachelor of Science (Nautical Science). For those who are declared qualified for the Bachelor of Science (Nautical Science) degree, the convocation form will be issued. The degree certificate will be issued to the students only if they apply for the same in the prescribed convocation form, along with the fee specified in the application form. The degree will be conferred in person or in absentia as requested.

B.Sc. (Nautical Science) - Course Curriculum
SEMESTER – I

Code	Subjects	Internal Assessment (IA) Marks					End Sem University Theory / Practical Exam (UE) Marks	Pass Mark in End Sem University Theory / Practical Exam (UE)	Total Marks	Total Passing Marks	Total Contact hrs per week / sem
		Attendance > 90%	Assignment (Home Work)	Class Test	**Practical** (Lab Work / Record Keeping)	Total Marks					
UG21T4101	English	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/72**
UG21T4102	Nautical Mathematics	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/72**
UG21T4103	Nautical Physics	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/70**
UG21T4104	Computer Science	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/70**
UG21T4105	General Ship knowledge	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/60**
UG21T4106	Terrestrial Navigation	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/70**
UG21P4107	Nautical Physics (Practical)	5	-	-	15	20	30	15/30	**50**	**25/50**	**04/50**
UG21P4108	Computer Science (Practical)	5	-	-	15	20	30	15/30	**50**	**25/50**	**4/60**

B.Sc (Nautical Science) - Course Curriculum
SEMESTER – II

Code	Subjects	Internal Assessment (IA) Marks					End Sem University Theory / Practical Exam (UE) Marks	Pass Mark in End Sem University Theory / Practical Exam (UE)	Total Marks	Total Passing Marks	Total Contact hrs per week / sem
		Attendance > 90%	Assignment (Home Work)	Class Test	**Practical** (Lab Work / Record Keeping)	Total Marks					
UG21T4201	Applied Mathematics	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/70**
UG21T4202	Applied Physics & Electricity	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/70**
UG21T4203	Nautical Electronics	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/70**
UG21T4204	Ship Construction	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/70**
UG21T4205	Ship Operation Technology	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/60**
UG21T4206	Chart Work & Collision Prevention Regulations	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/70**
UG21P4207	Applied Physics & Electricity (Practical	5	-	-	15	20	30	15/30	**50**	**25/50**	**04/45**
UG21P4208	Nautical Electronics (Practical)	5	-	-	15	20	30	15/30	**50**	**25/50**	**04/45**
UG21P4209	English Communication Lab	5	-	-	15	20	30	15/30	**50**	**25/50**	**04/30**

B.Sc (Nautical Science) - Course Curriculum
SEMESTER – III

Code	Subjects	Internal Assessment (IA) Marks					End Sem University Theory / Practical Exam (UE) Marks	Pass Mark in End Sem University Theory / Practical Exam (UE)	Total Marks	Total Passing Marks	Total Contact hrs per week / sem
		Attendance > 90%	Assignment (Home Work)	Class Test	**Practical** (Lab Work / Record Keeping)	Total Marks					
UG21T4301	Celestial Navigation Paper -I	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/60**
UG21T4302	Ship Stability Paper - I	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/60**
UG21T4303	Marine Engineering, Automation & Control Systems Paper –I	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/70**
UG21T4304	Environmental Studies	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/80**
UG21T4305	Cargo Handling & Stowage Paper –I	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/64**
UG21T4306	Bridge Equipment & Watch keeping Paper -I	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/70**
UG21P4307	Seamanship Lab - I (Practical)	5	-	-	15	20	30	15/30	**50**	**25/50**	**04/60**
UG21P4308	Marine Engineering Workshop - I (Practical)	5	-	-	15	20	30	15/30	**50**	**25/50**	**04/60**

B.Sc (Nautical Science) - Course Curriculum
SEMESTER – IV

Code	Subjects	Internal Assessment (IA) Marks					End Sem University Theory / Practical Exam (UE) Marks	Pass Mark in End Sem University Theory / Practical Exam (UE)	Total Marks	Total Passing Marks	Total Contact hrs per week / sem
		Attendance > 90%	Assignment (Home Work)	Class Test	**Practical (**Lab Work / Record Keeping)	Total Marks					
UG21T4401	Celestial Navigation Paper - II	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/70**
UG21T4402	Ship Stability Paper – II	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/60**
UG21T4403	Cargo Handling & Stowage Paper –II	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/64**
UG21T4404	Life Saving & Fire Fighting Appliances	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/60**
UG21T4405	Marine Engineering, Automation & Control Systems Paper -II	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/70**
UG21T4406	Meteorology	5	5	20	-	30	70	35/70	**100**	**50/100**	**05/80**
UG21P4407	Seamanship Lab - II (Practical)	5	-	-	15	20	30	15/30	**50**	**25/50**	**04/60**
UG21P4408	Marine Engineering Workshop - II (Practical)	5	-	-	15	20	30	15/30	**50**	**25/50**	**04/60**

B.Sc (Nautical Science) - Course Curriculum
SEMESTER – V

Code	Subjects	Internal Assessment (IA) Marks					End Sem University Theory / Practical Exam (UE) Marks	Pass Mark in End Sem University Theory / Practical Exam (UE)	Total Marks	Total Passing Marks	Total Contact hrs per week / sem
		Attendance > 90%	Assignment (Home Work)	Class Test	**Practical (**Lab Work / Record Keeping)	Total Marks					
UG21T4501	Coastal Navigation & Collision Prevention Regulations	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/80**
UG21T4502	Naval Architecture Paper – I	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/80**
UG21T4503	Ship Maintenance & Emergencies	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/74**
UG21T4504	Specialised Cargo Handling & Stowage	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/80**
UG21T4505	Shipping Management	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/70**
UG21T4506	Bridge Equipment & Watchkeeping Paper -II	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/80**
UG21P4507	Ship Operation Technology Lab (Practical)	5	-	-	15	20	30	15/30	**50**	**25/50**	**04/60**

B.Sc (Nautical Science) - Course Curriculum
SEMESTER – VI

Code	Subjects	Internal Assessment (IA) Marks					End Sem University Theory / Practical Exam (UE) Marks	Pass Mark in End Sem University Theory / Practical Exam (UE)	Total Marks	Total Passing Marks	Total Contact hrs per week / sem
		Attendance > 90%	Assignment (Home Work)	Class Test	**Practical** (Lab Work / Record Keeping)	Total Marks					
UG21T4601	Voyage Planning & ECDIS	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/90**
UG21T4602	Naval Architecture Paper –II	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/80**
UG21T4603	Ship Manoeuvring & Collision Prevention Regulations	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/75**
UG21T4604	IMO & International Conventions	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/60**
UG21T4605	Human Resource Management, Development & Leadership	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/80**
UG21T4606	Marine Environmental Protection	5	5	20	-	30	70	35/70	**100**	**50/100**	**06/75**
UG21P4607	Navigation Lab (Practical)	5	-	-	15	20	30	15/30	**50**	**25/50**	**04/64**

B.Sc. NAUTICAL SCIENCE

	SEMESER I	Hours
UG21T4101	English	72
UG21T4102	Nautical Mathematics	72
UG21T4103	Nautical Physics	70
UG21T4104	Computer Science	70
UG21T4105	General Ship knowledge	60
UG21T4106	Terrestrial Navigation	70
UG21P4107	Nautical Physics (Practical)	50
UG21P4108	Computer Science (Practical)	60
	TOTAL	524

INDIAN MARITIME UNIVERSITY
SEMESTER – I

UG 21T4101 **ENGLISH** **72 Hrs**

1	**Introduction:**	10 Hrs
	1.1 Communication: Concept, Process, Forms, Style, Importance of effective communication on-board ship 1.2 Difference between General and Technical Communication 1.3 Barriers to communication and ways to overcome the barriers 1.4 Means/Modes of communication on board ship.	
2.	**Introduction to SMCP and English Language among Multilingual Crew:**	10 Hrs
	2.1 Maritime English: Objectives, Definition, SMCP vs General English. 2.2 **Introduction to phonetics basic level (w.r.t "Sea Speak" Training Manual)** Demonstrate an understanding of the relevance of STCW English requirements to all seafarers; broaden knowledge of industry-specific vocabulary. 2.3 **Standard Marine Communication Phrases (SMCP):** Procedure, Spelling, Message Markers, Responses, Distress/Urgency/ Safety Signals, Corrections, Readiness, Repetition, Numbers, Positions, Bearings, Courses, Distances, Speed, Time, Geographical Names, Ambiguous Words etc.	
3.	**Reading Comprehension:**	20 hrs
	3.1 Reading Process, Subskills of Reading, Reading Techniques, Note Making Techniques, Summarizing and Paraphrasing. 3.2 Comprehension passages – prose and short stories 3.2.1 The Refugee – K.A. Abbas 3.2.2 Happiness 101 – GeetaPadmanabhan 3.2.3. The Google guys 3.2.4.The Postmaster – Rabindranath Tagore 3.2.5. A Garden So rich – Christie Craig 3.2.6. The Umbrella Man – Roald Dahl	
4.	**Writing Skills:**	20 Hrs

	4.1 Writing Process (identify, organize and list the points/ideas related to a given topic in a proper logical sequence and write a rough draft and final draft), Sentence Structure, Sentence Coherence, Paragraph Writing. 4.2 Letter Writing: Types, Parts, Style and Tone, Requisition Letter, Grievance Letter, Various applications writing, Resume writing. 4.3 Email Writing. 4.4 Factual Reports (Informative): Types of Reports (Routine/Special), Incident Report, Accident Report, Visit Report, Feedback. 4.5 Log book writing & Diary writing. 4.6 Formal (Interpretive) report writing. 4.7 Safety circulars, various notices, agenda and minutes of the meetings. 4.8 Essay writing on contemporary topics.	
5	**Integrated Grammar:**	12 Hrs

Text Books:

1. IMO (2003) IMO standard Marine Communication Phrases (SMCP) London: International Maritime Organisation.

REFERENCE BOOKS:

1. "Sea-speak" Training Manual for Maritime Communication/Maritime English, Essential English for International maritime use: Pargamon press UK.
2. Spring.
3. PANORAMA.
4. Effective Technical communication for M. Ashraf Rizvi.

INDIAN MARITIME UNIVERSITY
SEMESTER I

UG21 T4102 **NAUTICAL MATHEMATICS** **72Hrs**

1	**Integral calculus and Beta & Gamma Functions:**	20hrs
	Multiple Integrals-Double integration-definition, Evaluation of Double Integrals, Change of order of integration, Evaluation of double integrals by changing the order of integration and changing to polar form. Triple integration-definition and evaluation (Cartesian, cylindrical and spherical polar coordinates). Application of double integrals to compute Area, Mass, Volume. Application of triple integral to compute volume. Beta & gamma functions & their properties (without proof), Relation between Beta & Gamma functions, Duplication formula (with proof).	
2	**Spherical Trigonometry:**	15hrs
	Properties of a spherical triangle and oblique spherical triangle. Cosine formula, Haversine formula, Sine formula and Four Part Formula and their application to navigational problems. Polar triangle and application of their properties. Right angle and quadrantal triangles. Napier's Rules and their application to navigational problems. Supplemental Theorem, Identities of moderate difficulty.	
3	**Complex numbers:**	15 hrs
	Definition, Cartesian, Polar & Exponential form of complex number. De-Moivre's Theorem (without proof). Powers & Roots of Exponential and Trigonometric functions. Hyperbolic and Logarithmic functions. Inverse Hyperbolic & Inverse Trigonometric functions. Separation into real & imaginary parts of all types of functions. Expansion of $\sin^n\Theta$, $\cos^n\Theta$ in terms of sines and cosines of multiples of Θ and expansion of $\sin n\Theta$, $\cos n\Theta$ in powers of $\sin\Theta$, $\cos\Theta$.	
4	**Differential calculus:**	22 hrs
	Successive differentiation: Standard form to find the nth derivative. Leibnitz's theorem (without proof) & problems, Rolle's theorem (without proof), Lagrange's& Cauchy's mean value Theorem (without proof). Taylor's theorem, Taylor's and Maclaurin's series (without proof). Expansion of e^x ,sinx, cosx, tanx, sinhx, coshx, tanhx, log(1+x), $\sin^{-1} x$, $\cos^{-1} x$,Binomial series. Indeterminate forms. L'Hospital rules. Partial derivatives of first and higher Orders. Total differentials, differentiation of composite & implicit functions. Euler's theorem on homogeneous functions with two and three independent variables (with proof). Deductions from	

	Euler's theorem. Errors & Approximations. Maxima & Minima of the functions of two variables.	

RECOMMENDED BOOKS FOR REFERENCE:

1. An introduction to Spherical Trignometry - Clough-Smith J.H

2. Spherical Trignometry - Capt. H. Subramaniam

3. Higher Engineering Mathematics - Dr. Grewal, B.S

4. A Text book of applied mathematics Vol.I - Wartikar, P.N. &Wartikar,J.N

5. Further Engineering Mathematics – K.A.Stroud

6. Advanced Engineering Mathematics – Dr. A.B. Mathur&Prof. V.P. Jaggi

INDIAN MARITIME UNIVERSITY
SEMESTER - I

UG 21 T4103 **NAUTICAL PHYSICS** **70Hrs**

1	**Heat and Thermodynamics:**	13 hrs
	Heat Transfer Mechanism: Conduction, Convection and Radiation, Expansion of solids, liquidsand gases, application to liquid cargoes,heat capacity, specificheat capacity,sensible heat, latent heat. First andSecond law of Thermodynamics, Carnot cycle, Heat engine and refrigerator,Concept of Entropy, Steamchart and Mollier diagramHygrometry, Relative and absolute humidity, Vapour pressure, S.V.P., Dew Point, Effect on weather-Frost, Mist, Haze Cloud Formations, Rain, Snow and Hail, Hygrometer-wet, dry and hair.	
2	**Light:**	15 hrs
	Propagation of light, Shadows, Eclipses, Reflection of light at plane and curved surfaces, Rotation of a plane mirror, Sextant. Refraction, Total internal reflection and its applications, refraction through a prism, Azimuth mirror, Periscope. Lenses, Image formation, Telescope, prism Binocular. Diffraction due to a single slit and a circular aperture, Limit of resolution, Intensity of light, Chromaticity of light,Interference - Coherent beams, Lasers,He-Ne laser, optical fiber and its application. Explain why Wheelhouse windows are required to be inclined	
3	**Sound:**	08hrs
	Longitudinal and Transverse Waves, Velocity of sound, Effect of pressure, temperature, salinity and humidity on velocity of sound in air and water, Pitch, Quality & Loudness, Decibel. Doppler effect and its application. Interference of two travelling Waves – Beats, Phase comparison – use in Decca and Loran. Principle of Echo sounder, Refraction of sound waves.	
4	**Mechanics and Hydromechanics:**	18 hrs
	Relative velocity, Momentum, Impulse, collision-direct/oblique impact, circular motion,Centre of mass and Centre of gravity, Moment of Inertia, Fly wheel, angular momentum, torque, conservation of angular momentum, concept of gyroscope. Newton's Law of Gravitation, Machines, Mechanical Advantage, velocity ratio, Efficiency. Pulley-Differential wheel and axle pulley, Weston differential pulley and Gears. Explain and apply Triangle and Parallelogram of forces Explain basic concepts of S.H.M. and its features, typical examples such as a pendulum Explain resonance with relation to critical revolutions of machinery and rolling Pascal law and its applications, Total pressure on immersed surfaces, Law of	

	Floatation, Archimedes principle and buoyancy, Flow in pipe lines, streamline and turbulence flow, Bernoulli's theorem and its applications.	
5	**Properties of Matter:**	8hrs
	Atmospheric Pressure, Barometer, venturimeter, Elasticity, Modulus of elasticity, Hooke's Law, Cantilever, Bending of Beams, Shearing force, Rigidity, Surface tension, Capillarity, Angle of contact, Excess pressure inside a bubble, Air bubbles in oil tank, Viscosity and viscous flow, Reynolds number.	
6	**Earth and Ship Magnetism:**	08 hrs
	Earth as a magnet, Magnetic elements and their variation, Angle of dip, soft and hard magnetic material, Ship magnetism and its components, Effect of motion of ship and latitude on the compass, magnetic compass and gyrocompass.	

Recommended Books For Reference:

1. Advanced level physics: Nelkon& Parker
2. Applied physics: JH Clough-Smith
3. University physics: Young, Sears &Zemnasky
4. Text book of Engineering Mechanics: R.S.khurmi
5. Heat & Thermodynamics: Brijal&R.Subramaniam
6. Principles of Physics: Fredrick.J.Bueche
7. Advanced Practical Physics – Worsnop and Flint

INDIAN MARITIME UNIVERSITY
SEMESTER – I

UG 21 T4104	COMPUTER SCIENCE	70Hrs

1	**Introduction to MS Office:**	21hrs
	• MS Word: Create and save documentation. Open, find, and rename files and folders. Use "Print" commands. Use "Paragraph" options, "Bullets" and "Numbering" Use "Formatting Toolbar". Use spelling and grammar checks in the document. Use "Headers and Footers". Insert symbols and pictures. Create tables in MS-Word. Use formulas in MS –WORD Mail merge, Embedding Excel to WORD • MS Excel: Create workbooks, working with rows, columns, cells and Worksheets. Insert pictures and graphics. Format cells. Use conditional formatting on data in cells, Perform Basic Calculations – Add, Subtract, Multiply, Divide, Calculate averages, Find the maximum value. Advanced Calculations – Create formulas, employ the function wizard, Add comments, Create charts • MS Power Point: Create a presentation: Create a slide, Add new slides, Insert pictures, Format text, Format pictures, and Preview a presentation. Insert tables and charts, Employ design templates, Employ a master slide, and rearrange slides. Animate text, animate graphics, Create slide transitions, Advance slides automatically, Preparing Live Presentations, Make presentations portable. • MS Access: Working with Database Objects: Tour of a Table Adding, Editing and Deleting Records, Tour of a Form, Tour of a Query, Tour of a Report, Previewing and Printing a Database. Object Selecting Data Cutting, Copying and Pasting, Data Creating a Query, Sorting a Query Using AND and OR Operators in a Query, Creating a Form with the Form Wizard, Creating a Report with the Report Wizard.	
2	**Computer Arithmetic:**	16hrs
	Binary, octal, decimal& hexadecimal number Systems & mutual conversion: addition, Subtraction, Multiplication, Division, 1's & 2's complement method of subtraction in binary only.Bineary codes: BCD numbers, Excess – 3 code, ASCII code, EBCBIC code Gray code. **Memory** Main Memory, Secondary Memory, Backup Memory, Cache Memory, Real and Virtual Memory. System Software and Programming Techniques: Machine language, Assembly language, Low level and High level Languages, Compiler, Assembler, and Interpreter.	
3	**E – Commerce:**	13hrs

	Introduction, IT and business, E-commerce: ConceptsElectronic Communication, Internet and intranets. EDI to E-commerce. Concerns for E-commerce Growth, Technical issues, Security issues. Security Technologies: Cryptography, Public Key Algorithms, Private Key Algorithms, Hashing techniques, Cryptographic Applications, Encryption, Digital Signature Protocols for Transactions. SSL-Secure Socket Layer, SET-Secure Electronic Transaction. Cyber Cash, Dig cash.	
4	**Computer Programming Language:**	20 hrs
	History of C Language, Structure of a C program, Statements, Basic Data Types, Variables & Constants, Input & Output statements, Operators and Precedence, Expressions, Simple C programs. **Control Statements** Branching Structures : if.. else Multiple Branching Structures : switch .. case Repetitive Structures : for loop, while loop, do..while loop Jump Statements : break, continue and goto. **Arrays And Pointers** One & two dimensional arrays, strings, manipulation of arrays Introduction to Pointer. Declaring pointer variable, initialization of pointer variable, accessing address of variable, pointer expressions. **Functions** Introduction, modular approach of programming,creating user defined functions with and without parameters, Parameter passing mechanism and returning va lues from functions. **Structures** Defining structure, declaring and accessing structure members, initialization of structure. Advantages of using structures.	

Recommended Books For Reference:

1. Practical Microsoft office 2007: June JamrichParsons,DanOja,Donna Mulder, Course Technology
2. Information Technology for management: Henry Lucas, Tata Mc-Graw Hills
3. Computer Fundamentals Architecture and Organization: B.Ram ,New Age International Publisher
4. Microsoft Access 2007 Step by Step: Steve Lambert, Microsoft Press
5. Programming in 'C' by Balgurusamy, 3rd edition Tata Mc-Graw Hill
6. Let us 'C' by Kanitkar, 3rd edition BPB publication
7. Complete reference 'C' by Herbert Shildt, 4th edition Tata Mc-Graw Hill
8. The Complete E-Commerce Book:Design, Build, and Maintain a Successful Web-Based Business: Janice Reynolds

INDIAN MARITIME UNIVERSITY

SEMESTER– I

UG21 T4105	GENERAL SHIP KNOWLEDGE	60 Hrs

Objective: To familiarizethe studentswith generallayout of a ship.

1	**Introduction:**	3hrs
	Development of ocean-goingMerchant Ships andModernmerchant ships.	
2	**Types ofShips:**	9hrs
	Typesofshipsbasedonnatureofcargo.Passengerliners,Ferries,Specialisedcarriers, General Cargo,Bulk Carrier, Container,Car Carrier,Ro-Ro,Crude Oil Tanker, Product Tanker,LPG, LNG, Lash, Passenger Ship and Cattle Carrier.	
3	**Definitions and Meanings:**	4hrs
	LengthOverAll.LengthBetweenPerpendiculars,BreadthExtreme,BreadthMoulded,Depth of vessel, Draft, Freeboard, Camber of Deck, Sheer of Deck, Rake of Stem, Rise of floor, Air Draft, Flare of Bows. Parallel Middle Body, Entrance, Run, Forward Perpendicular, After Perpendicular, Amidships, Base Line, Tumblehome, Bilge Radius	
4	**Loadline and Draught Markings:**	2hrs
	DeckLine,Plimsoll line and various other load line markings- T,S,W,TF,F&WNA.	
5	**Principal Parts of Ship:**	14hrs
	Bow,Stern,Shellplating,DoubleBottomTanks,CargoHolds,TweenDecks, Deeptanks,Fore-peak and After Peak storeroom sand tanks, Plate Keels and Duct Keels. Forecastle deck,Quarter Deck, Main/ Weather decks, Hatchcovers, Cargo Gear, anchoring and mooring equipment, Mast House.	
6	**MachinerySpaces:**	4hrs
	Layoutof EngineRoom: EngineCasing,sub-division of EngineRoom,Steering Gear, Pumprooms, Workshops, etc.	
7	**Superstructure:**	2hrs
	WheelHouse,accommodationspaces,cabins,galley,pantry,diningsaloons,recreationrooms,variousstores and lockers, cold storage spaces,etc.	

