



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

(5th revision)

2021

(With effect from the Academic Year 2021-22)

*The Curriculum for the Three Year “**B.Sc. (Nautical Science)**” include the requirement of STCW Convention (as amended), of IMO Model Course 7.03 and that of the Directorate General of Shipping, Government of India for competencies required for “Officer In-charge of a Navigational watch”.*

Preface

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.

The English syllabus has been revised to the demand of time and industry. An attempt has been made to have soft skills learning in initial four semesters by including all aspects of soft skills in 80 hours.

In line with the National Education Policy for training in the developing technology which is going to be the need of the hour, FIVE micro credit courses, Cyber Security, Artificial Intelligence, Machine Learning, Internet of Things and Blockchain Technology have been added.

The old computer language C++ has been replaced by the Python language which is in current use.

The Navigating officers are required to critically think in complex situations and make intelligent and quick decisions, and to address this a Critical Thinking and Leadership course has been introduced.

The traditional Chartwork is reduced to give more space to Electronic Chart Display & Information System.

Maritime Risk Assessment is an integral part of seafarers' life and to address this a micro credit course "Maritime Risk Assessment" has been included.

All the semester courses have been re-structured and well defined by writing Specific Learning Objectives.

The syllabus has been revised in such a way to keep the total hours in semester between 520 and 540.

The pedagogy will be as per NEP, i.e. a blend of classroom lectures, practical training, Simulator based training, Group activities / Presentations, etc. to the possible extent.

To verify the learning of the cadets, continuous assessment in the form of Formative and Summative assessments is planned as per NEP.

It is suggested that efforts should be made to take the students for ship visit, alternatively use of “Ship in Campus” can be made.

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 extra-curricular activities (Parade, Swimming, Boat rowing, Sports,etc.) 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, Industry experts, Head (CTCE & Academics), Office 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.

Syllabus Revision Committee 2021

Syllabus Revision Committee 2021

B.Sc. (Nautical Science) Syllabus 2021 (5th Revision) has been revised in June 2021. In this regard, a Syllabus revision Committee was constituted with following members:

Capt. Y.C Shah-IMU NMC- Convener

Capt. Sujit Kumar Pathak- Co-Convener (Assistant Professor, IMU Kochi Campus)

Capt. Manoj Hirkane (Vice Principal, Tolani Maritime Institute)

Capt. Anand Subramanian (Principal, Hindustan Institute of Maritime Training)

Capt. S. Krishnamurthi, Industry Expert (Trimsail Digital Solutions Pvt. Ltd)

INDIAN MARITIME UNIVERSITY

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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 in 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 dated 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) **Teacher Assessment** - Teachers Assessment which may include parameters such assignments/behavior in class, responses/attentiveness in class etc.
- (b) **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.
- (c) **Practical (Lab Work / Record Keeping):** Every completed Practical (Lab Work / Record Keeping) shall be evaluated for a maximum of 40 marks. Average mark of all the prescribed experiments / exercises done during the entire semester shall be taken as Practical (Lab Work/ Record Keeping) marks.
- (d) 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 50 marks.
- c) 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 and 1917). 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:

- | | |
|---|---------------------|
| a) 75% of the marks and above in first attempt | -Distinction |
| b) 60% and above but below 75% -should have passed all the papers within the stipulated period of the programme | - I class |
| c) 50% and above but below 60% | - II class |
| d) 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.

Syllabus Index

Semester-I Courses

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5101	English & Human Factors	45	15	60	4
2	UG21T5102	Mathematics	45	15	60	4
3	UG21T5103	Physics	45	15	60	4
4	UG21T5104	Electronics	45	15	60	4
5	UG21T5105	General Ship knowledge	45	20	65	4
6	UG21T5106	Terrestrial Navigation	45	30	75	5
7	UG21P5107	Physics (Practical)	45	15 Project	60	2
8	UG21P5108	Electronics (Practical)	45	15 Project	60	2
9	UG21T5109	Soft Skills-I	15	5	20	1
		Total			520	30