8	**General Layout, MidshipSection&Profile View:**	8hrs
	General Cargo Ship, Bulk Carrier,Oil Tanker and Container Ship.Passenger Ship, Ro-Ro Ship, Chemical Tanker, GasTanker, Combination Carrier	
9	**ShellandDeckPlating:**	2hrs
	To understand shell plating, Numbering system of hull and deck Plating,Shell expansion plan, Sheer strake,garboard strake, Stealer Numbering of frames, frame spacing.	
10	**Bilge keels, Double bottom Tank, Peak tanks, Wing tanks and Bilges:**	5hrs
	Purpose of Bilge Keel, Double BottomTank,Peak tanks,Wing tanks and Bilges.	
11	**Sounding pipes, Air Pipes and Ventilators –**Purpose of Sounding pipes, Air Pipes,Ventilators.	2hrs
12	**Geographical Features affecting Shipping–**Climate, tides, wind, current, areas of bad weather, Time zone, International Dateline, Sea water density, Load line zones	5hrs

RECOMMENDEDBOOKSFORREFERENCE:

1. Ship construction notes - Kemp & Young
2. Ship Construction for Engineers- Reid
3. Ship construction– Pursey
4. Ship construction-D JEyres

INDIAN MARITIME UNIVERSITY
SEMESTER I

UG 21 T4106	**TERRESTRIAL NAVIGATION**	70 Hrs

1	**Earth:**	5 hrs
	Shape of Earth; Earth's axis, earth's poles, equator, meridians, latitude and parallels of latitude, prime meridian and longitude, difference of latitude (D'lat) and difference of longitude (D'long); Position by latitude and longitude; Great Circle, small circle; Spherical triangle; Nautical mile, Geographical mile; Statute mile, comparison of nautical mile with kilometre, 'cable' and explanation of 'knot' as a unit of speed; Effect of polar compression on nautical mile.	
2	**Compass Corrections:**	12 hrs
	True, magnetic and compass north; Compass corrections: Deviation, Variation and compass error; Boxing of Compass; Procedure to obtain variation from data given on the compass rose; Transit bearings, Compass error by transit bearings; Annual rate of change of Magnetic variation; Isogonals and Agonic lines; Deviation card; Compass course, Magnetic course, True course- conversion of one to another; Gyro Error; Conversion of gyro course to true course and vice versa and related calculations; Comparison of Gyro and Magnetic compass – use gyro error to calculate magnetic compass error; Precautions to be observed while taking compass bearings. Calculation based on above theory.	
3	**Parallel and Plane Sailing:**	14 hrs
	Departure and its relationship with Difference of Latitude and Distance; Relationship between Departure and D'long; Calculations based on this formula:- speed on earth at various latitudes, ships sailing at distances apart. True course and rhumb line; Plane and Parallel sailing formulae; Distances between two positions; Mean latitude; Middle latitude; Use of Traverse tables; and related calculations. Calculation based on above theory.	
4	**Mercator Sailing:**	10 hrs

	Mercator Chart; Mercator Projections; Meridional parts; DMP; Latitude and longitudinal scales and conversion of one to the other; Relationship between Course, D'long and DMP; Measurement of distance between two positions on a Mercator chart; Mercator sailing formula and related calculations; Calculation based on above theory. Construction Mercator chart, Natural scale.	
5	**Day's Work:**	12 hrs
	Exercise on Days Work with current and leeway The use of Traverse Table to obtain the position of the ship at any time, given compass course, variation, deviation, and the run recorded by the log or estimated speed or engine speed allowing for the effect of wind and current; Day's work Calculations	
6	**Great Circle and Composite G.C. Sailing:**	12 hrs
	Principle of gnomonic projection; Use of gnomonic chart for planning great circle; Obtaining initial and final course and find the position of vertex and the position of intermediate points on the Great Circle track;; Calculating the great circle distances; and related calculations. Calculations based on Composite Great Circle Sailing	
7	**Maritime Geography:**	5 hrs
	Locate ocean, continents, seas, canals, straits, navigable rivers, major ports of the world and major ocean routes.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Principles of Navigation by Capt. S.S.S Rewari& Capt. T.K.Joseph
2. Principal of Navigation by Capt. P.M. Sarma
3. The Admiralty Manual of Navigation: Principles of Navigation: Vol. 1- Nautical Institute
4. NAV Basics: The Earth, the sailings, Tides & Passage Planning Vol.1- Witherby Seamanship International Ltd.
5. Nicholls's Concise Guide to the Navigation Examinations Vol. 2- Edward J Coolen
6. Oxford School Atlas

INDIAN MARITIME UNIVERSITY

SEMESTER – I

UG 21 P4107	**NAUTICAL PHYSICS, PRACTICAL**	**Total 50 Hrs** **(10 X 4 hrs practical)** **(Assessment 10 Hrs)**

1. Determination of Y : single cantilever loaded at one end.
2. Surface tension of a liquid by capillary rise method.
3. Moment of inertia of a flywheel and frictional torque.
4. Determination of wavelength of laser by diffraction method. MJU
5. Determination of mechanical advantage, velocity ratio and efficiency of a Weston differential pulley.
6. Determine the velocity of sound in air using a CRO. MJU
7. Verification of Stefan's law of Radiation using a filament lamp.
8. Determination of angle of repose of grains and friction.MJU
9. Determine various magnetic elements using a dip circle.MJU
10. Determine focal length of a combination of lenses.MJU

INDIAN MARITIME UNIVERSITY

SEMESTER –I

UG 21 P4108	COMPUTER SCIENCE, PRACTICAL	60 Hrs

Objective: To impart hands-on training to students on computers.

List of Practical

1	**MS WORD** 10 hours
	• Moving through a Word document menu bar and drop down menus toolbars • Paragraph formatting • Page formatting :Page margins, Page size, and orientation • Page breaks, Headers and footers • Introducing tables and columns and use the formula in it. • Printing within Word Print setup Printing options Print preview • Development of application using mail merge • Mail merging addresses for envelopes • Printing an addressed envelope and letter
2	**MS-EXCEL** 10 hours
	• Creating and opening workbooks • Navigating in the worksheet • Selecting items within Excel • Inserting and deleting cells, rows and column • Moving between worksheets, saving worksheet, workbook • Formatting and customizing data, Formulas, functions and named ranges • Creating, manipulating & changing the chart type • Printing, Page setup, Margins • Sheet printing options, Printing a worksheet
3	**MS POWERPOINT** 10 hours
	• Preparing presentations with Microsoft Power Point. • Slides and presentations, Opening an existing presentation , Saving a presentation • Presentation titles, footers and slide number • Creating a simple text slide • Selecting a slide layout • Pictures and backgrounds drawing toolbar • AutoShapes • Using clipart • The format painter • Creating and running a slide show • Navigating through a slide show • Slide show transitions • Animation effects

4	**MS ACCESS**	10 hours
	• Create a **new database** • Maintain the relationship between two tables. • Create a Query • Create a form using the Form Wizard. • Create a Form with all fields on the Table. • Create a Report based on the Table • Create a report using the Report Wizard**.**	
5	**'C' Programming**	20 hours
	• To understand various types of control statements (if, if-else, nested if-else, for, do-while with sample example for each type) • To understand single dimensional & two dimensional integer arrays in 'C'. • To understand string functions in 'C', writing program for string comparison. • To understand pointers in 'C', by writing program to print values of variables and their addresses and call by reference. • To understand array of pointers in 'C'.	

B.Sc. NAUTICAL SCIENCE

	SEMESTER II	Hours
UG21T4201	Applied Mathematics	70
UG21T4202	Applied Physics & Electricity	70
UG21T4203	Nautical Electronics	70
UG21T4204	Ship Construction	70
UG21T4205	Ship Operation Technology	60
UG21T4206	Chart Work & Collision Prevention Regulations	70
UG21P4207	Applied Physics & Electricity (Practical)	45
UG21P4208	Nautical Electronics (Practical)	45
UG21P4209	English Communication Lab	30
	TOTAL	530

INDIAN MARITIME UNIVERSITY
SEMESTER II

UG 21 T4201	APPLIED MATHEMATICS	70 Hrs

1	**Vector Calculus:**	15 hrs
	Scalar and Vector Product of three and four vectors and their properties, Differentiation of vectors, Curves in space, SerretFrenet Formula (without proof), Scalar and Vector point functions- Vector differential operator ∇ ,Gradient of a scalar point function, Divergence and Curl of Vector point function, $\nabla(uv), \nabla.(\phi\bar{u})$, $\nabla X(\phi\bar{u})$, $\nabla X(\bar{u}X\bar{v})$. Line integral, Work Done. Surface integral, Green's theorem in the plane,Stoke's theorem, Volume Integral, Gauss Divergence Theorem.	
2	**Differential Equations:**	15 hrs
	First order & first degree exact differential equation and those which can be made exact by use of integrating factor. (i)Linear differential equations and equations reducible to linear (Bernoulli) equations, (ii) Method of substitution to reduce the equation to one of the above Forms. Linear Differential Equation of the nth order with constant coefficients. Complementary function, particular Integral of differential equation of the type f(D)y=X where X is e^{ax} , x^n, $e^{ax}V(x)$, Sin(ax + b), Cos (ax+b). Cauchy's linear homogeneous equation. Legendre's Linear equation. Variation of parameters method and method of undetermined coefficients.	
3	**Partial Differential Equations:**	15 hrs
	Introduction, Formation of partial differential equations. Solutions of partial differential equations. Equations solvable by direct integration. Linear equations of the first order. Non-linear equations of the first order. Charpit's Method, Homogeneous linear equations with constant coefficients. Rules for finding the complementary function and particular integral. Working procedure to solve homogeneous linear equations of any order. Non-homogeneous linear equations. Non-linear equations of the second order-Monge's method. One dimensional heat flow equation.	
4	**Numerical Methods:**	15 hrs
	Solutions of transcendental & algebraic equations: Newton -Raphson method, bisection Method, Method of False Position, (or Regular Falsi Method); Deductions from the Newton –Raphson formula. Finite differences of first and higher order, forward, backward, central,and divided differences, difference tables, Taylor's operator – D, shift operator E, averaging operator, Differences of polynomials. Interpolation: linear and quadratic interpolation, Newton's forward and backward difference interpolation formulas,	

	Langrangian interpolation, Sterling and Bessel's Interpolation formulas. Numerical integration: Trapezoidal rule, Simpson's rules. Solutions to systems of linear algebraic equations: Direct Methods: Gauss elimination, Gauss-Jordan method, Iterative Methods: Gauss-Seidal iteration, Jacobi iteration.	
5	**Laplace Transforms:**	10 hrs
	Function of bounded variation (statement only). Laplace transforms of 1, t^n, e^{at}, Sin(at), Cos(at),Cosh(at),Sinh(at).Linearity property, shifting properties. Expressions (with proofs) for: $(i)L\{t^n f(t)\}$ $(ii)L\left\{\frac{f(t)}{t}\right\}$ iii $L\left\{\int_0^t f(u)du\right\}$ $(iv)L\left\{\frac{d^n}{dt^n} f(t)\right\}$ Unit step functions, Heaviside, Dirac functions, and their Laplace transform. Laplace transform of periodic functions. Evaluation of inverse Laplace transforms using theorems & partial fraction methods, Heaviside development, convolution theorem (without proof). Application of Laplace transforms to solve initial and boundary value problems involving linear differential equations with constant coefficients. Simultaneous linear equations with constant coefficients.	

RECOMMEDNDED BOOKS FOR REFERENCE:

1. Higher Engineering Mathematics – Dr. B. S. Grewal, Khanna Publications
2. A Text Book Of Applied Mathematics Vol. II – P. N. Wartikar& J.N. Wartikar
3. Vector calculus – Shanti Narayan
4. Further Engineering Mathematics – K. A. Stroud
5. Advanced Engineering Mathematics – Dr. A.B. Mathur& Prof. V.P. Jaggi
6. Finite difference & Numerical Analysis – H.C. Saxena

INDIAN MARITIME UNIVERSITY
SEMESTER – II

UG 21 T4202	APPLIED PHYSICS& ELECTRICITY	70 Hrs

1	**Electromagnetic Induction:**	08hrs
	Relation between magnetism and electricity, Production of Electro-magnetic induction and current. Faraday-Lenz's Law, Self and Mutual inductance and their coefficients, coupling coefficients	
2	**A.C. Circuits:**	08hrs
	AC and DC voltage ,Resistances and capacitors in series and parallel, impedance, static electricity precaution and earthling insulators, electrostatic charge by petroleum and precaution. A.C. Fundamentals, Series and Parallel RLC circuits, Resonance frequency, Power, Power factor, Q factor and Applied Numerical.	
3	**Electrical Bridge Circuits:**	15 hrs
	Bridge circuits,Wheatstone Bridge, Maxwell Inductance and Capacitance Bridges, De Sauty Bridge, Schering Bridge, Hay's Bridge, Definition of Q of coil, Applied Problems.	
4	**Network Theorems and its applications:**	12hrs
	Kirchoff's Law, Classification of Network elements, Constant Voltage and Current Source, Nodal Analysis, Thevenin'sTheorem, Maxwell Theorem, Superposition Theorem, Norton's Theorem, Millman' Theorem, Maximum power transfer Theorem,Applied Numericals.	
5	**Generators and Motors:**	15 hrs
	Principle and working of AC generator, AC motor, induction motor ,DC generator ,DC motor, R.M.S. value, series and shunt type DC motor, heating effect of current, heaters, fuses, thermoelectric effect.	
6	**Instrumentation:**	12hrs
	Calibration, Accuracy, Precision , Methods of measurement of temperature, pressure, Fluid flow, venturitube , sound level meter, thermister and its application as heat sensors, transducers.	

Recommended Books For Reference:

1. Electricity and magnetism: Brijlal & Subramaniam
2. Fundamentals of physics: Nelkon
3. Applied physics: JH Clough- Smith
4. Text book of Electrical Engineering:B.L.Thereja
5. Instrumentation: measurement and Analysis – Nakra and Chaudhary.
6. Instrumentation: Devices and system – Rangan, Mani, Sharma

INDIAN MARITIME UNIVERSITY
SEMESTER– II

Course Code	Course Title	Hours
UG 21 T4203	**NAUTICAL ELECTRONICS**	**70 Hrs**

1	**Semiconductors and Diodes:**	**8 hrs**
	Types of Semiconductors, p-n junction diodes – their characteristics, half-wave and full wave bridge rectifiers, Ripple, Capacitor filter, Zener Diode, its use as a voltage regulator, clipper, clamper, LDR and LED, Photo Electric Cell, Applied numericals.	
2	**Transistors:**	**9 hrs**
	Bipolar-junction transistor, its characteristics and configurations, Transistor biasing, Current gain α *and* β of a transistor, their relationship. Transistor as a switch. A.C and D.C load lines, Operating point, Emitter bias, Base bias, voltage divider bias, Bias Stabilization, Applied Numerical.	
3	**Amplifiers:**	**9 hrs**
	CE amplifier, D.C and A.C equivalent circuit of CE amplifier, Frequency response. Cascading stages of amplifier, transistorised power amplifier, Negative and positive feedback amplifiers, Classification of amplifiers, Class A, B and C, RC coupled amplifiers, Push pull principle, Push pull power amplifier, Class-B push pull amplifier.	
4	**Oscillators and Multivibrators:**	**9 hrs**
	Basic principle of LC tank circuit. Barkhausen's criteria for oscillations, Voltage and current feedback, Different types of LC, RC and Crystal Oscillators, phase shift oscillators, transistor Wein bridge oscillator, LC oscillators-Hartley and Colpitts oscillators. IC 555 Timer: Types-Astable, Monostable&Bistable Timer and its applications. Applied Numericals.	
5	**Digital Electronics:**	**10 hrs**
	Basic logic gates such as OR and NOR gates using DTL and TTL circuits. NAND gates, NOR gates and XOR logic gates, Development of logic circuits, Universal logic gate, Boolean algebra, De-Morgan's theorem, Simplification of logic equation using Boolean theorems, Half adder, Full adder, Multiplexer and de multiplexer circuits. Introduction, Basic flip flop, RS flip flop, D-flip flop, JK flip flop, Counters, Binary ripple counters, decade counter.	
6	**Modulation and Demodulation:**	**10 hrs**

	Need of modulation, Amplitude modulation, modulation index, diode modulator, Frequency modulation, modulation index, side bands in F.M. Applied Problems. Demodulation of A.M. Wave, Diode detector circuit, Detection efficiency, Demodulation of F.M. wave, Frequency demodulator, balanced slope detector, ratio detector, frequency distortion.	
7	**Radio Receivers:**	**08 hrs**
	Straight and regenerative receivers, tuned RF receivers, super heterodyne receivers, AM receivers, communication receivers.	
8	**Radar and Satellite communication:**	**07 hrs**
	Elements of RADAR system, Radar range, limitation of Radar, Radar altimeters and beacons, interrogating Radar, Instrument landing system, Visual VHF Omni range (VOR), Tactical air Navigation (TACAN), Radio detection finding (RDF).Satellite links, ellipses, orbits and inclination, satellite construction, communication frequencies, domestic satellites, telemetry.	

Recommended Books For Reference:

1. Communication electronics: ND Deshpande, DA Deshpande, PK Rangole, TMH.

2. Electronic communication system: G Kennedy, MGH

3. Electronic Principles-5th Ed: Malvino

4.Electronic Devices and Circuit-PHI: Boylstead, Nashelsky

5. Operational amplifier and linear integrated circuits: R.A.Gaikwad

6. Electronic devices and circuits: A. Mottershead

7. Principle of Electronics: V.K.Mehta

8. Modern Digital Electronics: R P Jain, 4E-TMH.

INDIAN MARITIME UNIVERSITY
SEMESTER II

UG 21 T4204	SHIP CONSTRUCTION	70 Hrs

1	**Frames, Beams and Beam knees**	5 hrs
	Longitudinal & transverse framing, Beams and Beam knees – Sketch & their importance in Ship Construction. Combined system of framing on transverse sections of the ship.	
2	**Water Tight Bulkheads**	5 hrs
	Functions, construction and stiffening of water tight bulkheads including collision bulkheads, Corrugated bulkhead.	
3	**Sketch and Describe the following:**	10 hrs
	i) Bilge keels- Sketch and Describe Bilge Keel. ii) Double bottom Tank- Sketch and Describe Double bottom Tank. iii) Peak tanks - Sketch and Describe of Forepeak and Aft peak tanks. iv) Side, Wing tanks and Bilges – Sketch and Describe of Wing tanks and Bilges.	
4	**Deck Opening:**	5 hrs
	Construction, stiffening & closing arrangement of openings on deck & Superstructures, Water tightness of Hatches, Opening in Oil, Chemical & Gas tankers.	
5	**Anchor, Chain and Mooring Arrangements:**	10 hrs
	Chain lockers and attachment of Cables, Sketch and describe the Construction of Hawse pipes, Spurling Pipes & their securing arrangements. Typical mooring / anchoring arrangement in forecastle showing the Leads of mooring Describe Roller, multi angle, pedestal and panama fair lead Mooring bitts showing their attachment to the decks Cable stopper	
6	**Sounding Pipes, Air Pipes and Ventilators -** Sketch and describe the Construction of Sounding pipes, Air Pipes, Ventilators.	5 hrs
7	**Pump & Piping Arrangement:**	7 hrs
	General Pumping arrangements, Bilge & Ballast line system, Pumping arrangement on tankers. Hold drainage systems and related structure Bilge piping system, strum box Deck freeing arrangements, freeing ports, scuppers and open rails	
8	**Special Doors on Cargo Vessels:**	5 hrs
	Methods adopted to maintain integrity of divisions & openings in the hull including STERN DOOR, SIDE DOOR & BOW DOORS.	
9	**Rudder Arrangement & Stern Frame:**	8 hrs
	Rudders-Sketch Balanced & Semi balanced Rudders, Describe the Construction & Support Arrangement, Sketch and describe Stern Frame. Transom stern showing connections to the stern frame	

	Explain the purpose of rudder carrier and pintles, rudder trunking. Arrangement of watertight gland around the rudder stock.	
10	**Propellers & Propellor Shaft:**	5 hrs
	Simple sketch of Propeller & Propeller shaft, Stern Tube & adjacent structures. Boss, Rake, Skew, Face, Back, Tip, Radius, Pitch Explain Controllable pitch propeller.	
11	**Riveting and Welding:**	5 hrs
	Riveting as a joining process. Welding – its predominant use in ship construction. Advantages of welding over riveting in ship construction. General ideas of Electric Arc welding equipment, coated electrodes, methods used, Gas welding, Gas cutting. Precaution while welding. Testing and inspection of welds, Types of joints and edge preparation, Stresses set up due to welding, Defects in welding.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Ship construction notes - Kemp & Young
2. Ship construction – Pursey
3. Ship construction - D J Eyres
4. Ship construction for Marine Students - Reeds
5. Ship construction - Taylor

INDIAN MARITIME UNIVERSITY
SEMESTER – II

UG 21 T4205	SHIP OPERATION TECHNOLOGY	60 Hrs

1	**General:**	6 hrs
	Names of various parts of ship, Names and timing of watches, Types of merchant navy vessels, Sea terms, Look-out. Boxing of Compass, Personal Protective Equipment (PPE) – Safety goggle, Safety helmet, Safety Shoes.	
2	**Ropes Work:**	15 hrs
	Types of material used in construction of Ropes,Natural fibres, Synthetic fibres, Types of lay of rope and their advantages, Plaited ropes, Characteristics of different types of fibre ropes, Comparison of strength and elasticity of different ropes. Care and maintenance of fibre Ropes. Damage caused by surging, Meaning of marline, spun yarn, oakum, tarred hemp, 3ply and 5 ply twines, halliards, loglines, lead lines. Knots, Bends, Hitches& Whippings. Grades of steel used for making Wire ropes. Construction of wire ropes. Advantage of a fibre heart. Factors determining flexibility, Meaning of 6/12, 6/24, 6/37 types of wire ropes, Plaited wire rope. Plastic covered wire rope. Non-rotating wire rope, Care and maintenance of wire ropes, Measuring size of ropes, wires and chains, use of Chain Stoppers.	
3	**Flags and Halyard**	8 hrs
	Meaning of Bunting, Halyard at the dip, Close up, Half mast, Hoist, Fly, Tackline. Courtesy flag, Ship's numbers, Jack flag, Quarantine flag, Pilot flag, Blue Peter, Location on a ship of Jack Staff. Ensign staff, Gaff, Triatic stays, Foremast Yardarm, Main mast head. What flags are hoisted from these part of ship and When. Type of Ensign. Penalty for not using or wrongly using an Ensign.	
4	**Code of Safe Working Practices:**	23 hrs
	Contents of code of safe working practices for merchant seamen; Personal protective equipment (PPE); Precautions while entering confined / enclosed space; Rescue from enclosed spaces; procedures for manual lifting and carrying of weights; Precautions while working aloft, over side; Safety precautions while painting; Safety precautions during the use of personnel basket; Safety precautions while on mooring stations; Safety precautions while painting funnel, radar mast; Safety precautions while operating hatch covers; Precautions while using portable ladder; Method of guarding of openings; Precautions while using hand tools; Marking obstructions on the passage way on deck; Safety precautions whilst walking/ working on deck; Standard crane signals. Safety precautions while anchoring; Safety precautions while repairing radar; Safety precautions while entering	

	battery room; Safety precautions while using bosun's chair and stages; Safety precautions while rigging gangway and pilot ladder; Precautions while using electric, pneumatic and hydraulic (power) tools and appliances; Precautions while working with compressed air; precautions while working with chipping machines; Precautions whilst working on lathe machine. Importance of various Check list.	
5	**Safety Committee Meeting:**	8 hrs
	Importance of personnel health and hygiene on board ship; permit system - hot work permit, cold work Permit, entry into enclosed space permit, working aloft permit, working overside permit, electrical isolation permit, lockout and tag out, Procedures; risk assessment; safe bunkering practices.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Theory and Practice of Seamanship - Danton G.
2. Seamanship Notes - Kemp & Young
3. Seamanship & Nautical Knowledge- Nicholls
4. International code of signals
5. Code of Safe Working Practices for Merchant Seamen

INDIAN MARITIME UNIVERSITY
SEMESTER II

UG 21 T4206	**CHART WORK &** **COLLISION PREVENTION REGULATIONS** ***Chart No. BA 813/ BA 2675***	**70 Hrs**

SECTION A **CHARTWORK** **50 hrs**

1	**Charts:**	10hrs
	Charts (Source data, scale, colors used, corrections, date of publication, edition, publisher, hydrographer, chart title and chart number), Natural scale; Chart Symbols as given in INT 5011 limited to the symbols for the following: Rock, wreck, obstructions, depths and nature of sea bed, tidal stream, current, offshore installation, platform, mooring, submarine cable, submarine pipeline, tide and current, depths, tracks, routes, areas and limits, traffic lanes and separation zones); Abbreviations used on a nautical chart; Type of Chart Projections; Types of charts- Small Scale, large scale, meteorological charts, routeing charts, routeing guide charts, ocean charts, coastal charts, harbour charts; Gnomonic charts; Mercator Charts; Plan Charts; Indian and Admiralty Chart catalogue; Selection of charts for the voyage.	
2	**Chart Work Exercises:**	20hrs
	Procedure to read latitude and longitude; Use of parallel rulers, set squares and dividers; Compass Rose; Distance scale; Reason for using the nearest latitude scale for measuring distance; Plotting position on chart by latitude/ longitude, by bearing and distance from a navigational mark, by compass bearing of two or more shore objects, by horizontal sextant angles;	
3	**Information From Charts:**	5hrs
	Information from nautical charts; Degree of reliability of information shown on charts; Chart datum; Reference points used for heights; Units of soundings used; Depths and height contours; Nature of bottom; Information regarding lights (geographical range, nominal range, luminous range), buoys, radio beacons and other navigational aids; Use of leading lights and sector lights for safe navigation in harbour and for laying courses; Horizontal sectors of light; Use of clearing marks; Tidal streams; Traffic lanes and separation zones; Recognition of the coast and radar responsive targets.	
4	**Chart Work Exercises:**	10hrs
	Position plotting by cross bearing, bearing and distance, two distances, the rising or dipping bearing of a light, by bearing and vertical sextant angle of a lighthouse, by astronomical observation; Cocked hat; Finding out compass course between two positions on the chart; Vector resolution of Course Made Good, Course to Steer, Speed Made Good due to current	

	and leeway; Allowing and counteracting current and leeway; finding out actual set and rate of current;; Set, rate, drift and leeway due to wind Course to pass a lighthouse at a given distance.	
5	**Routeing Charts:**	5 hrs
	The use and information available on Routeing charts, number of routeing charts	

SECTION B

INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA (IRPCS) 1972, AS AMENDED:

1	**Collision Prevention Rules: 1 to 41**	20
	Part A – General Rule 1 to 3 **Part B – Steering and Sailing Rules** Section I – Conduct of Vessels in any Condition of Visibility Rule 4 to 10 Section II – Conduct of Vessels in Sight of One Another Rule 11 to 18 Section III – Conduct of Vessels in Restricted Visibility Rule 19 **Part C – Light and Shapes** Rule 20 to 31 **Part D – Sound and Light Signals** Rule 32 to 37 **Part E – Exemptions** Rule 38 **Part F – Audit** Verification of compliance with the provisions of conventions Rule 39 to 41 **Knowledge and understanding above rules.**	

Text Book :

Chart Work for Mariners- Puri, S.K.

RECOMMENDED BOOKS FOR REFERENCE:

1. Chart Work: Basic Concepts & Miscellaneous Calculations- Chaudhari S.S
2. Modern Chart work- Squair, W.H
3. Navigation Guide Vol. 1: Near Coastal Navigation- Alexander Simpson
4. Admiralty publication NP 294 (How to keep charts up to date)
5. IMO Rules of the Road – Bhandarkar Publications
6. International Lights, Shapes and Sound Signals – D. A.Moore
7. A guide to the Collision Avoidance Rules – Cockcroft and Lameijer
8. International Code Of Signals - HMSO
9. Collisions and their causes- Cahill, Richard
10. International Regulations for Preventing Collisions at sea- Nautical Press

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SEMESTER - II

UG21P4207	**APPLIED PHYSICS & ELECTRICITY, PRACTICAL**	**Total 45Hrs (10 X 4hrs Practical) (Assessment 5 Hrs)**

LABORATORY WORK

1. Verification of KVL & KCL
2. Verification of Superposition Theorem.
3. To find the ratio of inductance value of a coil having air core and iron core.
4. Study of R-L-C series resonance circuit.
5. Study of R-L-C parallel resonance circuit.
6. Measurement of Inductance and Capacitance by AC Bridges.
7. Low pass, High pass Filter circuit (RC).
8. Band Pass, Band stop Filter circuit (RC).
9. Study of Venturimeter.
10. Use of thermister as temperature / heat sensor.

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SEMESTER - II

UG21P4208	**NAUTICAL ELECTRONICS, PRACTICAL**	**Total 45Hrs (10 X 4 hrs Practical) (Assessment 5 Hrs)**

LABORATORY WORK

1. Class-A and class-B-push pull amplifier, frequency response.
2. Amplitude and frequency modulation and modulation index
3. CE amplifier-Frequency response and voltage gain
4. Op-Amp: Inverting and non-inverting amplifier.
5. Study of Radar trainer.
6. Hartley and Colpitt's oscillator.
7. Half wave and Full wave rectifier using capacitor filter.
8. Study ofIC 555 Timer & its types.
9. To study the characteristics of LED and LDR.
10. To study characteristics of a Zener diode and its use as a regulator.

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SEMESTER – II

UG21P4209	COMMUNICATIVE ENGLISH LABORATORY (NEW REVISION)	30 Hrs

Development of skills in Oral Communication: 20 hrs

1. Phonology: Pronunciation, Work Stress, Intonation, Sentence Stress.
2. Presentation Skills: Content Structuring, Preparation & Planning, Welcome Note, Vote of thanks.
3. Facing Interview: Attitude, Etiquette, Body Language and Diction.
4. "Sea Speak" Technical Manual: External Communication & Internal Communication on Board Ship.
5. Group Discussion & Extempore Speeches.

Standard Marine Communication Phrases: 10 hrs

- Importance of Standard Marine Communication Phrases:
  Procedure, Spelling, Message Markers, Responses, Distress/Urgency/Safety Signals, Corrections, Readiness, Repetition, Number, Position, Bearings Courses, Distances, Speed, Times, Geographical Names, Ambiguous Words, Omission of "may", "might", "should" and "could". Use and understand the IMO Standard Marine Communication Phrases.

Text Books:

1. IMO (2003) IMO standard Marine Communication Phrases (SMCP) London: International Maritime Organisation.

REFERENCE BOOKS:

1. "Sea-speak" Training Manual, Essential English for International maritime use: Pargamon press UK.
2. Spring.
3. PANORAMA.
4. Effective Technical communication for M. Ashraf Rizvi

B.Sc. NAUTICAL SCIENCE

	SEMESTER III	Hours
UG21T4301	Celestial Navigation Paper -I	60
UG21T4302	Ship Stability Paper - I	60
UG21T4303	Marine Engineering, Automation & Control Systems Paper –I	70
UG21T4304	Environmental Studies	80
UG21T4305	Cargo Handling & Stowage Paper – I	64
UG21T4306	Bridge Equipment & Watch keeping Paper -I	70
UG21P4307	Seamanship Lab - I (Practical)	60
UG21P4308	Marine Engineering Workshop – I (Practical)	60
	TOTAL	524

INDIAN MARITIME UNIVERSITY

SEMESTER III

UG21T4301	CELESTIAL NAVIGATION PAPER - I	60 Hrs

1	**Celestial Sphere and Equinoctial System of Coordinates:**	10 hrs
	Celestial sphere, celestial poles, celestial meridians and equinoctial; vertical circles; prime vertical; Ecliptic; Obliquity of the ecliptic; Equinoctial as a fixed reference plane; First Point of Aries as a reference; Equinoctial system of co-ordinates; Calculation based on above.	
2	**Solar System:**	10 hrs
	Composition and dimensions of the Solar System; Kepler's laws of planetary motion; Earth's elliptical orbit; Perihelion and aphelion with distances and dates; Eccentricity of the earth's orbit; Seasons; Solstices and equinoxes; Rotation and Revolution; Day and night; Tropics of Cancer and Capricorn; Arctic and Antarctic; Earth and Moon system; Phases of moon; Solar and lunar eclipses; Condition necessary for occurrence of solar or lunar eclipse; Umbra and Penumbra; Inferior and Superior planets.	
3	**Hour Angle and Time:**	12 hrs
	Greenwich Hour Angle (GHA); Local Hour Angle (LHA); Sidereal hour angle (SHA); Declination of bodies; 'd' correction and 'v' correction ; polar distance and Right Ascension (RA); Position of a heavenly body on celestial sphere by its declination and GHA, or by its altitude and azimuth, Time and hour angle; Greenwich time, Local time, Zone time and Standard time; GMT, LMT and relationship between longitude and time; Calculation based on above.	
4	**Altitude Corrections:**	7 hrs
	Visible, sensible and rational horizons; horizontal parallax; Sextant altitude and corrections; Observed altitude, apparent altitude and true altitude; Dip, refraction, semi-diameter and parallax; Index error; Altitude correction tables; True zenith distance; Calculation based on above.	

5	**Daily Motion and Horizontal System of Coordinates:**	5 hrs
	True and apparent motion of bodies; 'Zenith' and 'Nadir', 'vertical circle' and 'prime vertical circle', 'elevated pole' and 'depressed pole', observer's upper and lower celestial meridian.	
6	**Latitude by Meridian Altitude:**	9 hrs
	Relationship between the altitude of the elevated pole and the latitude of the observer; Meridian zenith distance; Polar distance of the body; Position line through an observer and a position through which it passes; Time of the meridian passage of Sun; Calculation of latitude by meridian altitude of Sun. Definition of a position line / position circle.	
7	**Nautical Almanac:**	7 hrs
	Information in Nautical Almanac and using it for celestial observations; and related calculations;	

RECOMMENDED BOOKS FOR REFERENCE:

1. Principles of Navigation by Capt. S.S.S Rewari& Capt. T.K.Joseph
2. Practical Navigation by Capt. H.Subramanium
3. Nories Nautical Tables
4. Nautical Almanac
5. The Admiralty Manual of Navigation: Principles of Navigation: Vol. 1- Nautical Institute
6. The Admiralty Manual of Navigation: Astro Navigation Vol. 2- Nautical Institute
7. Navigation Guide Vol. 2: Celestial Navigation- Alexander Simpson
8. Practical Navigation for Officers of the Watch- Frost, A
9. NAV Basics: Ocean Offshore and Celestial Navigation Vol.2- Witherby Seamanship International Ltd.

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SEMESTER – III

UG21 T4302	SHIP STABILITY PAPER - I	60 Hrs

1	**Laws of flotation:**	3 hrs
	Buoyancy, Reserve buoyancy, Displacement, Deadweight, Change of draft due to change of density.	
2	**Stability Terminology:**	3 hrs
	Tonnes per Cm. Immersion(TPC), Fresh Water Allowance (FWA),Dock Water Allowance (DWA),Calculations of TPC, FWA & DWA in various densities,The meaning of the terms Block co-efficient, water-plane co-efficient, Mid-ship Coefficient, Prismatic Coefficient and relationship between them.	
3	**Centre of Gravity :**	10 hrs
	The centre of gravity of ship and factors affecting the same. Calculation involving KG of a Ship. Determination of position of the longitudinal centre of gravity of a ship for different conditions of load & ballast. The effect on the position of centre of gravity of a ship by adding, removing and/or shifting weights Numerical involving above.	
4	**Centre of Buoyancy & Centre of Floatation:**	5hrs
	The centre of buoyancy and factors affecting the same. Calculation involving KB of a ship. Longitudinal Centre of Buoyancy & factors affecting their positions.LongitudinalMetacentre (KM_L) .Centre of Floatation and factors affecting their positions.	
5	**Density, Draft & Displacement:**	2 hrs
	Use of displacement and TPC curves and scales to determine weights of cargo or ballast from draughts or freeboards.	
6	**Transverse Statical Stability:**	3 hrs
	Metacentric height, Righting lever, RightingMoment, Calculations of Moment of Statical Stability.	
7	**Equilibrium of Ships:**	3 hrs

	Stable, Unstable and Neutral equilibrium.	
8	**Free Surface effect:**	6 hrs
	Free surface effect,Effect of Slack Tanks and it's Calculations,Calculation of GM (fluid), Stiff and Tender ships.	
9	**List:**	10 hrs
	Difference between and list heel, List and it's corrections, Calculation of List while Loading, Discharging and/or shifting weights, Correction of List. Numerical involving above.	
10	**M.V. HINDSHIP:**	15hrs
	Knowledge of Ship and Hydrostatic particulars of M.V. Hindship, Calculations based on above topics using Ship and hydrostatic particulars of M.V. Hindship	

RECOMMENDED BOOKS FOR REFERENCE:

1. Ship Stability I - Capt. Subramaniam H.
2. Ship Stability for Masters & / Mates - C.B.Barrass and D.R.Derrett
3. Ship Stability for Mates & Masters - Martin A. Rhodes
4. Problems on M.V. Hindship - Capt. Joseph & Capt. Rewari

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SEMESTER - III

UG 21 T4303	MARINE ENGINEERING, AUTOMATION & CONTROL SYSTEM PAPER-I	70 Hrs

1	**Strength of Materials:**	8 hrs
	Hook's Law, stress & strain, Tensile, Compressive and Shear forces, Failure of materials under tension, compression, shear & fatigue. Examples related to Marine Engineering.	
2	**Material Science:**	12 hrs
	Hardness, Ductility, Malleability, Melting Point etc., Common engineering materials. Various metals & alloys. Properties & uses. Ceramics & their uses. Elementary metallurgy of steels. Steel production- smelting & refining. Iron- carbon diagram to show role of carbon in steels & effect on properties. Types of steel & use. Heat treatment of steels. Obtaining desired properties from steel for use in different areas.	
3	**Electrical Engineering Science:**	18 hrs
	Procedure of maintenance of batteries. Purpose & operation of purifier drive. Navigation light circuit with indicators / alarms & alternative power supply. Services to be supplied from emergency generator. Procedure for starting emergency generator manually Parallel running & load sharing of alternators. Prime mover-Diesel engine, steam turbines High and Low voltage transformers. Step up/step down Transformers. Transformer efficiency and maintenance & care. Main switch boards, power distribution boards. Circuit breakers, measuring instruments. Overload trip, short circuit trip, fuses other protections.	
4	**Marine Engineering Auxiliaries and Practice:**	32 hrs
	General introduction and scope. Classification of ship as per propulsion plants. Main Engine Plants & supporting systems. Introduction about ship's Auxiliary Systems Methods of generation of freshwater from seawater at sea. Principle, construction & operation of low pressure freshwater generator, steam evaporator, flash evaporator & reverse osmosis plant. Treatment of water for obtaining portable water. Storage and supply of fresh water in ships. Fresh water and sanitary water. Hydrophore systems. Air compressor, uses of compressed air. Storage and distribution of compressed air. Types of marine steam boiler. Construction and operation of water tube and smoke tube boiler. Boiler mountings. Accessories, safety features. Waste heat recovery boilers. Boilers maintenance. Importance of boiler, feed water chemical treatment. Principle of refrigeration, compression refrigeration	

	cycle, components& operation. Working principle, construction of different types of pumps. Selection of Pumps for different duties on board the ship. Description and function of Hydraulic Aggregate pump (Hydraulically driven submerged pump-Framo), submersible, and deep well pumps, fire pumps emergency fire pump and its pumping arrangement, typical bilge system & ballast system of a ship. Common types of steering gear, electro hydraulic steering gears, 2 & 4 Ram systems, safe-matic steering gear. Telemotor and control systems. Safety features. Emergency arrangements. Legislation national and international, Hydraulic equipment, Operations and maintenance. Hydraulic systems; Ram & rotary vane actuators, common failures of hydraulic systems and remedial measures, necessity for cooling / heating of hydraulic oil.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Basic Marine Engineering – J. K. Dhar
2. Strength of Materials – Ryder
3. General Engineering Knowledge for Engineer – Reeds Vol-8
4. Marine and offshore pumping and piping systems – Crawford
5. Engineering Drawing – Reeds
6. Motor Engineering Knowledge for Marine Engineers – Reeds Vol. 12
7. Basic Electro technology – Reeds Vol. 6
8. Marine Electrical Equipment & Practice – McGeorge
9. Marine Engineering Practice Vol. 2 Part 17 Slow Speed Diesel Engines by Institute of Marine Engineers (England)
10. Materials for Marine Machinery – Fredrick & Capper

INDIAN MARITIME UNIVERSITY

SEMESTER – III

UG 21 T4204	ENVIRONMENTAL STUDIES	80 Hrs

Objective: (1)To impart basic knowledge of Environmental Studies.

(2) To impart knowledge of Marine Meteorology which are required during day-to-day Ship Operations.

1	**The Multidisciplinary nature of Environmental Studies:**	2 hrs
	Definition, Scope and importance, Need for public awareness	
2	**Natural Resources:**	8 hrs
	Renewable and non-renewable resources: Natural resources and associated problems a)forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. b) Water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems. c)Mineral resources: Use and exploitation, environmental effect of extracting and using mineral resources, case studies. d) food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy source. Case studies. f) Land resources: Land as a resources, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.	
3	**Ecosystems :**	6 hrs
	Concept of an ecosystem, structure and function of an ecosystem, producers , consumers and decomposers, energy flow in the ecosystem, Ecological succession, food chains , food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: forest ecosystem, grassland ecosystem, Desert ecosystem, Aquatic ecosystems(ponds, streams, lake, rivers, oceans, estuaries)	
4	**Biodiversity and its conservation :**	8 hrs
	Introduction- Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, social, ethical, aesthetic and option values, Biodiversity at global , National and local levels, India as a mega-diversity nation, hot-spots of biodiversity, threats of biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	
5	**Environmental Pollution :**	8 hrs
	Definition : causes, effects and control measures of : Air pollution, Water pollution , Soil pollution , Marine pollution , Noise pollution, Thermal pollution	

	,Nuclear hazards. Solid waste Management: Causes, effect and control measures of urban and industrial wastes. Role of an individual in prevention of pollution , Pollution case studies, Disaster management : floods, earthquake, cyclone and landslides.	
6	**Social Issues and the Environment :**	7 hrs
	From Unsustainable to sustainable development , Urban problems related to energy , Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people: its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions, climate change, global warming , acid rain, ozone layer depletion. Nuclear accidents and holocaust. Case studies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, wildlife Protection Act, Forest conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.	
7	**Human Population and the Environment :**	6 hrs
	Population growth, variation among nations, Population explosion – Family Welfare Programme, environmental and Human health, human rights, Value Education, HIV / AIDS, Women and child Welfare, Role of Information Technology in Environment and human health, Case Studies.	
8	**Field work :**	5 hrs
	Visit to a local area to document environmental assets-river/ forest/ grassland/ hill/ mountain , visit a local polluted site –Urban / rural / Industrial / agriculture, Study of common plants, insects, birds, study of simple eco systems-pond, river, hill slopes, etc.	
9	**Earth's Atmosphere :**	6 hrs
	Characteristics of the Earth's atmosphere; Composition and physical properties; Vertical layer of the atmosphere: Troposphere, tropopause, stratosphere, stratopause, mesosphere, mesopause and thermosphere; Insolation; Saturation; Evaporation, Condensation, Latent Heat, and Vapour Pressure; Ozone depletion, air pollution; Radiation laws; Emission, Reflection, absorption and scattering; Solar and terrestrial radiation, Greenhouse effect and global warming; Heat exchange process (conduction, convection and radiation); Radiation budget of the earth/atmosphere system; Environmental lapse rate and inversion; Diurnal, seasonal and geographical variation of temperature; Dry Adiabatic Lapse Rate (DALR) and Saturated Adiabatic Lapse Rate (SALR)	
10	**Atmospheric Pressure:**	4 hrs
	Definition of pressure; Unit used for recording pressure; Pressure gradient, barometric tendency, isobar, isallalobar and the relationship between atmospheric pressure and height above sea level; Horizontal and vertical distribution of atmospheric pressure and the resulting circulation; Diurnal variation of pressure.	
11	**Wind:**	6 hrs

	Factors affecting atmospheric motion & the resulting winds; Beaufort scale of wind force; Geostrophic wind; Gradient and Cyclostrophic winds; pressure gradient force, Coriolis force, Buys Ballot's law, True and apparent wind and its vector calculation; Interpreting Wind Rose.	
12	**Cloud and Precipitation:**	6 hrs
	Formation of Clouds, the Different types of Clouds, Classification of Clouds as per height, Cloud Atlas; Precipitation, Drizzle, Hail, Snow, Sleet; Dew;	
13	**Visibility:**	4 hrs
	Formation of fog, mist, haze, frost; Different types of fog; Effect of fog, mist, haze, and other meteorological conditions on visibility.	
14	**Water Vapour:**	4 hrs
	Changes of state, specific, absolute and relative humidity, dew point temperature, unsaturated and saturated states, super cooling, and frost point; diurnal and seasonal variation of water vapour.	