Semester-II Courses

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5201	Applied Mathematics	45	15	60	4
2	UG21T5202	Applied Physics & Electricity	45	15	60	4
3	UG21T5203	Computer Science	45	20	65	4
4	UG21T5204	Ship Construction	45	15	60	4
5	UG21T5205	Ship Operation Technology	45	15	60	4
6	UG21T5206	Environmental Studies	60	20	80	5
7	UG21P5207	Applied Physics & Electricity (Practical)	45	-	45	2
8	UG21P5208	Computer Science (Practical)	60	-	60	2
9	UG21P5209	English Communication Lab	30	-	30	1
		Total			520	30

Semester-III Courses

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5301	Celestial Navigation Paper –I	45	15	60	4
2	UG21T5302	Ship Stability Paper – I	45	15	60	4
3	UG21T5303	Marine Engineering, Automation & Control Systems Paper –I	45	15	60	4
4	UG21T5304	Chart Work & Collision Prevention Regulations	45	15	60	4
5	UG21T5305	Cargo Handling & Stowage Paper –I	45	15	60	4
6	UG21T5306	Bridge Equipment & Watch keeping Paper –I	45	15	60	4
7	UG21P5307	Seamanship Lab - I (Practical)	60	-	60	2
8	UG21P5308	Marine Engineering Workshop - I (Practical)	60	-	60	2
9	UG21T5309	Soft Skills-II	15	5	20	1
10	UG21E5310	Artificial Intelligence	15	5	20	1
11	UG21E5311	Machine Learning	15	5	20	1
12	UG21E5312					
Total					540	31

Semester-IV Courses

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5401	Celestial Navigation Paper – II	45	15	60	4
2	UG21T5402	Ship Stability Paper – II	45	15	60	4
3	UG21T5403	Cargo Handling & Stowage Paper –II	45	15	60	4
4	UG21T5404	Marine Engineering, Automation & Control Systems Paper –II	45	15	60	4
5	UG21T5405	Meteorology	45	15	60	4
6	UG21T5406	Critical Thinking and Leadership & Soft Skills	45	15	60	4
7	UG21P5407	Seamanship Lab - II (Practical)	60	-	60	2
8	UG21P5408	Marine Engineering Workshop - II (Practical)	60	-	60	2
9	UG21E5409	Cyber Security	15	5	20	1
10	UG21E5410	Internet of Things	15	5	20	1
11	UG21E5411	Blockchain Technology	15	5	20	1
12	UG21E5412					
Total					540	31

Semester-V Courses

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5501	Coastal Navigation & Collision Prevention Regulations	45	20	65	4
2	UG21T5502	Naval Architecture Paper – I	45	20	65	4
3	UG21T5503	Life Saving & Fire Fighting Appliances	45	20	65	4
4	UG21T5504	Specialized Cargo Handling & Stowage	45	20	65	4
5	UG21T5505	Marine Environmental Protection	45	15	60	4
6	UG21T5506	Bridge Equipment & Watch keeping Paper -II	45	15	60	4
7	UG21P5507	Ship Operation Technology Lab (Practical)	60	-	60	2
8	UG21P5508	Navigation Lab I (Practical)	60	-	60	2
9	UG21T5509	Maritime Risk Management	15	5	20	1
10	UG21E5510					
11	UG21E5511					
12	UG21E5512					
		Total			520	29

Semester-VI Courses

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5601	Voyage Planning & ECDIS	60	20	80	5
2	UG21T5602	Naval Architecture Paper – II	60	20	80	5
3	UG21T5603	Ship Maintenance and Emergencies	60	20	80	5
4	UG21T5604	Ship Manoeuvring & Collision Prevention Regulations	60	20	80	5
5	UG21T5605	IMO & International Conventions	45	15	60	4
6	UG21T5606	Human Resource Development & Shipping Management	60	20	80	5
7	UG21P5607	Navigation Lab II (Practical)	60	-	60	2
8	UG21E5608					
9	UG21E5609					
10	UG21E5610					
11	UG21E5611					
		Total			520	31

Curriculum Matrix

Semester-I

Serial No.	Course Code	Course Name	Internal Assessment				End Semester Exam		Total marks	Pass marks	Hours / week
			Teacher assessment	Class Test	Practical (Lab work / record keeping)	Total Marks	Max Marks	Pass Marks			
1	UG21T5101	English & Human Factors	10	20	-	30	70	35/70	100	50	4
2	UG21T5102	Mathematics	10	20	-	30	70	35/70	100	50	4
3	UG21T5103	Physics	10	20	-	30	70	35/70	100	50	4
4	UG21T5104	Electronics	10	20	-	30	70	35/70	100	50	4
5	UG21T5105	General Ship knowledge	10	20	-	30	70	35/70	100	50	5
6	UG21T5106	Terrestrial Navigation	10	20	-	30	70	35/70	100	50	5
7	UG21P5107	Physics (Practical)	10	-	40	50	50	25/50	100	50	4
8	UG21P5108	Electronics (Practical)	10	-	40	50	50	25/50	100	50	4
9	UG21T5109	Soft Skills-I	10	40	-	50	-	-	50	25	1

Semester-II

Serial No.	Course Code	Course Name	Internal Assessment				End Semester Exam		Total marks	Pass marks	Hours / week
			Teacher assessment	Class Test	Practical (Lab work / record keeping)	Total Marks	Max Marks	Pass Marks			
1	UG21T5201	Applied Mathematics	10	20	-	30	70	35/70	100	50	4
2	UG21T5202	Applied Physics & Electricity	10	20	-	30	70	35/70	100	50	4
3	UG21T5203	Computer Science	10	20	-	30	70	35/70	100	50	4
4	UG21T5204	Ship Construction	10	20	-	30	70	35/70	100	50	4
5	UG21T5205	Ship Operation Technology	10	20	-	30	70	35/70	100	50	4
6	UG21T5206	Environmental Studies	10	20	-	30	70	35/70	100	50	5
7	UG21P5207	Applied Physics & Electricity lab	10	-	40	50	50	25/50	100	50	4
8	UG21P5208	Computer Science	10	-	40	50	50	25/50	100	50	4
9	UG21P5209	English Communication Lab	10	-	40	50	50	25/50	100	50	2

Semester-III

Serial No.	Course Code	Course Name	Internal Assessment				End Semester Exam		Total marks	Pass marks	Hours / week
			Teacher assessment	Class Test	Practical (Lab work / record keeping)	Total Marks	Max Marks	Pass Marks			
1	UG21T5301	Celestial Navigation I	10	20	-	30	70	35/70	100	50	4
2	UG21T5302	Ship Stability I	10	20	-	30	70	35/70	100	50	4
3	UG21T5303	Marine Engineering, Automation & Control Systems -I	10	20	-	30	70	35/70	100	50	4
4	UG21T5304	Chart Work & Collision Prevention Regulations	10	20	-	30	70	35/70	100	50	4
5	UG21T5305	Cargo Handling & Stowage -I	10	20	-	30	70	35/70	100	50	4
6	UG21T5306	Bridge Equipment & Watch keeping -I	10	20	-	30	70	35/70	100	50	4
7	UG21P5307	Seamanship Lab - I	10	-	40	50	50	25/50	100	50	4
8	UG21P5308	Marine Engineering Workshop - I	10	-	40	50	50	25/50	100	50	4
9	UG21T5309	Soft Skills-II	10	40	-	50	-	-	50	25	1
10	UG21E5310	Artificial Intelligence	10	40	-	50	-	-	50	25	1
11	UG21E5311	Machine Learning	10	40	-	50	-	-	50	25	1

Semester-IV

Serial No.	Course Code	Course Name	Internal Assessment				End Semester Exam		Total marks	Pass marks	Hours / week
			Teacher assessment	Class Test	Practical (Lab work / record keeping)	Total Marks	Max Marks	Pass Marks			
1	UG21T5401	Celestial Navigation Paper – II	10	20	-	30	70	35/70	100	50	4
2	UG21T5402	Ship Stability Paper – II	10	20	-	30	70	35/70	100	50	4
3	UG21T5403	Cargo Handling & Stowage –II	10	20	-	30	70	35/70	100	50	4
4	UG21T5404	Marine Engineering, Automation & Control Systems – II	10	20	-	30	70	35/70	100	50	4
5	UG21T5405	Meteorology	10	20	-	30	70	35/70	100	50	4
6	UG21T5406	Critical Thinking and Leadership & Soft Skills	10	20	-	30	70	35/70	100	50	4
7	UG21P5407	Seamanship Lab - II	10	-	40	50	50	25/50	100	50	4
8	UG21P5408	Marine Engineering Workshop- II	10	-	40	50	50	25/50	100	50	4
9	UG21E5409	Cyber Security	10	40	-	50	-	-	50	25	1
10	UG21E5410	Internet of Things	10	40	-	50	-	-	50	25	1
11	UG21E5411	Blockchain Technology	10	40	-	50	-	-	50	25	1