RECOMMENDED BOOKS FOR REFERENCE :

1. Marine Meteorology- Capt. H. Subramaniam
2. Meteorology for Mariners – HMSO
3. Meteorology for seafarers – Frampton, R. M.
4. Meteorology Demystified : self teaching guide – Gibilisco Stan
5. Meteorology for Sea –Sanderson Ray
6. Mariners Handbook (NP 100) – Admiralty
7. Cloud types for Observers – HMSO
8. Agarwal, K.C.2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
9. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380013, India , Email: mapin@icenet.net(R)
10. Brunner R.C.,1989, Hazardous Waste Incineration, McGraw Hill Inc.480p.
11. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
12. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001,Environmetnal Encyclopedia, JaicoPubl, Mumbai, 1196p.
13. De A. K., Environmental Chemistry, Wiley Eastern Ltd.
14. Down to Earth, Centre for Science and Environment (R)
15. Gleick, H. P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute. Oxford Univ. Press 473p.
16. Hawkins R.E, Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
17. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
18. Jadhav, H &Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p.

19. Mckinney, M.L. & School R.M. 1996. Environmental Science system & Solutions, Web enhanced edition. 6396p.
20. Mhaskar A.K, Matter Hazardous, Techno-Science Publications (TB)
21. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
22. Odum, E.P.1971. Fundamental of Ecology. W.B.Saunders Co. USA 574p.
23. Rao M N. &Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
24. Sharma B.K., 2001. Environmental Chemistry. Goel Publ. House, Meerut
25. Surevy of the Environment, The Hindu (M)
26. Townsend C., Harper J. and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
27. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R)
28. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications (TB)
29. Wagner K.D. ,1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p.

(M) Magazine
(R) Reference
(TB) Textbook

INDIAN MARITIME UNIVERSITY

SEMESTER - III

UG 21 T4305	**CARGO HANDLING AND STOWAGE** **PAPER – I**	**64 Hrs**

1	**General Introduction to Dry Cargo Ships:**	5 hrs
	General cargo ship, Basic ship's cargo gear – derricks and cranes, types of general cargo e.g. bales, boxes, bags, crates, cases, pallets, Bulk carrier, examples of bulk cargoes and method of loading by Conveyor and discharging by Grab.	
2	**Basic Aspects of Cargo Operations:**	7 hrs
	Importance of cargo care to economical operation of ships and care of cargo on board ships. The hazard of fire and its prevention, control and extinction in cargo operations. Interaction between cargoes and the resultant contamination and tainting. Stowage and handling to prevent breaking, chafing, crushing. Sea water damage, importance of structural integrity and Hatch cover water tightness. Bale and Grain Capacity; Stowage factor, Broken stowage; Load density; Cargo density; Ullage and soundings; Deadweight and displacement; Ballasting and deballasting operations Duties of the Officer on Cargo Watch Log Book Entries	
3	**Items of Cargo Gear, their use, Care and Maintenance:**	12 hrs
	Ropes, wires & chains: Natural and synthetic ropes-manila, polypropylene, terylene, nylon. Breaking stress of ropes, wires and chains as given in the Chain Register. Calculation of SWL using Factor of Safety given,. Care of ropes and wire used for cargo gear.Maintenance of wire ropes. When to condemn a wire rope. **Slings:** Types of slings used for lifting cargo of different types. Use of snotters,	

	canvas slings, vehicle slings, trays, pallets, nets, hooks and slings. **Blocks:** Parts of a block, Types of block, snatch blocks. External and internal binding. Markings on a block. Size of a block and sheave, size of rope/wire to be used in a block. Relationship between diameter of sheave and diameter of rope/wire. Care and maintenance of blocks. Overhauling blocks. **Tackles:** Parts of a tackle, using a tackle to advantage or disadvantage. mechanical advantage. Velocity ratio or power gained, efficiency of a tackle; relationship between effort and load. Types of purchases used on ships. Reeving a three-fold purchase. **Shackles:** Types of shackles. Marking on shackles. **Cargo hooks:** Swivels, Marking on cargo hooks.	
4	**Segregation, Separation and Securing of Cargoes:**	8 hrs
	Segregation of different cargoes with reference to dangerous goods, dry, wet, delicate, dirty, valuable cargo. Separation between parcels of cargo and methods of separation. Separation between parcels of cargo for different ports. Separation of cargoes by natural bulkheads or artificial divisions. Dunnage and its use to increase friction, prevent damage from sweat and in separating cargoes. Shifting boards. Shifting of cargo, toppling, and methods of securing to prevent the same viz. blocking, chocking and lashing. Methods of blocking, lashing, shoring and tomming cargo. Method of securing heavy loads, vehicles, containers. Contents of Lashing Code and Cargo Securing Manual.	
5	**Ventilation and Control of Sweat :**	5 hrs
	Need for ventilation of cargo spaces Ship sweat and cargo sweat, and differentiate between them. Factors affecting sweat. Control of sweat by ventilation, Operation of ventilation system Cargoes requiring special ventilation due to emission of gases, absorption of oxygen, dust, release of moisture. Temperature variations leading to sweat damage, ship and cargo sweat, monitoring	

	of dew-point temperature and ventilation to prevent sweat.	
6	**Derrick Rigs:**	5 hrs
	Parts of a Simple Derrick. Importance of preventer guys. The union purchase system. Rigging of derricks for loading and discharging of cargoes Maximum load to be used for angle between runners. Swinging derrick with powered guys. Putting winches in double gear. The working of ship's cranes. Hoisting, lowering and securing a derrick and crane. Operational checks to be done on ship's cargo gear before handing over to stevedores including checks on limit cut outs Contents and use of the Rigging Plan	
7	**Cargo work Calculations:**	5 hrs
	Using parallelogram law of forces calculate the stresses in beam slings, tray slings, triangular trays, sheer legs(tripods), simple derrick and union purchase systems. Measurement of cargo; Safe working load (SWL); Breaking strength; Proof Load; Factor of Safety; Load lines. Calculation of cargo quantities given height, area or volume of hold, stowage factor, broken stowage, load density, bale or grain capacity. Calculating the effort on the hauling part of a purchase for a given load and using this tension to find the correct size of rope/wire to be used. Finding mechanical advantage and efficiency of a system using a combination of two purchases to advantage/disadvantage.	
8	**Hatch-covers:**	5 hrs
	Types of hatches. Opening and closing of chain-pull and hydraulic hatch covers. Closing arrangements. Battening down a hatch.	

	Maintenance of hatch covers: Procedures to check weather tightness of hatch covers Securing of hatch pontoons Maintenance and use of side cleats and cross-joint wedge mechanism Importance of clear drainage channels and drain holes. Importance of compression bars and sealing gaskets Need to check hydraulic system for leakages Procedure for securing hatches in open position to guard against accidental movement.	
9	**Cargo-handling Safety:**	5 hrs
	Inspection of cargo gear prior work. Precautions during cargo operations while using cargo gear. Effective communication during loading and discharging. Precautions to be taken whilst operating hatch covers.	
10	**Stowage Plans:**	7 hrs
	Planning, stowage and drawing up of stowage plans of general cargo taking into account stowage factor, port rotation, hazardous nature, special stowage requirement relating to cargoes not covered by special codes.	

RECOMMENDED BOOKS FOR REFERENCE;

1. Cargo Work for Ship officer – Capt Errol Fernandes
2. Cargo Work – Kemp and Young
3. Cargo Works – Taylor
4. Cargo Works – D.J. House
5. Cargo Notes- DhananjaySwadi

INDIAN MARITIME UNIVERSITY

SEMESTER - III

UG 21 T4306	BRIDGE EQUIPMENT & WATCH KEEPING PAPER - I	70 Hrs

SECTION A

BRIDGE EQUIPMENT

1	**Lay out of Bridge and Integrated Bridge:** Sketch the layout of the Bridge with its Navigational Equipment, Use of various Navigational Equipments, Integrated Bridge.	4hrs
2	**Sextant:** Explain use of Sextant & its principle and errors.	3hrs
3	**Magnetic Compass:** The magnetism of the earth. Magnetic poles and variation. The magnetic compass: Liquid and dry card magnetic compass, lubber line and ship's deviation, Location of Magnetic compass. The construction of the binnacle and use of periscope, Compass points. True and Magnetic north. Magnetic variation and changes in its annual value. Isogonals. Magnetic compass error. Course & Bearing. Conversion of compass course to true course and vice versa. The use and care of magnetic compasses. Precaution to be observed while taking compass bearings. Practical limitation of the magnetic compasses.	4hrs
4	**Telemotor, Helm Orders and Internal Communications:** Demonstrate clear, concise communication and acknowledgement at all times in a seaman like manner with due regards to Standard Marine Communication Phrases, Explain various methods to call the Master to the bridge. Inter-switching of follow-up and Non follow-up & Emergency steering system.	5hrs
5	**Speed Log:** Differentiate between ground reference speed and water reference speed, Electro-magnetic log: Explain: Principle and Errors, Doppler speed log: Explain: Principle, The Limitations, Janus configuration, Dual axis configuration and its	4hrs

	uses during docking operations, Calibration of the log, List: The main error sources of Doppler log, Describe: How ship's speed is transmitted to remote displays (block diagram), Draw: A Sketch showing how indication of distance run is derived from a speed log.	
6	**Echo Sounder:** Echo sounder: Draw a block diagram, Explain: Echo sounder as a valuable navigational aid, Basic principle, Effect of density, temperature and pressure on velocity of sound and the limits in which the true value may lie, Ranging and Phasing, Danger of wrong phasing, Inaccuracies of equipment, scale error and measures to eliminate them. False echoes, Errors due to Trim, List & positioning, Various alarms and settings, Briefly describe Operation use and maintenance such as clean plate, change paper, change and adjust stylus.	5 hrs
7	**Course Recorder& The automatic pilot:** Explain working of course recorder, use, care and record keeping, Starting course recorder, Changing of paper of course recorder. Principle, functions, auto pilot alarm, Various settings of the auto-pilot for optimal Performance, Adaptive Autopilot.	5 hrs
8	**Steering control systems:** Knowledge of steering control systems, operational procedures, and change over from manual to auto and vice-versa, procedure for testing of steering system. Wheel House posters, Use of Rate of Turn Indicator (ROTI).	5 hrs
9	**Other Equipments in the Wheel House:**	8 hrs
	Chronometer: Types of Chronometer, Checking Chronometer error from radio time signal, Care of Chronometer, Running down and restarting Chronometer. **Telegraph:** Electric telegraph, description and its operation. **Day Light Signalling Lamp:** Day light signalling lamp – use, care and Emergency source of power. **Fog Signalling Equipment:** Sound signally Equipments as in part-D of IRPCS 1972. **Wiper & Clear View Screen:** Use, care and precaution of wiper & clean view screen (CVS).	

SECTION B

WATCH KEEPING

1	**Watch-keeping arrangements :** **Describe:** Watch-keeping Arrangements in accordance with the situations any limitation in qualifications or fitness of individuals, Individual roles, responsibility and team roles shall be established, Effective use of the resources available, such as information, installations/equipment and other personnel; Understand functions, operation and handling of installations/equipment, Sharing of information from equipments, Need for appropriate communication, Protection of the marine environment.	5 hrs
2	**Handing over and taking over watch:**Procedure for handing over and taking over bridge watches	3 hrs
3	**Bridge manning levels:**Circumstances in which the OOW (officers on watch) should call Master, extra lookouts, Explain responsibilities of OOW as in-charge of Navigational watch, Navigation with a pilot embarked.	4hrs
4	**Keeping a safe navigational watch as per Section A-VIII/2 and B-VIII/2 of International Standard of Training, Certification& watchkeepingforSeafarers, 1978 as amended (STCW Convention):** Describe: Principles to be observed in keeping safe, Lookout.	4 hrs
5	**Record keeping and Entries in logbook:** Explain the importance of recording all relevant information in Logbooks. Monitor navigational instruments and record their performance and other relevant details, Check and compare Compasses regularly for errors and apply them correctly, Record all movements and activities related to the navigation of the ship, IMO Guidelines for recording of events related to Navigation Res A. 916 (22).	4 hrs
6	**Keeping an effective anchor watch:**	5 hrs
	Importance of Beam bearing, Use of Global Position Fixing System (GPS) and Radar during anchor watch, Turning circle in relation to length of vessel and length of cable used, Indication of anchor dragging, Swinging of vessel anchored	

	to tide / wind, Use of shapes, lights and sound signals as per IRPCS 1972.	
7	**Pilot embarking & disembarking:**	2hrs
	Understand importance of compliance with safe procedures for embarking and disembarking of pilot, Pilot transfer arrangements as per SOLAS and its upkeep.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Bridge Watch Keeping – Capt. H. Subramaniam
2. Modern Electronic Aids—Bhatia and SinhaK.
3. Bridge Procedure Guide - ICS
4. Bridge Team work - Nautical Institute
5. Shipborne Radar and ARPA-- Capt. H. Subramaniam
6. Electronic Navigational Aid-- Sonnenberg
7. Mariners Handbook – HMSO Publication
8. A Seaman's Guide to the RULES OF THE ROAD- Morgans Technical Books Ltd

INDIAN MARITIME UNIVERSITY

SEMESTER – III

UG 21 P4307	**SEAMANSHIP LAB –I (PRACTICAL)**	**60 Hrs**

Objective: To impart necessary practical Seamanship training required for Nautical Cadets

1	**Seamanship:**	40 hrs
	i) Demonstrate taking soundings and ullage to find quantity of liquid in a tank using Calibration Table. ii) Demonstrate taking hold temperature. iii) Demonstrate and conduct practice on the use of various types of cordage, fibre and wire ropes usedon the ship. Natural fibre rope, synthetic fibre rope, wire rope – construction, care and lay, measuring thesize of rope. • Identify between right hand lay and left hand lay ropes • Demonstrate and conduct practice on various types of whippings. • Demonstrate and conduct practice on various typesof knots, bends and hitches. Practical usage of knots and understanding where each knot is used. • Demonstrate the method of connecting a heaving line / messenger line to a hawser. • Demonstrate the method of belaying and racking a wire rope. • Conduct practical exercises on throwing heaving lines, use of rope and chain stoppers, mooring shackle and safe handling of mooring ropes. Use of slip-	

	ropes. Use of fenders, messenger line. • Demonstrate the method of joining two mooring hawsers. To transfer rope from mooring winch to bollards and making fast. iv) Demonstrate the method of securing oil drums, and other loose gear. v) Demonstrate the method of belaying rope to cleats and Stag horn. vi) Conduct Practical exercises in reading draft marks. vii) Demonstrate the use of various power tools such as pneumatic/ electrical chipping and de-scaling tools and precautions needed. viii) Demonstrate hazards associated with the use of portable ladders onboard. ix) Demonstrate understanding of different manual lifting techniques for heavy weights. x) Opening a new coil & coiling of ropes. xi) Demonstration of handling of boat under oars, coming alongside and pick up a man overboard. xii) Splicing of Fibre Ropes & Wire Ropes: Fibre Rope; eye splice, short splice, back splice Wire Rope; Eye splice (group activity of 2-3 cadets). xiii) Demonstrate the use of bulldog grips and bottle screws / turnbuckles in joining wires.	
2	**Stage, Bosun's Chair, Pilot Ladder and Mast Work:**	20 hrs
	Safety procedure involved in working aloft on stage and a Bosun's chair (group activity of 2-3 cadets) Demonstrate the ability to climb a ship's mast Demonstrate ability to climb down stairs in accommodation and ladders. Show the procedure to carry objects up or down the ladders or stairs. Learn and Demonstrate how a 'Pilot Ladder' can be rigged up according to the relevant rule requirements. Demonstrate how to climb up a 'Pilot Ladder' after taking all due safety Precautions.	

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SEMESTER –III

UG 21 P4308	MARINE ENGINEERING WORKSHOP - I (PRACTICAL)	60 Hrs

Objective: To impart Basic knowledge & hands-on training on various machineries in Marine Engineering Workshop.

1	**Basic Marine Workshop:**	5 hrs
	Cutting, Filing, preparation of level surfaces on metals. Drilling, tapping, reamer operations. Shaping, drilling, grinding operations. Edge preparation on steel objects for welding. Welding of simple joints. Removal and fittings of ball bearing. Overhaul of valves, practice fittings on pipelines. Competency – Cuttings & planing, Dove tail joints	
2	**Fitting Work Shop:**	10 hrs
	i) Demonstrate the ability to perform at least four basic fitting jobs of given dimension by using proper hand tools suchas files, hacksaw, chisel, hammer, etc. (group activity of 2-3 cadets). ii) Demonstrate the use of feeler gauge, thread gauge, screw gauge, vernier calliper, on the above said job. iii) Identify various spanners, nuts and bolts, allen screws, studs and demonstratestheir use. iv) Demonstrate the use of grinding machine including portable grinders and drillingmachine on the above said job.	
3	**Welding Shop:**	10 hrs
	i) Demonstrate the safety precautions to be observed while welding including earthing. ii) Identify the arc and gas welding tools and welding kits. iii) Identify ferrous and non-ferrous metals. iv) Demonstrates the ability to carry out oxyacetylene gascutting. (group activity of 4-5 cadets). v) Connects the arc welding kit and selects the current /electrode to carry out arc welding.(group activity of 4-5 cadets). vi) Demonstrate the ability to carry out arc bead welding.(group activity of 4-5 cadets).	
4	**Electrical Shop:**	10 hrs
	i) Identify electrical insulated hand tools. ii) Demonstrate the ability to identify electrical conductors (wires and cables). iii) Identify the electrical accessories such as fuse, circuit breakers, choke,	

	starters, etc. and demonstrates the use of it in electrical circuits. iv) Assemble a tube light fitting by using tube fittings and test it. v) Demonstrate the ability to carry out battery check and maintenance - voltage, acid density and battery capacity by continuous current drain (group activity of 2-3 cadets). vi) Identifies safety precautions to take to avoid shock and to rescue a person from electrical shock location.(Instructor demonstration for a group of 5 cadets). vii) Demonstrate the use of relay in electrical/ electronic circuits.	
5	**Plumbing Shop:**	10 hrs
	i) Identify plumbing hand tools such as pipe wrench, dies, pipe benders, hacksaw, pipe vice, spanners, etc. (ship specific). ii) Identify leak stopping material such as Teflon, sealant, jubilee clips, ermeto couplings. and demonstrate their use. iii) Demonstrate the procedures to cut threads on pipes by selecting appropriate die.(group activity of 2-3 cadets). iv) Demonstrate the ability to identify different pipes, pipe material and methods to join the pipes. v) Identify various taps, cocks and valves used in sanitary System, demonstrate ability to repair them (ship specific). vi) Identify various plumbing accessories such as 'T' joint, socket, reducer, adapter, etc. used in pipe fitting and demonstrate its use. vii) Cut the gasket as per sketch by selecting appropriate material and tools. viii) Demonstrate the ability to clear choked pipes in accommodation plumbing system by using appropriate tool / choke clearing material	
6	**Carpentry Shop:**	5 hrs
	i) Identify carpentry hand tools such as chisel, jack plane, augur, mortise gauge, etc. ii) Identify various wood for specific purposes treatment materials. iii) Identify various wood jointing material using adhesive, nails, screws etc. iv) Demonstrate the ability to execute wood jointing (group activity of 2-3 cadets) v) Demonstrate the ability to make a cement box; wooden box as per drawing by using appropriate tools, wood jointing method and wood jointing material / adhesives (group activity of 4-5 cadets) vi) Use clamps/ cement box to arrest a leak. (Instructor demonstration for group of 20 cadets) vii) Use of fibre glass repair kits. (Instructor demonstration for group of 20 cadets)	

7	**Machinery Maintenance**	10 hrs
	i) Identify various fasteners such as nut and bolts, allen screws, studs and demonstrates its use. ii) Identify valves and cocks used onboard. iii) Overhaul a globe valve and butterfly valve by using appropriate tools and gaskets(group activity of 2-3 cadets) iv) Demonstrate the procedure to carry out greasing and Oiling pumps and motor by using grease gun, oilcans and pneumatic grease gun.	

B.Sc. NAUTICAL SCIENCE

	SEMESTER IV	Hours
UG21T4401	Celestial Navigation Paper -II	70
UG21T4402	Ship Stability Paper – II	60
UG21T4403	Cargo Handling & Stowage Paper –II	64
UG21T4404	Life Saving & Fire Fighting Appliances	60
UG21T4405	Marine Engineering, Automation & Control Systems Paper -II	70
UG21T4406	Meteorology	80
UG21P4407	Seamanship Lab - II (Practical)	60
UG21P4408	Marine Engineering Workshop – II (Practical)	60
	TOTAL	524

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SEMESTER - IV

UG 21 T4401	CELESTIAL NAVIGATION PAPER - II	70 Hrs

1	**Star Identification:**	2 hrs
	Recognition of important stars with reference to stellar constellations; stellar magnitudes;	
2	**Hour Angle and Time:**	10 hrs
	Relationship between LHA (sun) and LAT, Solar time, solar day, apparent sun, mean sun, Sidereal time; Sidereal day; Equation of Time; Keeping time at sea; Advancing and retarding of clocks with change of Longitude; International Date Line; Time Signals. Calculation based on above.	
3	**Amplitude and Azimuth:**	10 hrs
	Theoretical and visible sunrise and sun set, Apparent altitude of sun and moon at the time of theoretical rising or setting; calculation of true amplitude; Derivation of formula "Sin amp= Sin decl. sec lat"; Calculate the time of sunset, sunrise, Azimuths, calculation of magnetic compass and gyro compass errors by observing heavenly bodies, including the use of ABC tables. Calculation based on above.	
4	**Pole Star Observations:**	10 hrs
	Identification of Polaris, a_0, a_1, a_2 corrections and calculation of latitude, azimuth and position line & a position through which it passes; Calculation based on above.	
5	**Position Fixing:**	30 hrs
	Geographical position; Circle of position; Position fixing by long by chron, intercept and ex-Meridian (Sun) methods of sight calculation; true azimuth of a body and relationship with PL, position finding by simultaneous & staggered observations, cocked hat and its interpretations; and related calculations. (No questions on resolution of cocked hat. No calculations shall be based on ambiguity of time or date, incorrect application of chronometer error, index error or dip, etc.) Calculation based on above.	

6	**Twilights:**	8 hrs
	Twilights- civil, nautical and astronomical; Conditions necessary for twilight all night; Calculation of twilight timings; circumpolar bodies; conditions necessary for a body to be circumpolar; and related calculations.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Principles of Navigation by Capt. S.S.S Rewari& Capt. T.K.Joseph
2. Principles of Navigation by Capt. P.M. Sarma
3. Practical Navigation by Capt. H.Subramanium
4. Nories Nautical Tables
5. Nautical Almanac
6. The Admiralty Manual of Navigation: Principles of Navigation: Vol. 1- Nautical Institute
7. The Admiralty Manual of Navigation: Astro Navigation Vol. 2- Nautical Institute
8. Navigation Guide Vol. 2: Celestial Navigation- Alexander Simpson
9. Practical Navigation for Officers of the Watch- Frost, A
10. NAV Basics: Ocean Offshore and Celestial Navigation Vol.2- Witherby Seamanship International Ltd.

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SEMESTER – IV

UG 21 T4402	SHIP STABILITY PAPER - II	60 Hrs

1	**Trim :**	8 hrs
	Theory of Trim- Changes in the position of COG & COB. Role of COF in change of trim. Trimming Moment, MCTC, Changes of drafts & Trim due to Loading discharging &shifting weights. Calculation of F & A drafts using Trim Tables. Numerical involving above.	
2	**Effect of change of density on Trim:**	3 hrs
	Change of density – Change of underwater volume, Bodily sinkage or rise, Location of COG, COB & COF, Change of Trimming Moment, Change of trim due to change of density. Calculations of F & A drafts due to change of density.	
3	**Curve of Statical Stability and Cross Curves:**	5 hrs
	Curve of Statical Stability & its practical usage including finding Dynamical Stability. Cross curves of stability- GZ curves, GZ tables, K. N. values & K.N. Curves, Determination of Righting moment using K.N. Values.	
4	**Righting Moment Calculations:**	3 hrs
	Stability at moderate and large angles of heel, Use of the wall-sided formula for calculation of Righting Moment.	
5	**Simpson's Rule:**	8 hrs
	Simpson's Rule- First Rule, Second Rule & Third Rule. Use of Simpson's Rule in the computation of areas. Use of Simpson's Rule in the computation of volumes. Use of Simpson's Rule in the computation of Centroid for area & volume. Numerical involving above.	

6	**Deck Cargo:**	3 hrs
	Carriage of cargo on deck, Carriage of Deck cargo – their effect on ship stability. Dangers to a ship with a heavy list, Dangers associated with deck cargoes including timber, Preventive and corrective actions.	
7	**Stability of Ships loading Grain:**	6 hrs
	Definition of Grain, Angle of Repose, Document of Authorisation,Volumetric Heeling Moment, Hazards associated with respect to ship stability while loading grain. Stowage of grain and stability, Stability aspectwith respect to grain loading and Stability calculations including heeling moment, Statutory Regulations.	
8	**Angle of Loll:**	4 hrs
	Definition of "Angle of Loll", Danger to a ship at the angle of loll, Derivation of the formulae for Angle of Loll, Causes & Remedial Actions for Angle of Loll (Ballasting sequence to rectify same), Simple Calculations on above.	
9	**Derivation of the Formulae:**	5 hrs
	Derivation of the formulae for TPC, Derivation of the formulae for FWA, Derivation of the formulae for BM (Transverse) BMT, MCTCand Angle of Loll, Derivation of the formulae for Virtual loss of GM due to free surface effect, Derivation of the formulae for Virtual loss of GM during Dry Docking, Derivation of Wall sided formula, and Attwood formula.	
10	**Hydrostatic Curves and Tables of M.V. HINDSHIP:**	15 hrs
	Calculations based on above topics using Hydrostatic particulars of M.V. Hindship	

RECOMMENDED BOOKS FOR REFERENCE:

1. Ship Stability for Masters & / Mates - C.B.Barrass and D.R.Derrett
2. Ship Stability for Mates & Masters - Martin A. Rhodes
3. Ship Stability I - Capt. Subramaniam H.
4. Problems on M.V. Hindship - Capt. Joseph & Capt. Rewari
5. IMO - Grain Code

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SEMESTER - IV

UG 21 T4403	CARGO HANDLING AND STOWAGE PAPER – II	64 Hrs
1	**Inspection and Preparation of Holds:**	5 hrs
	Need for inspection of holds, Items to be inspected, Importance of cleaning holds, Checking weather tightness of hatch covers Use of dunnage & spar ceiling, Disposal requirements of dunnage Importance of checking bilge suction Use of deodorising wash Blanking of ballast lines	
2	**Deck Cargo:**	5 hrs
	Dangerous Cargoes not permitted below deck Various types of Deck Cargo Efficient means of securing of deck cargoes, Need of battening of hatch cover before loading deck cargo, Safe access to equipment and spaces Maximum permissible load Unobstructed view from the navigating bridge	
3	**Dock Labour Regulations:**	10 hrs
	Competent person, authorized person, responsible person, loose gear, lifting appliance. Duties and powers of the Dock Safety Inspector. Annual thorough examination of cargo gear; Maintenance of cargo gear;	

	Markings of ship's lifting appliances and cargo gear; Requirements for initial and periodical testing of cargo gear and annealing; Register of lifting appliances and cargo handling gear (Chain Register); The requirements of guarding dangerous parts of the machinery. Precautions to be taken when using forklifts, bulldozers, grabs and other heavy gear on board. Dock safety regulations pertaining to cargo handling (dust, personal protection, awareness of moving parts of machinery). Testing of cranes – static, dynamic test.	
4	**Detailed Study of Bulk Cargoes and Concentrates:**	8 hrs
	Preparations of holds prior to loading bulk cargoes; Use of various equipment for hold cleaning; Testing for weather tightness of hatch covers; Log Book entries Classification of cargoes as per IMSBC Code. Main hazards and precautions with the shipment of bulk solids (Ores, Concentrates, HBI/DRI) Documentation required prior loading. Hazards associated with and precautions to be taken whilst loading/ carrying high density cargoes, Maximum allowable weight for single and adjacent holds, Angle of repose, moisture migration, flow moisture point, flow state, transportable moisture limit, dry and wet shift, spontaneous combustion Preparations of holds prior to loading bulk cargoes, Hazards associated with bulk cargoes and precautions prior, during and after loading of: Coal, sulphur, iron ore, urea. Protection of deck machinery from dust. Liquefaction of bulk cargo, Bulk Cargo which will not liquefied, Trimming of Bulk Cargo. Purpose and objectives of Bulk carrier loading and unloading, check list as per BLU code. MSDS Sheets; Cargo stow plan; Precautions to be taken prior entering cargo holds when pesticides are used for fumigation;	

	Ship/Shore safety checklist. Material hazardous in Bulk.	
5	**Grain Cargoes (SOLAS Ch. VI, IMO Grain Code):**	8 hrs
	Definition of Grain, Filled and Partly filled compartments, Trimmed and untrimmed cargo, Specially suitable compartment. Preparation of holds for carriage of grain cargo especially for insect or rodent infestation; Pre loading inspections/surveys; Securing free grain surface in filled and partly filled compartments, Separation of different grain cargoes loaded in same compartment; Use of Shifting boards and bundling arrangements Document of Authorisation Grain loading stability criteria for ships with and with a DoA Contents of Grain loading booklet. Methods to reduce Grain heeling moments in order to meet Grain stability criteria.	
6	**Inspection Report; Assess reported defects and damage to cargo spaces, hatch covers and ballast tanks and take appropriate action:**	8 hrs
	Outline and describe the common damage/defects that may occur on watertight transverse bulkheads situated at the ends of dry cargo holds of a bulk carrier Cracks may often be found at or near the connection of the stool of the transverse bulkhead and the tank top in bulk carriers having combination cargo/ballast holds Ability to explain how to avoid the detrimental effects on bulk carriers of corrosion, fatigue and improper cargo handling. Actions to be taken to avoid the detrimental effects on bulk carriers of corrosion, fatigue and inadequate cargo handling.	
7	**Timber:**	5 hrs
	Contents of Code of safe practice for ships carrying timber deck cargoes. Stowage and securing of deck timber cargoes Hazards involved with the carriage of deck timber cargo Effect on stability due to absorption of water or ice accretion	

	Lashing arrangement of Timber cargo Need for regular inspection of lashing arrangements Need for controlling height of deck cargo Need for provision of walkways and access to the top of the cargo. Action if cargo is lost overboard Stability criteria to be fulfilled Rolling period test for determining ship's stability and limitations of the method.	
8	**Procedures for Receiving, Tallying and Delivering Cargo:**	4 hrs
	Mate's receipts, Bill of Lading (Information available and different types of B/L) Charter Parties Note of protest Cargo claims Third party damage	
9	**Dangerous Goods in Packaged Form (SOLAS Ch. VII, IMDG Code and MARPOL Annex III):**	6 hrs
	Classification of IMDG cargo with distinctive labels and examples Use of IMDG Code and cargo informations obtained from the same - UN No., General Index, MFAG, EmS Compatibility and segregation, Use of segregation table Precautions when handling dangerous goods, Dangerous cargo manifest, Inspections before loading dangerous goods Construction of magazine for carriage of explosives Limitations on carriage of explosives Precautions during stowage, handling, loading and carriage of explosives	
10	**Cargo calculations on Bulk Carrier:**	5 hrs

	Draft survey and calculations for quantity of cargo loaded.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Cargo Work for Ship officer – Capt Errol Fernandes
2. Cargo Work – Kemp and Young
3. Cargo Works – Taylor
4. Cargo Works – D.J. House
5. Cargo Notes- DhananjaySwadi
6. IMDG Code Vol I,II & Supplement
7. IMO Grain Code, IMSBC Code &BLU Code

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SEMESTER – IV

UG 21 T4404	LIFE SAVING & FIRE FIGHTING APPLIANCES	60 Hrs
1	**Life Saving Appliances:**	20 hrs
	SOLAS requirements for LSA's on Cargo Ships, Classification of ships for Life saving appliances. **Life boat**: Description of lifeboat. Construction and parts of life boat. Buoyancy tanks. Means of propulsion. Different classes of lifeboats used. Totally enclosed lifeboats, partially enclosed lifeboats. Determining the carrying capacity of a lifeboat. Lifeboat equipment, rations, GMDSS life-saving appliances, EPIRB, SART, Pyrotechnics on board and in Lifeboat. Types of Life boat davits and their method of operation, Life boat on load release, Precautions when lowering/ launching survival crafts; Recommended procedures for launching and retrieving enclosed lifeboats and free fall life boats; Simulated launching of free-fall lifeboats; use of fall preventer device (FPD); launching appliances and arrangements of survival craft; importance of cut-off switches; **Liferaft**: -*Types of Life raft davits and their methods ofoperation,*Inflatable and rigid. Construction and parts of life raft. Life raft equipment, ration and distress signals. Repairing leaks and punctures. Boarding a life raft. Inflatable chute, use of hydrostatic release unit (HRU); Procedure to inflate liferaft; method of righting a liferaft; **Life Buoy**: - Description of a lifebuoy. Correct procedure for use of a lifebuoy, MOB marker; Attachments of lifebuoys **Life Jacket**: - Description of a life jacket. Buoyant material used. The correct method of putting on a life jacket and jumping into water, **Immersion suits, TPAs** and **Line Throwing Appliances**: - Description and use of line throwing appliance, care and maintenance of life saving appliances. Operation of survival craft and rescue boats; Procedure to start lifeboat and rescue boat engines; life boat and liferaft repairs.	
2	**Introduction to Fire Fighting:**	4hrs
	Safety & Principles	

	Theory and Chemistry of Fire Fire triangle, Spontaneous Combustion. Limits of flammability. Advantages of various fire extinguishing agents including vaporising fluids and their suitability for ship's use. *Classes of Fire*, Control of Class A, B and C fires.	
3	**Fire Prevention:**	4hrs
	SOLAS Convention, Requirements in respect of materials of construction and design of ships, Fire detection and Extinction systems, Escape means, Electrical installations, Ventilation system and venting system for tankers. Statutory requirements for fire fighting systems and equipment on different vessels.	
4	**Fire Detection and Safety Systems:**	5 hrs
	Fire safety precautions on cargo ships and tankers during working. Types of Detectors, Selection of Fire Detectors and Alarm systems and their operational limits. Commissioning and periodic testing of sensors and detection system. Description of various systems fitted on ships. Fire Fighting Equipment (Fixed & Miscellaneous types)	
5	**Fire Fighting Appliances:**	20hrs
	Construction, operation and merits of different types of portable and non-portable fire extinguishers and fixed fire extinguishing installations for ships. Fire hydrants and hoses. Types of connections. International shore connection. Types of nozzles, Description of portable fire extinguishers, various types and their suitability for different types of fires. Properties of chemicals used. CO2 systems and inert gas systems. Fireman's outfit, its use and care. Maintenance, testing and recharging of appliances. Operation and refilling of fire extinguishers. Safety devices: i) Fireman's outfit, Smoke helmet and Self- Contained Breathing Apparatus (SCBA).Safety lamps and their arrangement for prevention of sparks. Fire axe. Asbestos suit, Fixed smothering system: Brief description of steam smothering system, Carbon dioxide smothering system, Inert gas system, Flue gas system, Foam smothering system for liquid fires, High expansion foam system, Care and maintenance of all fire fighting	

	appliances. Use of EEBD; Action to be taken in the event of fire, including fires involving oil systems; Operation, care and maintenance of FFA equipment; Fire Drills and statutory requirements for fire drills;	
6	**Fire Control, Fire fighting & Shipboard Organisation:**	7 hrs
	Action required and practical techniques adopted for extinguishing fires in Accommodation, Machinery spaces, Boiler rooms, Cargo holds, Galley etc. Fire fighting in port and dry dock. Procedure for re- entry after putting off fire, Rescue operations from affected compartments. First aid, Fire organization on ships. Fire signal and Muster. Fire drill. Leadership and duties.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Life Boat and Life Raft - Capt. Puri S.K.
2. Survival at sea - C.H. Wright
3. Theory and Practice of Seamanship - Danton G.
4. Seamanship Notes - Kemp & Young
5. Seamanship & Nautical Knowledge- Nicholls
6. Life Saving Appliances Rules - Govt of India
7. Fire Fighting Appliances Rules -Govt of India
8. Seamanship – D.J House

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SEMESTER - IV

UG 21 T4405	MARINE ENGINEERING, AUTOMATION & CONTROL SYSTEM, PAPER-II	70Hrs

1	**Internal Combustion Engines:**	8 hrs
	Working principles: Classification of various types of engines, various types of modern diesel engines. Basic principles of cycles, P-V diagrams. Work done etc. four stroke and two stroke engine. Components; Construction, main components and working of two and four stroke engines.	
2	**Marine Engineering Auxiliaries:**	14 hrs
	Fuels; Different types and properties. Fuel storage and supply on board the ship. Treatment of fuel. Calculate bunker fuel required for the voyage, speed for a given daily consumption, speed required to complete a voyage with given consumption. Turbines; Impulse and reaction turbine, gas, turbines, steam turbine operations and care. Turbines as prime movers for various duties including as cargo pumping operations of tankers. Propellers and main shafting; types of propeller, fixed pitched and variable pitch propellers. Pitch, pitch angle, real and apparent slips, propeller efficiency, calculations. Shafting tail end shaft, thrust block, intermediate shaft, alignment. Effect of condition of hull, tips of propeller on fuel coefficient, fuel consumption and propeller efficiency. Deck machinery; cargo winch, windlass, lifeboat winch. Hydraulic, pneumatic electric drives. Safety features. Pollution control; Sewage Treatment plant, Bilge oil water separator, Control of pollution form machinery exhausts, Operation of a waste incinerator regulations.	
3	**Main Propulsion Units (IC Engines & Others):**	14 hrs
	Process of exhausting, scavenging and supercharging. Scavenge fire. Lubricating oil, jacket (and other) cooling water system. Types of lubricating oils for different duties. Simple CW, L.O. and F.O. flow circuit for large diesel engine. Reasons and method of chemical treatment of CW system. Testing of jacket cooling water. Operations of IC engine as main propulsion engine. Warning up, starting maneuvering, reversing and full power running of the main engine. Limitations and care required on IC engine during manoeuvring and at full power. Purpose of turbocharger and need to control rpm whilst carrying out turbocharger washing. Selection criterion of IC engines, power weight ratio, specific fuel consumption, indicated power, brake power, shaft power, delivered power, thrust power, effective power. Various efficiencies, calculation. Maximum continuous rating (MCR). Calculation of fuel consumption, economic speed. Heat balance, various losses and calculations. Other Propulsion units: Steam	

	turbine, gas turbine as main propulsion units. Advantage and disadvantages. Maneuvering operations.	
4	**Automation & Control Engineering:**	10 hrs
	Growth in shipboard automation, understanding terminology. Transmitter and actuators. Automatic control systems open loop, closed loop control system, general principles. Controllers and proportional controller. Pneumatic, hydraulic, electric, electronic control systems. Applications in various shipboard operations. Bridge control on main propulsion. Manoeuvring aids – CP. Propeller, bow thrusters. Care and precautions. Construction and operation of fin stabilizer. Arrangements necessary for appropriate and effective engineering watches to be maintained for the purpose of safety under normal circumstances and UMS operations. Arrangements necessary to ensure a safe engineering watch is maintained when carrying dangerous cargo. Trim indicator, heel indicator, draft gauge, load and stress indicators. Types of remote control valves used on board ships. Remote operation for loading, discharging and ballasting operations. Information display, data logging, alarm systems. Testing and maintenance.	
5	**Safety Arrangements:**	4 hrs
	Inert gas for cargo. Inert gas production, generation from boiler fuel gas etc. inert gas system plant. Use of O2 analyzer, explosive meter, dragger pump and other portable measuring instruments.	
6	**Steering Gears:**	4 hrs
	Electro hydraulic ram steering gear, Rotary vane steering, Electric steering, Single failure criteria, Variable delivery pump, Steering gear circuits, Rules & Regulations.	
7	**Deck Machinery:**	4 hrs
	Windlass, Capstan, Automatic constant-tension mooring winch, Winches for cargo handling, Cocks& valves, Bow thrusters, Whistle.	
8	**Pump & Pumping System:**	4 hrs
	General, Types of pumps, reciprocating piston pump, gear pump or gear wheel pump, screw pumps or screw displacement pump, trochoid gear pump, centrifugal pump, axial flow pump, use of different type pumps, bilge & ballast system of a dry cargo vessel, pump and pumping system of gas, chemical & oil tankers.	
9	**Engine Room Watchkeeping & Equipment Operation:**	4 hrs
	The engine department, watchkeeping system, watchkeeping, UMS, periodic safety routines, heavy weather precautions for main propulsion plant, steering, etc.	
10	**Refrigeration, Air Conditioning & Ventilation:**	4 hrs
	Refrigeration principle, trouble shooting, air conditioning systems, ventilation.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Basic Marine Engineering – J. K. Dhar
2. General Engineering Knowledge for Engineer – Reeds Vol-8
3. Marine and offshore pumping and piping systems – Crawford
4. Engineering Drawing – Reeds
5. Motor Engineering Knowledge for Marine Engineers – Reeds Vol. 12
6. Basic Electro technology – Reeds Vol. 6
7. Marine Electrical Equipment & Practice – McGeorge
8. Marine Engineering Practice Vol. 2 Part 17 Slow Speed Diesel Engines by Institute of Marine Engineers (England)
9. Marine Machinery – Harrington

INDIAN MARITIME UNIVERSITY

SEMESTER –IV

UG 21 T4406	**METEOROLOGY**	**80 Hrs**

Objective: To impart Advanced knowledge of Marine Meteorology, which are required during day-to-day Ship Operations.