Semester-V

Serial No.	Course Code	Course Name	Internal Assessment				End Semester Exam		Total marks	Pass marks	Hours / week
			Teacher assessment	Class Test	Practical (Lab work / record keeping)	Total Marks	Max Marks	Pass Marks			
1	UG21T5501	Coastal Navigation & Collision Prevention Regulations	10	20	-	30	70	35/70	100	50	4
2	UG21T5502	Naval Architecture I	10	20	-	30	70	35/70	100	50	4
3	UG21T5503	Life Saving & Fire Fighting Appliances	10	20	-	30	70	35/70	100	50	4
4	UG21T5504	Specialized Cargo Handling & Stowage	10	20	-	30	70	35/70	100	50	4
5	UG21T5505	Marine Environmental Protection	10	20	-	30	70	35/70	100	50	4
6	UG21T5506	Bridge Equipment & Watch keeping -II	10	20	-	30	70	35/70	100	50	4
7	UG21P5507	Ship Operation Technology Lab	10	-	40	50	50	25/50	100	50	4
8	UG21P5508	Navigation Lab I	10	-	40	50	50	25/50	100	50	4
9	UG21T5509	Maritime Risk Management	10	40	-	50	-	-	50	25	1
10	UG21E5510										
11	UG21E5511										
12	UG21E5511										

Semester-VI

Serial No.	Course Code	Course Name	Internal Assessment				End Semester Exam		Total marks	Pass marks	Hours / week
			Teacher assessment	Class Test	Practical (Lab work / record keeping)	Total Marks	Max Marks	Pass Marks			
1	UG21T5601	Voyage Planning & ECDIS	10	20	-	30	70	35/70	100	50	6
2	UG21T5602	Naval Architecture Paper –II	10	20	-	30	70	35/70	100	50	5
3	UG21T5603	Ship Maintenance and Emergencies	10	20	-	30	70	35/70	100	50	5
4	UG21T5604	Ship Manoeuvring & Collision Prevention Regulations	10	20	-	30	70	35/70	100	50	5
5	UG21T5605	IMO & International Conventions	10	20	-	30	70	35/70	100	50	4
6	UG21T5606	Human Resource Development & Shipping Management	10	20	-	30	70	35/70	100	50	4
7	UG21P5607	Navigation Lab II (Practical)	10	-	40	50	50	25/50	100	50	4
8	UG21E5608										
9	UG21E5609										
10	UG21E5610										

Credit System

1. Credit Score Criteria –

One Credit is given for approximate 15 hrs theory and 30 hrs practical training.

Credit Score	Lecture	Practical Hours
1	Upto 15	Up to 30
2	16-30	31-60
3	31-45	
4	46-60	
5	61-75	

2. All Micro Credit Courses are of One Credit Score.

3. Semester wise Credits summary -

Sr. No	Semester	Hours	Credit Score
1	I	520	30
2	II	520	30
3	III	540	31
4	IV	540	31
5	V	520	29
6	VI	520	31
Total		3160	182

Training outcomes

The syllabus adequately covers the knowledge and skill competencies required for an operational level officer.

After completion of this BSc Nautical Science Degree Course the students will be able to demonstrate a knowledge and understanding of:

1. Thorough knowledge of the Collision Regulations,
2. Principles in keeping a navigational watch,
3. Bridge Resource Management,
4. Use of Routing
5. Use of information from Navigational equipment for maintaining a safe Navigational watch,
6. Knowledge of blind pilotage techniques
7. Use of reporting in accordance with the general principles for ship reporting systems and with VTS procedures,
8. Knowledge of the fundamentals of RADAR and ARPA,
9. Precautions for protection and safety of people on board in emergency
10. Initial actions following a collision or grounding,
11. Rescuing persons from the sea
12. Assisting a ship in distress
13. English reading, writing, listening and speaking,
14. Use of Standard Marine Communication Phrases
15. Use the International Code of Signals,
16. The effect of cargo, including heavy lifts on the seaworthiness and stability of the ship,
17. Safe handling, stowage and securing of cargoes including dangerous, hazardous and harmful cargoes and effect on the safety of life and of the ship,
18. Precautions to be taken to prevent pollution of marine environment,
19. Anti-pollutions procedures and associated equipment,
20. Proactive measures to protect the marine environment,
21. Stability, trim and stress table,
22. The principal structural members of a ship,
23. The surveys carried out to maintain the ship,
24. Basic knowledge of Physics and Electricity uses on board
25. Basic knowledge of Electronics' applications on board
26. Fire prevention,
27. Organizing fire drills,
28. Chemistry of fire,
29. Firefighting systems,
30. The action to be taken in the event of fire,
31. Organizing abandon ship drill, use of various Life Saving Appliances,
32. Survival at Sea techniques,
33. Shipboard personnel management & training,