1	**Climatology:**	12 hrs
	Wind and Pressure systems over the oceans; Mean Surface Pressure and Wind distribution; Anabatic and Katabatic winds; Land and sea breezes; Local winds; Westerlies, Polar Easterlies, Monsoons, Doldrums and Inter-tropical Convergence Zones; General distribution of surface temperature, surface current, sea fog, pattern of clouds; Dynamics of Indian monsoon; Seasonal weather & climatic characteristics in India.	
2	**Weather Systems:**	9 hrs
	Air Masses; Factors governing development; Classification and properties of air masses; Types of fronts and associated weather ; Warm Front, Cold Front, Weather associated with Cyclone, Anticyclone, Ridge, Col, Trough and other pressure systems; Origin, life and movement of Frontal Depressions; Structure of Depressions.	
3	**Weather Reports:**	5 hrs
	Types of weather services for shipping; Meteorological Offices; Weather Facsimile Receiver; Digital weather receivers; Ship's weather code for sending reports; Coding and Decoding of weather messages; Weather reporting and recording procedures; Weather observation reports;	
4	**Weather Forecasting and Reporting System:**	15 hrs
	Methods and techniques; Sources of meteorological data; Symbols on weather charts and associated weather; Cold and warm front, Occlusion on a synoptic chart; Codes on a synoptic chart and analysis of synoptic charts; Interpretation of symbols and isobaric patterns on weather charts and facsimile charts; Structure of weather bulletin; Voluntary observing fleet under I.M.D; type and nature of information collected: ships weather code; weather reporting from ships and its significance in weather forecasting. International system of weather reporting;	
5	**Ice on the Sea:**	4 hrs

	Different types of ice, icebergs, limits of icebergs, accumulation of ice on ships.	
6	**Tropical Revolving Storms (TRS):**	10 hrs
	Local names, seasons and areas affected; Origin, structure, movement and lifespan of TRS; Weather associated with TRS; Definitions and nomenclature; Warning signs of an approaching TRS; Characteristics of TRS; Forecasting techniques; Action to be taken when the presence of TRS is confirmed; Cyclone tracking and warning bulletins under international conventions; Practical Rules for navigation for manoeuvring in the vicinity of TRS; Avoidance of storm centres and the dangerous quadrants; Ideal conditions for the formation of TRS; Comparison between a TRS and a temperate latitude depression; Avoiding TRS – 1-2-3 theory and sector theory.	
7	**Ocean Circulation System and Sub- Surface Circulation:**	7 hrs
	Identification of main ocean currents on the world map; Causes of ocean currents; Characteristics of ocean currents; General circulation of currents; Effect of ocean currents on the climate; Seasonal changes; Formation, source region and movement of water masses.	
8	**Oceanic Waves and Tides:**	8 hrs
	Speed, length, period, height and significance of waves; difference between waves and swell;types of waves, wave energy, behaviour of wave in deep and shallow waters; sea waves, swell, storm surge, tsunami, bore tides; tide producing forces, types of tides, tide prediction and analysis; tidal streams; co-tidal charts; interpretation of tidal charts; relationship between tides and phases of moon.	
9	**Sea Water:**	3 hrs
	Properties of ocean water- Temperature, salinity, density - their relationship and measurement; and vertical and horizontal distribution.	
10	***Ship Borne Meteorological Instruments:***	7 hrs
	Principle, construction, use and operation of Aneroid Barometer, Barograph, Hygrometer, Hydrometer, Stevenson's screen, Whirling psychrometer, Anemometer.	

RECOMMENDED BOOKS FOR REFERENCE:

1 Marine Meteorology – Capt. H. Subramaniam
2 Meteorology for Mariners- HMSO
3 Meteorology for Seafarers- Frampton, R.M
4 Meteorology Demystified: self teaching guide- Gibilisco Stan
5 Dynamical Meteorology: an introductory selection- Atkinson, B.W.
6 Meteorology at Sea- Sanderson Ray
7 Meteorology - Charles W. Roberts
8 Mariners Handbook (NP 100) - Admiralty
9 Cloud Types for Observers- HMSO
10 Ships' Code and Decode Book- The Met. Office

INDIAN MARITIME UNIVERSITY

SEMESTER – IV

UG 21 P4407	SEAMANSHIP LAB –II (PRACTICAL)	60 Hrs

Objective: To impart necessary Seamanship hands-on training required for Nautical Cadets.

1	**Blocks and Tackles:**	15 hrs
	• Conduct practical exercise on the use of blocks, snatch blocks and the differential pulley (chainblocks). • Demonstrate the method of reeving a threefold purchase.(group activity of 2-3 cadets) • Overhauling of blocks • Conduct practical exercises on the use and maintenance of various types of blocks, tackles, shackles and bottle screws / turnbuckles, including opening, greasing, (group activity of 2-3 cadets) • Demonstrate the use of container lashing gear. (group activity of 2-3 cadets)	
2	**Flag work:**	15 hrs
	• Recognition of Nation flag of all countries, Recognition of House flag, Recognition of flag denoting numbers and flags used as substitutes, How to bend on or unbend a flag from halyard. Breaking a flag at close up, Flag hoisting practice at colours and sunset, Practical usage of "International Code of Signals".	
3	**Fire Fighting:**	15 hrs
	• Fire Fighting Drills, • Demonstrate use of vaious types of Fires and Extinguishers. • Refilling of Foam and DCP types Portable Fire Extinguishers, • Connecting Coupling to fire hose using Copper Seizing wire • Handling charged Fire hose during fire drill • Creating water wall with spray nozzle. • Donning Self Contained Breating Apparatus • Operation of Breathing apparatus Compressor, • Refilling the air bottles by compressor, • Entering a smoke filled compartment wearing breathing apparatus. • Rendering first aid to a person injured during fire.	
4	**Life Saving Appliances:**	15 hrs

	• Demonstrate the correct method connecting Life raft painter, hydrostatic release unit (HRU) and weak link. • Identify Life boat equipments and their uses. • Identify parts of Life boat davit. • Demonstrate the method of changing Life boat falls end to end • Care and Maintenance of Immersion suit.	

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SEMESTER –IV

UG 21 P4408	MARINE ENGINEERING WORKSHOP – II, PRACTICAL	60 Hrs

Objective: To impart necessary hands-on training on various equipments in Marine Engineering Workshop

1	**Mechanical Drawing:**	10 hrs
	• Brief description of drawing papers, pencils, instruments & their use. Types of lines & dimensioning. Loci of points. Orthography projection of points. Straight lines, planes, solids. Isometric projection. Concept of form and shape, plan, elevation and end views of objects. Contours, change of sections, hidden (Internal) construction, dotted lines, etc. • Discussion on ship's plans. Isometric views, cut/cross sections. Simple assembly drawings engineering drawing by free hand sketching.	
2	**Hydraulics Workshop:**	20 hrs
	• Identify various components used in hydraulic system. • Interpret basic hydraulic circuit diagrams .Explain with sketch the purpose and symbols of direction control valves and methods of their operation. • Identify symbols of various accessories used in hydraulics such as heater, cooler and filters, pressure control valves and flow control valves, actuators and pumps. • Use ermeto type couplings for joining pipes taking safety precautions. • Execute common fault finding and rectification in hydraulic system taking safety precautions. (group activity of 2-3 cadets). • Use the hydraulic hand pump used for emergency operations in the hydraulic system taking safety precautions. • Carry out air purging in the hydraulic system taking safety precautions. • Tighten leaking hydraulic connections taking safety precautions. • Demonstrate the procedure to clean and replace filters in the system taking safety precautions (group activity of 2-3 cadets). • Demonstrate the ability to prepare and start a hydraulic power pack system including accumulator and expansion tanks taking safety precautions (group activity of 2-3 cadets). • Demonstrate the understanding of working of hydraulic door closer taking safety precautions.	
3	**Pneumatics Work Shop:**	20 hrs

	• Identify the various equipment operated by pneumatics such as pneumatics wrench, lights, grinders, drilling machines, spray painting machines etc. • Identify various components used in pneumatics like relays, transmitters, actuators etc. • Identify symbols used in pneumatics and how they are different than the hydraulics. • Trace the simple pneumatic circuits • Detect and rectify common faults in pneumatic circuits. • Demonstrate the ability to clean compressedair filters including dryers (dehumidifier) (group activity of 2-3 cadets) • Demonstrate the ability to overhaul the pneumatictools / equipment such as pneumatic torque wrench (group activity of 4-5 cadets)	
4	**Machining:**	10 hrs
	• Cutting, filing, preparation of level surface on metals • Drilling, tapping, reamer operations • Shaping, drilling, grinding operations • Thread cutting by taps and die • Thread cutting by lathe machine	

B.Sc. NAUTICAL SCIENCE

	SEMESTER - V	Hours
UG21T4501	Coastal Navigation & Collision Prevention Regulations	80
UG21T4502	Naval Architecture Paper – I	80
UG21T4503	Ship Maintenance and Emergencies	74
UG21T4504	Specialised Cargo Handling & Stowage	80
UG21T4505	Shipping Management	70
UG21T4506	Bridge Equipment & Watch keeping Paper -II	80
UG21P4507	Ship Operation Technology Lab (Practical)	60
	TOTAL	524

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SEMESTER V

UG 21 T4501	**COASTAL NAVIGATION & COLLISION PREVENTION REGULATIONS** *Chart No. BA 5047/BA 5048/ BA 813*	**80Hrs**

SECTION A

1	**Position Lines and Positions:**	5 hrs
	Finding the position by range and bearings; Dead reckoning position (DR); Estimated position (EP); Observed position (Fix); Set and drift of current; Leeway; position fixing by horizontal and vertical sextant angles and related exercises.	
2	**Tidal Calculations:**	8 hrs
	Calculating predicted time and height of high and low water at standard and secondary ports (including intermediate times and heights); Tidal stream atlas; Tidal information given on a chart; Obtaining current direction and rate from approach charts;	
3	**IALA System of Buoyage:**	4 hrs
	Various buoys and marks as per IALA system of buoyage; Precautions whilst using floating navigational aids such as buoys, light vessels;	
4	**Chart Work Exercises:**	20hrs
	Ship's speed, effective speed, course and distance made good and applied leeway; Determining ship's position by the Running Fix, with and without current; Determining ship's position by doubling the angle on the bow; Keeping safe distance off the coast using single position line obtained from celestial observations.	
5	**ELEMENTARY KNOWLEDGE OF PASSAGE PLANNING AND ITS EXECUTION:**	13hrs
	Plan a passage between two ports from berth to berth using the procedures for passage planning (taking into consideration important factors such as	

	ship type, draft and displacement of ship, depth of water, distance off dangers, current, TSS, navigations aids available, Ocean Passages of the World, Sailing Directions, Routeing Charts, List of Lights and Fog Signals, List of Radio Signals, Guide to Port Entry etc.); Landfall in thick and clear weather; Selection of a suitable anchorage. Appraisal – Ascertain the charts and publication required for the voyage (use the Admiralty Catalogue to identify the charts) and whether they are corrected and up-to-date, Extract all relevant information from the publications and obtain weather prognosis. Planning – Plot courses on the charts, both small and large scale, way points, no-go areas, contingency anchorages, alerts, abort points and other relevant marks; Select a suitable anchorage; Selection of ocean routes; Execution – During the voyage, fix positions as indicated on the passage plan, maintain sufficient bridge manning levels, obtain Navigational and weather warnings, maintain lookout and navigate to keep clear of other vessels and navigational hazards. Monitoring – Monitor frequently the traffic, position, weather, visibility and maintain a situational awareness at all times. Check the proper functioning of navigational instruments and fills up logs periodically during watch.	

SECTION B

International Regulations for Preventing Collisions at Sea (IRPCS) 1972, as Amended:

1	**I) Collision Prevention Rules:**	30hrs
	i) Rules 1 to 41, Applications of these rules, already studied in the last semester	
	ii) Annex I: Positioning and Technical details of Lights and Shapes	
	iii) Annex II: Additional Signals for Fishing Vessels Fishing in Close Proximity	
	iv) Annex III: Technical Details of Sound Signal Appliances	
	v) Annex IV: Distress Signals	
	vi)Case Studies: Discuss Investigations of Marine accidents with reference to COLREGS 1972, carried out by Various Administrations and Organisations	

Text Book :

Chart Work for Mariners- Puri, S.K.

RECOMMENDED BOOKS FOR REFERENCE:

1. Admiralty Tide Tables
2. IALA Maritime Buoyage System
3. Ocean passages of the world
4. The Admiralty Manual of Navigation: Principles of Navigation: Vol. 1- Nautical Institute
5. Navigation Guide Vol. 1: Near Coastal Navigation- Alexander Simpson
6. NAV Basics: The Earth, the sailings, Tides & Passage Planning Vol.1- Witherby Seamanship International Ltd.
7. Admiralty publication NP 294 (How to keep charts up to date)
8. Modern Chart work- Squair, W.H
9. Chart Work: Basic Concepts & Miscellaneous Calculations- Chaudhari S.S
10. Chart Correction Log- Admiralty Charts and Publications
11. Catalogue of Admiralty Charts and Publications- Admiralty Charts and Publications
12. IMO Rules of the Road – Bhandarkar Publications
13. International Lights, Shapes and Sound Signals – D. A.Moore
14. International Regulations for Preventing Collisions at sea- Nautical Press

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SEMESTER – V

UG 21 T4502	**NAVAL ARCHITECTURE PAPER - I**	**80Hrs**
1	**Simpson's Rule:**	15hrs
	Use of Simpson's Rules for the computation of second moment of area (Moment of Inertia).	
2	**Centre of Pressure:**	7hrs
	Centre of pressure for regular shapes, Centre of pressure for combination of regular shapes.	
3	**Bilging:**	15hrs
	Effects of Bilging of a Compartment, Permeability of a compartment, Calculation on bilging and flooding of a compartment, symmetrical about centre line anywhere along the ship's length for a box-shaped vessel, Actions to be taken in the event of partial loss of intact buoyancy.	
4	**Dry – Docking and Grounding:**	10hrs
	Stability and trim during Dry- docking and Grounding.	
5	**Stresses & Strains:**	10hrs
	Stresses & strains in ships in still water and in seaway, Hogging, Sagging, Racking. Tortional Stresses, Parts of Ship specially strengthened and stiffened to resist such stresses including Panting & Pounding (Slamming).	
6	**SF & BM**:	12hrs
	Shearing Forces and Bending Moment, The ship as a box shaped girder, The calculation, and graphical representation of the SF and BM for box- shaped vessel, on even keel, under various conditions of load.	
7	**Increased Beam or Freeboard – Effect on Ship Stability:**	2hrs
	Effect of increasing beam and freeboard on Ship Stability.	
8	**Loadicator:**	5hrs
	Modern methods of determining the effect of different conditions of load and ballast on the Ship structure and stability-Loadicator, Stress tables and stress calculating equipment.	
9	**Inclining Experiment:**	4hrs
	General ideas on the Inclining Experiment (Theory only).	

RECOMMENDED BOOKS FOR REFERENCE:

1. Ship Stability for Masters & / Mates - C.B.Barrass and D.R.Derrett
2. Ship Stability for Mates & Masters - Martin A. Rhodes
3. Ship construction –D.J. Eyres
4. Ship Construction for Engineers - Reid
5. Ship construction - Pursey

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SEMESTER – V

UG 21 T4503	SHIP MAINTENANCE AND EMERGENCIES	74 Hrs

1	**General Ship Maintenance:**	10hrs
	Preparing a surface for painting. Removing rust and scale by chipping hammers. Paint brushes. Painting defects and their Prevention, Cleaning of wooden decks, Cleaning and polishing of brass and copper.	
2	**Inspection and Maintenance of Ship and Equipment:**	10hrs
	Items to cover include Hull, Bulkheads, DBs, Deep and Peak tanks, Bilges, Pipelines, rudders, Anchors, Cables. Davits, safety equipment, derricks and other cargo gear, Navigation lights, A practical knowledge of screening of Navigational lights.	
3	**Planned Maintenance System:**	10 hrs
	Inspection and maintenance of the ship and equipment; purpose of PMS; types of PMS. Hatch-covers Types of hatch covers; operation and maintenance of hatch covers; side cleats and cross-joint wedge mechanism, weather tightness and hose testing before loading, Ultrasonic testing of hatch covers.	
4	**Contingency Plans for Response to Emergencies:**	18 hrs
	List the Contents of muster list, Describe the divisions of the crew into a command team, emergency team, back-up team and engine room team. State that good communication between command team and emergency teams are essential, Describe the actions taken in various emergencies, Measures to be taken in emergencies for the protection and safety of the ship, passengers and crew, Actions to be taken on stranding. Initial damage, assessment and control, sounding of compartments, sounding depths all round the ship using hand-lead line. State the Actions to be taken following a collision, considering Initial damage, assessment and control, stoppage of engine, preparing life boat. Sending distress or urgency signal, Precautions for the protection and safety of passengers in emergency situations; warning the passengers, evacuating all passengers, taking a roll call, instructing passengers during drills and supply of blankets. Means of limiting damage and salving the ship following a fire or explosion: Cooling of compartment boundaries, inspection for damage.	

	Procedure for abandoning ship: Transmission of distress call until acknowledged, Extra food and blanket, EPIRB, SART and hand held VHF sets, warm clothing and life jackets, TPA and Immersion suits, launching rescue boat in heavy weather, use of parachute rocket, line-throwing appliances and breeches buoy. Use of emergency steering: Arrangement of emergency steering, Arrangements for towing and being taken in tow: Towing equipment and tools on board ship, methods of towing disabled ship and communication between two ships. Rescue of persons from sea or from a vessel in distress: Use of oil in rough weather, waiting for day light, providing a lee, method of rescue when sea conditions are too dangerous to use boat.	
5	**Dry Docking Operations:**	10 hrs
	Dry Docking – general procedures – Precautions to be observed – Distribution of weights, preparations and the checks prior and after sitting on blocks and prior flooding the dry dock. Routine maintenance in the dry dock.	
6	**Maintenance of Crew Accommodation:**	5 hrs
	General cleaning and maintaining hygiene in crew quarters, Methods of Pest control. Fumigation of holds and living spaces.	
7	**Preparation for Various Surveys of Ships:**	6 hrs
	Preparations with reference to Safety Equipment, Load Line, IOPP, Safety Radio and Safety Construction Certificates with particular attention to maintenances aspects.	
8	**Respond to Distress Signal at Sea:**	5hrs
	Measures for assisting a vessel in distress: Knowledge of the contents of the IAMSAR, various search pattern and signals to be made by ships & aircraft. Man-overboard procedures: Initial actions, use of man-overboard function in GPS for homing in to the man in the water, preparations for rescuing man, picking up man and picking up boat.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Ship Board Operations by H.I. Lavery
2. Life Boat and Life Raft - Capt. Puri S.K.
3. Survival at sea - C.H. Wright
4. Theory and Practice of Seamanship - Danton G.
5. Seamanship Notes - Kemp & Young
6. Seamanship & Nautical Knowledge- Nicholls

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SEMESTER – V

UG 21 T4504	**SPECIALISED CARGO HANDLING AND STOWAGE**	**80Hrs**
1	**Introduction to Specialized Ships and Cargoes:**	5hrs
	Heavy lift ships and heavy lift cargoes, refrigerated ships and reefer cargoes, dangerous goods, multipurpose ships, ro-ro ships and their cargoes, offshore supply vessels and their functions**.**	
2	**Containers:**	10hrs
	Parts and Features of a container Types, sizes and markings of containers. Segregation and care of containers carrying dangerous goods, Stowage and securing gear of containers viz. container shoes, stacking cones, interlayer stackers, twist locks, bottle screws and turnbuckles. Arrangement of a container ship, and how the position of container is designated, Bay plans and stack weight, Factors affecting a container stow: Stability, trim, list, stresses, stack height, weight, dangerous goods, special requirements, Anti-heeling tanks Torsional stresses Container code (CSC). Special requirements of Dangerous Cargo, reefer containers and out-of-gauge containers Securing and lashing arrangement of containers. Out of Gauge container, damages to container, checks to carried out on reaper container.	
3	**Refrigerated Cargo and Reefer Ships:**	5hrs
	Cooled, chilled and frozen cargoes with examples. Preparation of holds, Dunnaging requirements, Inspections of the cargo,	

	General outline of refrigeration systems (Direct, Indirect and air-cooled systems) Care, monitoring and records of cargo during passage, Purpose of temperature recording. Use and inspection of cargo and brine traps Pre-cooling and preparation of cargo spaces General precautions to be observed whilst working cargo	
4	**Oil Cargoes, Oil Tanker Operations and Related Pollution- Prevention Regulations:**	20 hrs
	History of oil carriage Crude oil, Refined products, Spiked crude, Sour crude, Reid vapour pressure, Upper and lower flammable limits, Pour point. Flammability diagram, Flammable Range, Lower and Upper flammable limits. Threshold Limit Value. Tanker arrangement (tanks, pump rooms, slop tanks, cofferdams, deep tanks) Cargo piping system (Free flow, Ring main, Direct) and pollution prevention. Segregated ballast, Clean ballast, Dirty ballast, Slop tank and handling of slops, Load-on-top, ODMCS Inert gas system including boiler uptake valve, scrubber, blowers, oxygen analyser, deck seal, non-return valve, PV valve, PV breaker and mast riser Crude Oil Washing, its hazards and benefits, Items of COW checklist, MARPOL regulations for COW Cleaning, purging and gas freeing procedures Items of pre-arrival checklist Loading and discharging operations on a tanker. Procedure for man entry in enclosed spaces on tanker The use of Oxygen analyser, Explosimeter, Tankscope, Multigas detector using tubes Cargo pumps (Centrifugal, Reciprocating, Eductors) Contents and application of the International Safety Guide for Oil Tankers and Terminals ISGOTT, Check list as per ISGOTT Cargo calculations for quantity and ullage of oil cargo based on volume and height of space, density of cargo and temperature change.	
5	**Heavy Lifts:**	3hrs
	Effect of the heavy lifts on the seaworthiness and the stability of the ship;	

	Precautions to be taken whilst loading/discharging heavy lifts.	
6	**Deep Tank Cargoes:**	3hrs
	Procedures for cleaning and preparation of deep tanks for loading. Securing of deep tank lids	
7	**Chemical Tankers (SOLAS Chapter VII, MARPOL Annex II, IBC Code):**	9 hrs
	Type 1, Type 2 and Type 3 chemical tankers Various categories (X,Y,Z, OS) of cargoes Hazards associated with chemical cargoes and control measures Various types of tank coatings Purpose and use of IBC code. Purpose and objective of P & A manual Equipment for evaluation of tank atmosphere (flammable gas detector, O2 analyser and measurement of concentration of toxic gas), Threshold limit value (TLV) of product Odour threshold Information available in cargo data sheets With the aid of a simple diagram, a "closed circuit" loading operation using a vapour- return line Items of pre-arrival checklist Entries made in Cargo Record Book Independent, integral, gravity and pressure cargo tanks Typical tank arrangements with piping Tank cleaning and control of pollution in chemical tankers: Hazards involved with tank cleaning Use of slop tanks, Cycle of a tank washing system, wall wash test. Discharge criteria as per Annex II of MARPOL 73/78. Framo pump.	
8	**Gas Tankers :(Ch. VII of SOLAS, SIGTTO and IGC Code) LNG, LPG, LEG and Chemical Gases in Bulk:**	9 hrs
	Type A, Type B and Type C tanks; each cargo tank is fitted with high level alarm and auto- shut off.	

	Purpose and objectives of the IGC Code Hazards of gas cargoes and control measures adopted The terms- Boiling point, cargo area, cargo containment systems, gas carrier, gas/dangerous zone, gas- safe space, hold space, inter barrier space, MARVS, primary and secondary barrier, tank dome Various types of ships (Fully pressurized, Semi pressurized, Fully refrigerated) Various types of tanks (integral, membrane, semi-membrane, independent and internally insulated tank) Certificate of fitness Detection of cargo leakage through primary barrier Deepwell pump Re-liquefaction plant Contents of pre-cargo checklist Check list as per SIGTTO	
9	**Ro- Ro Vehicles and Multi-purpose Ships:**	5 hrs
	Preparation of the car decks for the loading of trailers and vehicles, Floating decks. Procedures for opening, closing, securing of bow, stern and side doors and ramps Care and maintain the systems. Maintaining water-tight integrity of the cargo decks. Cargoes common to multipurpose ships Features of multipurpose ships that make them suitable for a variety of cargoes	
10	**Offshore Supply Vessels:**	5hrs
	Types and features of Offshore supply vessels Use and purpose of OSVs.	
11	**Cargo Calculations:**	6hrs
	Oil Tanker – calculations involving determination of quantity of cargo.	

RECOMMENDED BOOKS FOR REFERENCE;

1. Cargo Work for Ship officer – Capt Errol Fernandes

2. Cargo Work – Kemp and Young
3. Cargo Works – Taylor
4. Cargo Works – D.J. House
5. Cargo Notes- DhananjaySwadi
6. ISGOTT, IGC Code, Container Code

INDIAN MARITIME UNIVERSITY

SEMESTER-V

UG 21 T4505	SHIPPING MANAGEMENT	70 Hrs

1	**International Trade and Shipping:**	6 hrs
	Seaborne trade of the world.Composition and direction of cargoes – Commodity groups- different types of ships which carry them – Technological developments. Measurement of shipping transport in ton-miles. Demand and Supply of ships. Shipping is a derived demand. How do Lay-up, scrapping, new-buildings and slow-steaming affect supply and demand.	
2	**Basic Structure of Shipping Industry:**	5hrs
	Type of Shipping Services - Liner and Tramp –Types of ships and cargoes in Liner and Tramp shipping. Freight brokers, Clearing and Forwarding Agents- Bunker and Stores suppliers, shipping Agencies.	
3	**Organization of Shipping Companies:**	8 hrs
	Role of Shipping Companies; Types of Shipping Companies - Manning – Business and cargo management; Statutory regulations affecting Shipping. Various departments in shipping company's office and their functions. Role of superintendents and Designated person in supply of stores, spare parts and other requisites to ships. Control of maintenance, surveys and inspections of ships.	
4	**Liner Trade characteristics:**	10 hrs
	Liner Conferences – How Freight rates are fixed Components of Liner Freight – Non Conference lines – competition. Procedures of Shipping cargoes and related documentation: Mate's receipt, Bill of Lading. Unitization. Containerization. Consolidation business. Consortiums of container ship companies. Multi-modal transport.	

5	**Ship Chartering:**	10 hrs
	Meaning of charter. Types of charters and their relevance to trades – Procedures and documentation relating chartering – Charter markets of the world – How freight/charter hire is fixed. Freight Indices of the Baltic Exchange and how they are used. Sighting of common charter parties. Charter party – various clauses and their interpretation	
6	**Role of ports**:	5 hrs
	Ports locations- functions and range of services.India ports, their organization and administration. Modernization and development of ports.	
7	**Contract of Affreightment:**	10 hrs
	Responsibilities, obligations, immunities and liabilities of carrier and shipper and the limitations of liabilities as per the - Carriage of Goods by Sea Act, 1925 The Indian Multimodal Transport of Goods Act, 1993 Hague Visby rules; Hamburg rules, Rotterdam Rules	
8	**Marine Insurance:**	10hrs
	Principles of marine insurance (Insurable interest, indemnity, subrogation, proximate clause). Application of risk management and risk transfer to marine insurance. Covers provided by H & M insurers and P & I liability insurers. Various policies and their salient clauses and warranties. Marine Insurance Act.	
9	**General Average:**	6 hrs

	Particular and general average. York-Antwerp Rules. Examples of GA and PA acts.	

RECOMMENDED BOOKS FOR REFERENCE:

1. The Business of Shipping by James, Jr. Buckley
2. Elements of Shipping Alan Edward Branch
3. Management (6/E) Stoner & Freeman
4. General Management - Processes & Action- David A. Garvin
5. Maritime Logistics: A Complete Guide to Effective Shipping and Port Management by Dong-Wook Song and Photis M. Panayides (May 28, 2012)
6. Maritime Economics (3/E) Martin Stopford
7. The Business of Shipping James, Jr. Buckley
8. Reeds Sea Transport: Operation and Economics (Reed's Professional) by Patrick M. Alderton

INDIAN MARITIME UNIVERSITY

SEMESTER - V

UG 21 T4506	BRIDGE EQUIPMENT &WATCH KEEPING PAPER - II	80 Hrs

SECTION A

BRIDGE EQUIPMENT

1	**RADAR** **Fundamental Principles of Radar:** Radiation hazards and precautions, Safety precautions necessary in the vicinity of open equipment, radiation hazard near antennae and open waveguides, The characteristics of radar sets: Bearing range accuracy, HBW. VBW, pulse length, pulse recurrence rate, Block diagram, use of various controls and radar as range and bearing measuring instrument, Safe distances: With respect to radar spares and magnetic compasses, maximum & minimum range of radar, range and bearing discrimination, Factors external to the radar set affecting radar detection, Radar horizon, sub refraction, super refraction & ducting, effect of precipitation and sea on radar detection, Factors that might cause faulty interpretation: Indirect echoes, side echoes, multiple echoes, second 'trace echoes. Bearing: Range & bearing accuracy, error in range & bearing. **Setting Up and Maintaining Displays of Radar and ARPA:** Function and adjustment of controls Transmitter controls, reception controls, display controls, different types of display, performance monitor. Measurement of range & bearings. **IMO Marine Radar Standards:** Marine Radar Performance Specifications, Performance standards for radar equipment, Limitations of the radar X-band and S-band. **Radar Plotting:** Plotting, The relative motion triangle: Drawing of relative motion triangle and identification of various vectors and angles, Plotting devices, Drawing the relative motion triangle on a plotting chart, Course, speed and aspect of other ships in relative and true presentation. Closest point of approach (CPA) and time t point of approach (TCPA), bow pass, in relative and true presentation and plot, Standardized report format and reporting procedure: Elements of the two parts of a report (bearing and change, range and change CPA, TCPA course, aspect and speed).	15 hrs

	Automatic Radar Plotting Aid (ARPA): Set vector lengths based on own vessel speed and range scale in use. Advantages and limitations of use of relative and true vectors and when to use which for optimum efficiency, The effect of course and speed changes on the display. Advantages of compass stabilization of a relative display, Use of Trial manoeuvre and predictive motion vectors.	
2	**The Use of Radar in Navigation:**	8 hrs
	Obtaining position fix by radar bearings and ranges, possible errors, Reliability of fix, Aids to radar navigation: Use of passive (trails, history) and active aids, RACONs and SARTs. Explain AIS overlay on radar / ARPA, The use of parallel indexing technique in radar navigation:, wheel over positions and safety margins.	
3	**Terrestrial Navigation Systems:**	5 hrs
	Principle, block diagram, working, and errors of new terrestrial electronic position fixing systems, e.g. E-Loran (when functional).	
4	**Gyro Compass:**	10 hrs
	The properties of free gyroscope. The relationship between applied force and precession. The effect of earth's rotation on a free gyroscope. Drift, tilt and damping. Errors associated with gyro compasses including latitude, course and speed error, ballistic deflection and its relation to change of speed error. Latitude, course and speed correction, rolling error and how it is minimized. The principal parts of gyro compass, follow up and repeater systems. Gyro-compass: Familiarisation with various types of Gyro-compasses used on Merchant Navy ships. Explain procedure starting and stopping and routine maintenance.	
5	**Ship Security Alert System (SSAS):**	3hrs
	Operation as per manual precaution and limitation.	
6	**Induced Magnetism in Ship and Magnetic Compass Corrections:**	5hrs
	The method of determination and compensation of the effects of a ship's magnetic field on the magnetic compass. Method of obtaining a table of deviations. Healing error effect and method of correction. Cause sitting of compasses with reference to the proximity of magnetic material and electric appliances. Care and maintenance of liquid compasses.	

7	**Various Other Navigation – Aids:**	10 hrs
	GPS & DGPS: Introduction, Basic working principle, limitation, errors, information, controls & setting & various alarm systems Explain "Global Navigation Satellite Systems" (GNSS) as a system of position fixing using earth orbiting satellites that broadcast their locations to receiver units which in turn calculate the ground position based on that State that presently fully operational GNSS systems arethe United States' Global Positioning System (GPS)and the Russian Federation's Global Navigation SatelliteSystem GLONASS). Indian Regional Navigational Satellite System (IRNSS) -operated by India Differential GPS (DGPS) system. Describe World Geodetic System 1984 (WGS 84) as a terrestrial reference system (geodetic datum) which is used by the GPS satellites for position fixing. Explain the basic working principle of GPS, its limitations & alarm setting. Augmented Satellite systems. **Automatic Identification System (AIS):** Purpose of AIS information exchanged and types of messages Ship to ship data exchange Information displayed on AIS screen Limitations of AIS and precautions during use of AIS for collision avoidance. **VDR (Voyage Data Recorder):** Concept and purpose of VDR Details of data recorded on VDR and the duration of data stored; modules of VDR float free Playback options S-VDR (Simplified VDR). **Bridge Navigation Watch Alarm System:** Operation as per manual, Precaution and limitation. **LRIT (Long Range Identification and Tracking):** Purpose of LRIT, Data transmitted by LRIT. Authorised receivers/ users of LRIT. Difference between LRIT and AIS.	

SECTION B

WATCH KEEPING

1	**Performing Safe Navigational Watch as per Section A- VIII/2 and B-VIII/2 of International Convention on Standards of Training and Watch keeping for Seafarers, 1978 as amended (STCW Convention):** Principles observed in keeping safe navigational watch. Relieving of duties, procedure of taking over watches. Effective use of all navigational equipment at their disposal. Operational test of shipboard navigational equipment shall be carried out at sea as frequently as practicable, Shall not be assigned or Undertake any duties which would interfere with the safe navigation of the ship, Shall not hesitate to use the helm, engines and sound signalling apparatus. A proper record shall be kept during the watch of the movements and activities relating to the navigation of the ship, Steering the correct course. The standard compass error is determined at least once a watch and, when possible, after any major alteration of course. The standard and gyro compasses are frequently compared and repeaters are synchronized with their master compass, Automatic pilot is tested manually, navigation and signal lights are functioning properly, radio equipment is functioning properly. UMS controls, alarms and indicators are functioning properly, Comply at all times with the requirements in force of the International Convention for the Safety of Life at Sea (SOLAS), 1974 as amended.	10hrs
2	**Action on Receiving Storm Warning:**	4 hrs
	Read barometer and record corrected barometric pressure, obtain average atmosphere pressure of area from publication like sailing direction, routeing chart etc. Reading Hygrometer & air temperatures. Estimate wind force, direction, & state of sea. Obtain sea water temperature, Understand obligations of Meteorological services as per SOLAS.	
3	**Bridge Procedures Guide and its Contents:**	5hrs
	Understanding of the principles of safe watchkeeping as detailed in the ICS Bridge Procedures Guide.	
4	**Watch Keeping at Sea under Different Conditions in Different Area:**	3 hrs
	In clear weather. In hours of darkness. In coastal and congested waters In rough whether Ice navigation & Ice patrolling as per SOLAS (SAFETY OF NAVIGATION).	

5	**Tests as per Safety of Life at Sea(SOLAS), as amended:**	2 hrs
	Preparation for proceeding to sea, making port and entering harbours	

RECOMMENDED BOOKS FOR REFERENCE :

1. Bridge Watch Keeping – Capt. H. Subramaniam
2. Bridge Procedure Guide - ICS
3. Bridge Team work - Nautical Institute
4. Bridge Equipments by Capt. A. Bhatia
5. Watch Keeping Notes – E. Fernandes
6. Electronic Navigation Systems by L. Tetley & D. Calcutt

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SEMESTER – V

UG 21 P4507	**SHIP OPERATION TECHNOLOGY LAB, PRACTICAL**	**60 Hrs**

Objective: To impart hands-on training on Ship Operations & Marine Communications.

1	**Watch Keeping & Marine Communication :**	15 hrs
	• Demonstration clear concise communication with positive reporting is adopted at all time in a seaman like manner with due regards to standard marine communication phrase. • Morse symbols for the alphabet and numerals, to send and receive morse code messages by flash lamp up to six words per minute. • Knowledge of operation of radio equipment to be carried and used in a life boat & life raft (EPIRB, SART etc), • Demonstrate close loop communications using VHF / Walkie Talkies, Ship to Ship and Ship to Shore communication exercises by portable VHF sets, Use of EPIRB & SART, Ability to transmit and receive the distress signal "SOS", urgency signal "XXX", and Safety signal "TTT".	
2	**SMCP:**	7 hrs
	• Demonstration of clear concise communication with positive reporting is adopted at all times in a seaman like manner with due regards to standard marine communication phrase.	
3	**Pilot Embarking and Disembarking:**	3 hrs
	• Explain action and precautions on Navigating Bridge during Pilot Embarkation and Disembarkation.	
4	• Safe working practices as per Code of safe working practices for Merchant Seaman.	10 hrs
5	**Enclosed Space Entry:**	5 hrs
	• Filling up the check list prior entering Enclosed Space and use of Gas measuring equipments- Explosimeter, O_2Analyser, Multi gas detector, Carbon monoxide detector, rescue of a person from enclosed space. • Demonstrate entering enclosed spaces with atmospheres suspected to be unsafe for entry- donning SCBA, permit systems and adequate safe working practices. (Group activity).	

6	**Corrosion Prevention & Surface Preparation:**	10 hrs
	• Demonstrate understanding of importance of 'Surface Preparation methods' required prior painting a surface. • Demonstrate the proper use of following Electric and Pneumatic machines for surface preparation Needle Guns, Chipping Machines, Angle Grinders. • Demonstrate the understanding of maintenance routines of above Equipments. • Demonstrate how 'Wet' and 'Dry' film thickness can be measured after painting a surface. • Explain the difference in results after painting a surface using a brush, a roller and using a sparay machine. • Demonstrate the use of a 'Paint Spray Machine' to paint a given surface after taking all due precautions.	
7	**Risk assesment:**	5 hrs
	• Carry out risk assesment for working on mast. • Demonsrate use of gas measuring instruments.	
8	**Moorings**:	5 hrs
	• Demonstrate taking rope stopper and wire stopper • Demonstrate rigging of slip wire • Demonstrates reeving the wire on the drum of mooring winch correctly. • Demonstrate putting number of lines on a single bollard • Demonstrate connecting mooring wire to tail by Mandal / Tonsberg shackle	

B.Sc. NAUTICAL SCIENCE

	SEMESTER VI	Hours
UG21T4601	Voyage Planning & ECDIS	90
UG21T4602	Naval Architecture Paper –II	80
UG21T4603	Ship Manoeuvring & Collision Prevention Regulations	75
UG21T4604	IMO & International Conventions	60
UG21T4605	Human Resource Management, Development & Leadership	80
UG21T4606	Marine Environmental Protection	75
UG21P4607	Navigation Lab (Practical)	64
	TOTAL	524

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SEMESTER – VI

UG 21 T4601	**VOYAGE PLANNING & ECDIS** ***Chart No. BA 5118/ BA 5056/ BA 2675***	**90 Hrs**

Objective: To impart knowledge of Chart Corrections, Voyage Planning Procedures & ECDIS, required for Deck Officers on Board.

1	**Chart Corrections:**	10 hrs
	Chart Folio system and Chart Correction Log (NP 131); Chart corrections; Procedures for correction of charts and publications including T&P notices, using information from Notices to Mariners and corrections using tracings; Use of Admiralty publication NP 294; Checking newly received chart for last correction; Chart correction using digital notices; Finding the date when chart was last brought up to date (***Practical exercises on Chart Corrections***). Corrections for digital publications, Digital Notices to Mariners	
2	**KNOWLEDGE OF VOYAGE PLANNING AND ITS EXECUTION:**	20 hrs
	Plan a voyage between two ports from berth to berth using the procedures for passage planning (taking into consideration important factors such as ship type, draft and displacement of ship, depth of water, distance off dangers, current, TSS, navigations aids available, Ocean Passages of the World, Sailing Directions, Routeing Charts, List of Lights and Fog Signals, List of Radio Signals, Guide to Port Entry etc.); Landfall in thick and clear weather; Selection of a suitable anchorage. ***(Practical Voyage Planning Exercises)*** Appraisal – Ascertain the charts and publication required for the passage (use the Admiralty Catalogue to identify the charts) and whether they are corrected and up-to-date, Extract all relevant information from the publications and obtain weather prognosis. Planning – Plot courses on the charts, both small and large scale, way points, no-go areas, contingency anchorages, alerts, abort points and other relevant marks; Select a suitable anchorage; Selection of ocean routes; Prepare a Voyage Plan document. Execution – During the voyage, fix positions as indicated on the voyage plan, maintain sufficient bridge manning levels, obtain Navigational and weather warnings, maintain lookout and navigate to keep clear of other	

	vessels and navigational hazards. Monitoring – Monitor frequently the traffic, position, weather, visibility and maintain a situational awareness at all times. Check the proper functioning of navigational instruments and fills up logs periodically during watch. Plan a passage between two ports from berth to berth using the procedures for passage planning (taking into consideration important factors such as ship type, draft and displacement of ship, depth of water, distance off dangers, current, TSS, navigations aids available, Ocean Passages of the World, Sailing Directions, Routeing Charts, List of Lights and Fog Signals, List of Radio Signals, Guide to Port Entry etc.); Landfall in thick and clear weather; Selection of a suitable anchorage. ***(Practical Voyage Planning Exercises)***	
3	**Ship reporting systems:**	5 hrs
	The use of reporting in accordance with general principles for ship reporting systems and with VTS reporting procedures INDSAR as per M.S. Notice of DGS	
4	**Bridge Resource Management:**	10 hrs
	Knowledge of bridge resource management principles including: allocation, assignment, and Prioritization of resources; effective communication; assertiveness and leadership; obtaining and maintaining situational awareness 1.Ocean Passages, 2. In coastal waters, 3. Restricted visibility, 4. Pilot embarked, 5. Action on receiving storm warming. 6.Monitoring of controls	
5	**Weather Routeing:**	5 hrs
	Weather routing services available to shipping; Shore based weather routeing; Information of current, wind and ice to select an optimum route, use of wave charts to select the best route; Basic considerations in Voyage Planning, selection and use of data; Least time track and ship's performance curves.	
6	**Voyage Planning Exercises:**	5 hrs
	Selection of ocean routes; Shore- based whether routeing; Planning & executive a coastal passage; Navigation in pilotage waters; Approaching and passing through a traffic separation scheme.	
7	**ECDIS:**	20 hrs
	IMO Performance standard for ECDIS, Difference between ENC and SENC, Safety Contours and Safety Depth, Features of ECDIS, Limitations of ECDIS Raster Charts, Vector Chart, Simplified Symbols (5012), Traditional	

	Symbols, Chart Quality and Accuracy (M Quality), Chart Scale, Information Layers. Practical - Draw courses Graphically and Alphanumerically, Indicate Courses and Distances, Set Track Limits, Set appropriate Alarms, Carry out Route Check, Modify Route, Create Maps, Prepare Schedule, Obtain Tidal Information, Chart Assistant	
8	**GMDSS:**	10 hrs
	Introduction and use of radio communication equipments on board ship for distress and safety, Basic knowledge of the various components of a shipboard GMDSS station. Communication procedure under GMDSS in Distress and safety situations in accordance with regulations contained in SOLAS, ITU and other publications. Selection of suitable frequencies, Radio regulations relating to maritime services including maritime frequency allocation, Satellite communication and alerting system-Equipment on board and shore. Methods adopted, Global Maritime Distress and Safety System-principle and actual application, World Wide Navigational Warning System-India's role for co-coordinator as area 8, Meteorological Broadcast- Routine weather messages and storm warnings, Search and Rescue Communication.	
9	**Documents:**	5hrs
	A systematic knowledge and use of the contents of the Sailing Directions, List of light and fog signals, List of radio signals, Ocean passage of the world, Notices to mariners, M & MS Notices and Guide to port entry.	

Text Book :
Chart Work for Mariners- Puri, S.K.

RECOMMENDED BOOKS FOR REFERENCE:

1. Admiralty publication NP 294 (How to keep charts up to date)
2. Catalogue of Admiralty Charts and Publications- Admiralty Charts and Publications
3. Chart Correction Log- Admiralty Charts and Publications
4. NAV Basics: The Earth, the sailings, Tides & Passage Planning Vol.1- Wither by Seamanship International Ltd.
5. The Admiralty Manual of Navigation: Principles of Navigation: Vol. 1- Nautical Institute
6. Navigation Guide Vol. 1: Near Coastal Navigation- Alexander Simpson
7. Practical Navigation for Officers of the Watch- Frost, A
8. Modern Chart work- Squair, W.H
09. Chart Work: Basic Concepts & Miscellaneous Calculations- Chaudhari S.S
10. Ocean passages of the world

11. Guide to Port Entry
12. Admiralty Sailing Directions
13. Admiralty List of Radio Signals
14. Admiralty List of Lights
15. GMDSS for GOC by Clifferd Merchant
16. Electronic Navigation Systems by L. Tetley & D. Calcutt

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SEMESTER – VI

UG 21 T4602	NAVAL ARCHITECTURE PAPER - II	80 Hrs
1	**Principles of Design:**	10hrs
	Overview of design principles of Oil Tanker, Bulk Carrier and Container ship covering 1. Longitudinal bending and transverse strength, 2. Continuity of strength- Joining of various strength members 3. Local strengthening – Panting, pounding, racking, stress concentrations, 4. Statutory requirements of Intact and damaged stability 5. Weather/Water tightness	
2	**Shipyard Plans and Practices:**	15hrs
	General ideas on various plans supplied by shipyard. An out-line knowledge of shipyard practice and procedure, Preparing and Drawing, Plans, Lines prior construction of a vessel, Process control and Prefabrication, Launching and Sea trials.	
3	**Various Specialised Ships:**	10hrs
	General ideas on strength and construction explained using Midship sections of Passenger ships, LASH, Ro-Ro,Refrigerated cargo, Liquefied gas carrier (LPG & LNG),Chemical tankers.	
4	**Ships' Corrosion and Control:**	10hrs
	Causes of corrosion in steel and also between dissimilar metals, Methods of corrosion control in Steel Work and also between dissimilar metals including cathodic protection, Impressed current system.	
5	**Surveys & Classification Societies:**	10 hrs
	An outline knowledge of the role and functions of Classification Societies, various classification societies and IACS,Surveys for assignments & retention of class.	
6	**International Tonnage Regulations:**	5 hrs
	An outline knowledge of Tonnage Regulations; Calculation of Gross Tonnage and Net Tonnage.	
7	**International Load Line Regulations**:	10hrs

	Load Line Regulations, Assignment of freeboard, Sub divisional Load Lines on passenger ships.	
8	**Factor of Subdivision and Criterion Numeral:**	10hrs
	Knowledge of application of floodable length curves, Factor of subdivision, Criterion of service numeral, Permissible length affecting hull division on passenger ships.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Ship Construction for Engineers - Reid
2. Ship construction –Pursey
3. Ship Construction by D. J. Eyres
4. Taylor- Ship construction
5. Ship Construction by Capt. ErolFernandes
6. Reed's Ship Construction for Marine Students E.A.Stokoe

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SEMESTER – VI

UG 21 T4603	SHIP MANOEUVRING & COLLISION PREVENTION REGULATIONS	75Hrs

1	**Types of Anchors and Anchor Work:**	5hrs
	Different types of anchors; stockless anchor; anchoring procedure; securing anchor for sea; covering spurling pipe; marking on anchor cable; chain hook; emergency use; use of bow stopper; sledge hammer; hanging off an anchor; breaking cables; connecting a lugless shackle; standing moor; running moor. Windlass; Terminology such as cable, link, swivel, joining shackle, shackle as a term of length, bitter end, a'cockbill(anchor ready for letting go), Anchor aweigh, clear hawse, foul hawse, clear or foul anchor, anchor dragging, long stay, short stay, up and down, to veer cable, weighing anchor, yawing, brought up to three in water / four on deck, devil's claw.	
2	**Anchoring:**	5hrs
	Procedures for anchoring in deep water and in shallow water, Load on anchor due to wind, current, waves, Yawing, factors involved in determining the length of cable to be used, anchor holding power Dragging anchor, clearing fouled anchor, hanging off anchor, slipping cable, Use the correct terminology for communication between bridge and anchor station crew, Use of anchor buoys, Marking of the cable, sealing of spurling pipes. Causes for loss of anchor.	
3	**Ship Manoeuvring:**	10 hrs
	The effects of various deadweights, draughts, trim, speed and under-keel clearance on turning circles and stopping distances. Manoeuvring Data of Ship: Advance, transfer, drift angle, tactical diameter, track reach, head reach, side reach, turning circles of a ship, directional stability. Effect of wind and current on ship handling: Effect of wind on a given ship	

	while moving and when making large turns, effect of current on the motion of the ship, Manoeuvres for the rescue of a man overboard: Immediate action, delayed action, single turn, Williamson turn and Scharnow turn, sequence of actions when a person is seen to fall overboard. Squat and Shallow-water and similar effects: Shallow water, squat and bank effect. Reduction in under keel clearance due to rolling and pitching Interaction between passing ships and between own ship and nearby banks (canal effect) Effectiveness of Bow thrusters and stern thrusters Rigging pilot ladder /combination ladder,	
4	Mooring Safety during mooring, snap back zone, Mooring plan of a ship, optimum mooring pattern and rope leads, load on mooring lines due to wind, current, waves, surging at berth, OCIMF recommendations on mooring equipment. Joining of two mooring ropes, slip wire. Dangers of using different rope types in one mooring system, making fast tugs, using fenders during berthing. Effects of under keel clearance on current, vertical dip, Synthetic fibre tails, Mooring winches – Heaving load, render load, stalling load Correct layers of lines on split drums, correct reeling of lines on drum Precautions in freezing weather, Mooring winch Brake testing Care of mooring ropes, Danger of belaying rope on a single bollard Single Point Mooring, CBM Mooring	10hrs
5	**International Regulations for Preventing Collisions at Sea (IRPCS) 1972, as amended** Revision of Regulations for the Prevention of collision at Sea, Overview of the Annexures to Colregs. Describe the positioning, spacing and screening of lights. Case study on collision	20hrs
6	**Navigation in restricted visibility:-** Navigational Equipment and Techniques used for safe navigation in restricted visibility (blind navigation / blind pilotage techniques). Procedures for embarkation and disembarkation	5hrs

	of pilot.	
7	Application of constant radial turn techniques, determining wheel over position, determining radius,	5 hrs
8	Contingency Plans – Grounding, beaching, collision, steering failure, parting of moorings at berth, spills of dangerous goods	5 hrs
9	Piracy – Best Management Practices for protection against Somalia Based Piracy	5 hrs
10	Basic ship handling in ice, sighting of ice / open water, working through ice, navigation in ice. Polar Code. effects of ice accretion on stability of vessel	5 hrs

RECOMMENDED BOOKS FOR REFERENCE:

1. Life Boat and Life Raft - Capt. Puri S.K.
2. Survival at sea - C.H. Wright
3. Theory and Practice of Seamanship - Danton G.
4. Seamanship Notes - Kemp & Young
5. Seamanship & Nautical Knowledge- Nicholls
6. BMP 4 – OCIMF / SIGTO/INTERTANCO
7. Seamanship – D.J House

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SEMESTER-VI

UG 21 T4604	IMO & INTERNATIONAL CONVENTIONS	60 Hrs

1	**International Organisations & IMO:**	8 hrs
	Organizations with maritime functions: UNO, IMO, ILO, ITF, WHO, CMI, (Outline of objectives and functions). UNCITRAL, UNCTAD, WTO (Outline of work relevant to maritime sector) IMO: Formation of IMO, organizational structure, role of various organs and committees and sub-committees, functions of IMO, is IMO an enforcing body? IMO Instruments: Conventions, Protocols, Codes, Recommendations, and Guidelines. (purpose and examples of each) IMO Conventions: List of IMO conventions. Development, adoption, conditions for coming into force, implementation, enforcement and amendments of conventions. Brief overview of all conventions except SOLAS, ILLC, MARPOL and STCW.	
2	**Indian Merchant Shipping Act, 1958:**	10 hrs
	Sections reviewed: Definitions. Registration of Indian ships; Section 20 to 74 Seamen and Apprentices. Section 88 to 218 Investigation and inquiries. Section 357 to 389	
3	**International Law of the Sea:**	10 hrs
	Historical Background; UNCLOS 1982; Definitions - Baselines; Internal Waters and Territorial Sea; Contiguous Zone; Hot Pursuit, Continental Shelf; Exclusive Economic Zone; The High Seas, Legal jurisdictions and Freedoms in various zones; Nationality of Ships, Duties of Flag states and Flag State Control	

	Responsibilities of coastal states, Settlement of Disputes; Law of the Sea Tribunal. UNCLOS definition of marine pollution and duties of states towards environmental protection. UNCLOS definition of piracy. IMO's definition of "armed robbery" Duties of states to suppress piracy.	
4	**Maritime Labour Convention and Maritime Safety:**	15 hrs
	Manning and Certification; - STCW Convention ILO's Convention – MLC 2006 - Engagement, Discharge, Welfare of Seamen and Repatriation; Discipline; Abandonment of Seafarers; Ship Owner Responsibility for Injury and Death Claims; Ship Safety; SOLAS 1974 as amended (Brief contents of all chapters incl. new chapters) ILLC 1966 as amended (Main contents and brief features of amendments) ISM Code: outline of contents of all chapters, latest amendments, certification, audits. Human error, commitment and motivation. Impact and practice of Risk management Port State Control (authority, inspections, detentions, common deficiencies, MOUs and their benefits)	
5	**Other Conventions and Codes:**	17 hrs
	LLMC, CLC 1992, FUND 1992. Supplementary Fund and Bunker Conventions. (purpose and contents in brief) International Convention on salvage 1982. (Outline in brief) COLREGS (purpose, contents in brief) Nairobi convention on removal of wrecks (purpose and responsibility for wreck removal) MARPOL 1973/78 (overview of amendments to annexes) ISPS Code: Security threats, SSO, CSO, PFSO, SSP, ISSC, Security duties, Security Levels, Restricted areas, Security equipment, Declaration of security, Contingency plans to deal with security incidents. Code of Casualty Investigation (IMO) : Brief outline of contents.	

RECOMMENDED BOOKS FOR REFERENCE:

1. Maritime Legislation and Shipboard Management for deck officers by Capt. M.V. Naik& Capt. C.L. Dubey

2. SOLAS 1974 as amended
3. MARPOL as amended
4. ISM Code
5. ISPS Code
6. MLC 2006
7. STCW as amended

Website for reference: www.imo.org

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SEMESTER - VI

UG 21 T4605	HUMAN RESOURCE MANAGEMENT, DEVELOPMENT & LEADERSHIP	80 Hrs

1	**Human Resource Management:**	8 hrs
	The Personnel Function, Requirement & Selection, Performance Appraisal and Reward System, Legal Requirements and Regulation of Working Condition, Employer's Liabilities for Health and Safety, Relation with Trade Union & Workers Participation in Management. Cross cultural, multi-racial and multi-lingual environment.	
2	**Human Values and Managerial Effectiveness:**	5 hrs
	Indian insight on managing self, human relationships, managing stress, decision making and resolving ethical dilemma; enhancing life satisfaction.	
3	**Communication and Negotiation:**	10 hrs
	The importance of communication; interpersonal communication; barriers to effective interpersonal communication, communication in organizations; using communication skills – negotiating to manage conflicts. Effective communication, Competent Person: Experience, Knowledge, Skills, Attitude, Age, Fatigue, Control of human errors, Situational awareness, Need for familiarisation with work environment and procedures.	
4	**Leadership Team Work and Positive Attitude:**	12 hrs
	Importance of team work, team spirit, Necessity of positive attitudes, work ethics, allocation, assignment, and prioritization ofresources, assertiveness and motivation and decisionmaking. Motivational Theory -i) McGregor's Theory X and Theory Y (ii). Maslow's Hierarchy of Needs Theory (iii). Herzberg's Motivation-Hygiene Theory Trait approaches to Leadership, Fiedler's Contingency Approach to leadership The Managerial Grid	
5	**Personnel Management:**	12 hrs

	Nature of the job at sea, demands of the career – technical, practical, physical, emotional and psychological, Personal traits that will assist in effective functioning onboard, Physical fitness, health and personal hygiene, Travel Arrangements, Human factors and their importance, Onboard human relations, Role of human error in accidents, Importance of Interpersonal relationship. Maritime Resource Management- Building positive attitude and behaviour by developing a professional and organizational culture.	
6	**Organization & Structure:**	5 hrs
	Sketch Company's Organizational Chart. Describe Shipboard organizational structure. Describe functions and responsibilities of shipboard staff. List cadet's role on board and expectations from him / her.	
7	**Pre - Sea Human Resource Development and Life Skills Program:** (Introduction of Human Resource Development Programme for training of seafarers at Pre-sea stage – DGS Circular 24 of 2005) Topics covered: • Introduction to the Industry, • Behavioural patterns & Attitudes with due cognizance to implementation of legislation • Communication and the Art of listening • Prioritization, Time Management & Planning • Mental Gymnastics & Creative Problem solving • Anger/Violence Prevention/Aggression Control &Conflict Management • Management of Stress, Distress situations, Accidents proneness. • Emotional Management, Management of Depression / Fear / Fatigue / Revenge v/s Forgiveness, Coping with anxiety of being away from home. • Use of Drugs & Alcohol. Sexual health • Team Bonding	15 hrs
8	**Shipping and Special Needs:**	5 hrs
	Awareness on the M.S. (Recruitment and Placement of Seafarers), Rules, 2005 Attached module: Implementation of Merchant Shipping (Recruitment and	

	Placement of Seafarers) Rules, 2005 Spreading awareness among Indian Seafarers thereof- DG Shipping Order 6 of 2006. Topics Covered: MS Act 1958 • Overview • Section 95 (registration of recruitment and placement agencies) • Part VII (Employment of seafarers on Indian flag vessels Recruitment and placement rules 2005 • Introduction & definitions • Significance of the RPS, Rules, 2005 • Purpose of the rule • Benefit to seafarers under the rule • Responsibilities of employer • Rights and responsibilities of the seafarer • How to access information regarding registered recruitment and placement agencies Article of Agreement (Indian Ships) • Lecture on general content of agreement • Responsibilities of employer & seafarer • Discussion on the content Article of Agreement (foreign flag ship) • Lecture on general content of agreement • Relevance of RPS, Rule 2005 on foreign ships • Responsibilities of foreign employer & seafarer Discussion on the content.	
9	**Social Responsibility and Ethics:**	8 hrs
	The changing concept of social responsibilities; the shift to ethics; the tools of ethics; the challenge of relativism	

RECOMMENDED BOOKS FOR REFERENCE :

1. General Management - Processes & Action- David A. Garvin
2. Maritime Logistics: A Complete Guide to Effective Shipping and Port Management by Dong-Wook Song and Photis M. Panayides (May 28, 2012)
3. Maritime Economics (3/E) Martin Stopford
4. The Business of Shipping James, Jr. Buckley
5. Reeds Sea Transport: Operation and Economics (Reed's Professional) by Patrick M. Alderton
6. Management (6/E)Stoner & Freeman
7. Elements of Shipping Alan Edward Branch

INDIAN MARITIME UNIVERSITY

SEMESTER – VI

UG 21 T4606	MARINE ENVIRONMENTAL PROTECTION	75Hrs

1	**Conventions:**	5 hrs
	The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)- Brief history of convention;	
2	**Marpol Annex I: (Regulations for the Prevention of Pollution by Oil)-**	10hrs
	General: Definitions- Application -Surveys - Issue of endorsement of certificate- Duration and validity of certificate – Port State control on operational requirements; **Requirements for machinery spaces of all ships** – Tanks for oil residues (Sludge)- Standard discharge connection - Oil filtering equipment **Control of Operational discharge of oil from Machinery space –** Discharge outside special areas; Discharge in special areas; Requirements for ship of less than 400 gross tonnage in all areas except the Antarctic area; General requirements. **Requirements for the cargo areas of oil tankers** – Segregated ballast tanks; Accidental oil outflow performance; Slop tanks; Pumping, piping and discharge arrangement. **Equipments -** Oil discharge monitoring and control system - Oil/water interface detector; Crude oil washing requirements; **Control of operational discharge of oil from Cargo Area of Oil Tanker**– Control of discharge of oil – General requirements; Crude oil washing operations; Oil Record Book, Part II- Cargo/ballast operations; Shipboard oil pollution emergency plan and equipments. **Reception facilities –** Outside Special Areas and within Special Areas. **Forms -**Form of IOPP Certificate and Supplements; Form of Oil Record Book. **PSSA – Vessel Response Plan (VRP)- connection of small diameter line to the manifold valve.**	
3	**Marpol Annex II: (Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk)**	8hrs

	General - Definitions- Application - Exception – Survey and certification of chemical tankers – Issue or endorsement of certificate – Duration and validity of Certificate. **Operational discharges of residues of noxious liquid substances**- Control of discharges of residues of noxious liquid substances; Procedures and Arrangements Manual; Cargo Record Book. **Measures of control by port States** **Prevention of pollution arising from an incident involving noxious liquid substances** – Shipboard Marine Pollution Emergency Plan for noxious liquid substances and equipments. **Reception facilities and cargo unloading terminal arrangements.** **Appendices to Annex II** Guidelines for the categorization of noxious liquid substances; form of Cargo Record Book for ships carrying noxious liquid substances in bulk; Form of International Pollution Prevention Certificate for the carriage of Noxious Liquid substances in Bulk; Standard form for the Procedures and Arrangements Manual; Prewash Procedures; Ventilation procedures.	
4	**Marpol Annex III: (Regulations for the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form)**	4hrs
	General – Application; Packing; Marking and labeling; Documentation; Stowage; Quantity Limitations; Exceptions; Port State control on operational requirements. **Appendix to Annex III** Guidelines for the identification of harmful substances in packaged form	
5	**Marpol Annex IV: (Regulations for the Prevention of Pollution by Sewage from Ships)**	4hrs
	General - Definition- Application-Exceptions – Surveys - Issue or endorsement of a Certificate - Issue or endorsement of a Certificate by another Government - form of Certificate – Duration and validity of certificate **Equipment and control of discharge** – Sewage systems - Standard discharge connections - discharge of sewage. **Reception facilities** **Appendix to Annexure IV –** Form of International Sewage Pollution Prevention Certificate	
6	**Marpol Annex V: (Regulations for the Prevention of Pollution by Garbage from Ships)**	5 hrs
	General-Definitions - Application; Disposal of garbage outside special areas; Special requirements for disposal of garbage; Disposal of garbage within	

	special areas; exceptions; Reception facilities; Port State control on operational requirements; Placards, garbage management plans and garbage record – keeping **Appendix to Annexure V-** Form of Garbage record book	
7	**Marpol Annex VI: (Regulations for the Prevention of Air Pollution from ship)**	10hrs
	General – Application- Definitions General exceptions – Surveys; Issue or endorsement of certificate; Issue or endorsement of a Certificate by another Government; Form of Certificate; Duration and validity of Certificate; Port State control on operational requirements; Detection of violations and enforcement. **Requirements for control of emission from ship** - Ozone depleting substances - Nitrogen oxides (NOx) - Sulphur oxides (Sox) - Volatile organic compounds - Shipboard incineration - Reception facilities - Fuel oil quality **Appendices to Annexure VI** – Form of IAPP Certificate; Test cycle and weighting factors; Criteria and procedure for designation of Sox emission control areas; Type approval and operating limits for shipboard incinerators; Information to be included in the bunker delivery note.	
8	**Ballast Water Management:**	5 hrs
	Introduction; Brief History; IMO Resolutions regarding BWM; BWM systems –Ballast water Exchange system and Ballast water treatment system; safety procedure for ship and crew during BWM; Procedure for disposal of Ballast water Residue; Crew training and familiarization as per BWM convention; Records to be maintained.	
9	**Anti Fouling Paint Pollution:**	5 hrs
	Introduction; Brief History; Antifouling, Effects and Zones: Antifouling purpose and types; Environmental Impact ; IMO Regulation for Anti Fouling paints; Alternate Antifouling System; Futures of Antifouling Paints.	
10	**Anti Pollution Equipment (Introduction):**	5 hrs
	Operating procedures and precautions of anti-pollution equipments: Sewage plant, incinerator, commutator, ballast water treatment plant;	
11	**National Response Centre with respect to pollution prevention:** General idea	5 hrs
12	**Ship Recycling:** Brief history, IMO Guidelines on ship recycling, concept of Green Passport for ships	5 hrs
13	**National Pollutant Discharge Elimination System (NPDES) of US Clean**	4hrs

	Water Act – Overview	

RECOMMENDED BOOKS FOR REFERENCE:

1. MARPOL 73/ 78 as Amended (Latest Edition)
2. International convention on Ballast Water Management.
3. International convention on Anti-fouling Paint Pollution.

INDIAN MARITIME UNIVERSITY

SEMESTER – VI

UG 21 P4607	NAVIGATION LAB, PRACTICAL	64 Hrs

Objective: To impart necessary hands-on training on Navigational Equipments required for Deck Officers on Board.

1	• Demonstrate taking altitude of celestial bodies using sextant. • Carry out Boxing of Compass. • Demonstrate use of azimuth mirror in a binnacle/ repeater for taking compass bearings. • Demonstrate, with the use of models the proper signals or lights and the proper action to be taken to avoid collision. • Read the aneroid barometer and calculate atmospheric pressure at sea level, by applying the corrections. • Calculate the dew point using a hygrometer. • Demonstration for the use and reading of Barograph. • Star Identification - Identify certain major stellar constellations and navigational stars using star finder.	15 hrs
2	• Identification of various collision situations and action to avoid collision, using magnetic board, wooden models or any other aid. • Identification of lights and shapes and IALA buoys. • Candidates will be required to deal; with each collision broadly under the heading 'recognition', 'responsibility', 'action', 'appropriate sound signal and day light signals' and 'any ordinary practice of seaman' and observance of good seamanship. • Collision situations In restricted visibility with or without Radar.	15 hrs
3	**Officer On Watch Simulator:**	18 hrs
	• Demonstration various methods used on board the ship by OOW to call the Master. • Simulator- Demonstrate the ways to carry out lookout duties, helmsman duties and fixing of position relative to other ships by consistently	

	recognizing lights, shapes and sound signals in the International Regulations for Preventing Collision at Sea. • COLREGS – Dealing collision situation between own ship and target vessel using any aid to simulate such condition. • Speed log - Explain the various controls on different types of Speed Logs • The automatic pilot - Explain the various controls on Auto Pilot (Adaptive), Explain the functions of OFF-COURSE ALARM. • Echo sounders - Explain the various controls on Echo Sounder. • **Marine Radar** - Explain controls on Marine Radar and ARPA. • Hand Steering on simulators - Importance of positive reporting, steering by compass & sight on simulator course keeping with respect to rudder angle, rate of turn & response of ship. • Application of rules between the own ship and target ship's in restricted visibility. • GPS - Explain controls of GPS.	
4	**Gyro Compass:**	10 hrs
	Starting and stopping procedure of Ship board Gyro compass, Synchronization of Master Gyro and Repeaters, Care and maintenance on Gyro compass on board ship Exercise on obtaining Position Lines and Gyro error.	
5	Operation of **GMDSS** Equipments:	6 hrs