Training outcomes (Contd..)

34. National Maritime legislations & International Conventions and regulations,
35. Effective Resource Management,
36. Decision making techniques,
37. Knowledge of Personal Safety and Social Responsibility,
38. Knowledge of Piracy at Sea and counter measures,
39. Basics of MS Word, Excel,
40. Introduction to Digital Twins
41. Introduction to Autonomous and Semi-Autonomous Ships,
42. Basics of Cyber Security,
43. Basics of Artificial Intelligence,
44. Basics of Machine Learning,
45. Basics of Internet of Things,
46. Basics of Blockchain Technology,
47. Leadership qualities, and
48. Good Officer Like Qualities.

INDIAN MARITIME UNIVERSITY

Semester-I Courses

Semester-I Courses

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5101	English & Human Factors	45	15	60	4
2	UG21T5102	Mathematics	45	15	60	4
3	UG21T5103	Physics	45	15	60	4
4	UG21T5104	Electronics	45	15	60	4
5	UG21T5105	General Ship knowledge	45	20	65	4
6	UG21T5106	Terrestrial Navigation	45	30	75	5
7	UG21P5107	Physics (Practical)	45	15 Project	60	2
8	UG21P5108	Electronics (Practical)	45	15 Project	60	2
9	UG21T5109	Soft Skills-I	15	5	20	1
		Total			520	30

INDIAN MARITIME UNIVERSITY
B.Sc. Nautical Science

UG21T5101	English & Human Factors	45 Lectures +15 Tutorials =60 Hrs	Credits - 4
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SN	Specific Learning Objectives	Lectures	Tutorials
01.	Fundamentals of Communication:	9	3
	1.1 Communication: Concept, Process, Levels, Flow, and Styles <ul style="list-style-type: none"> • Define the concept of communication. • Explain the process of communication with a diagram. • Draw a diagram of the communication process. • Explain the levels of communication- i.e. Extra-personal, Intrapersonal, Interpersonal, and Organizational communication. • Describe and compare different communication styles i.e. Passive, Aggressive, Passive-aggressive, and Assertive. • Draw the diagrams of the flow of communication- Downward, Upward, Horizontal, and Diagonal Communication. • Outline the main features of different flows of communication. 	4	
	1.2 Verbal and Non-verbal Communication <ul style="list-style-type: none"> • Describe and Compare Verbal and Non-verbal Communication • Explain the following terms: Kinesics, Paralinguistics, Proxemics, and Chronemics. • List the features of non-verbal communication. 	2	
	1.3 Technical Communication, Effective communication, and Barriers to communication <ul style="list-style-type: none"> • Compare General and Technical Communication. • Outline the main features of technical communication. • Explain the importance of visual aids in technical communication. • List the factors that would help you decide whether communication has succeeded or failed. • Classify and explain communication barriers under the following categories: Linguistic, Psychological, Cultural, Physical, and Organizational Barriers. • Match the situations with the categories of communication barriers. • Describe the ways to overcome communication barriers. 	3	

SN	Specific Learning Objectives	Lectures	Tutorials
	<p>5.2 Letter/email Writing</p> <ul style="list-style-type: none"> • Explain the principles of letter writing. • Describe different parts of a formal letter/email. • List the steps to write a letter. • Compare letter writing layouts/styles- Full Block, Modified Block, and Semi Block. • Write a formal/semi-formal letter/email. (For Acceptance, Acknowledgement, Adjustment, Job Application, Complaint, Inquiry, Response, etc.) • Describe ‘your attitude’ in a letter. <p>5.3 Résumé writing</p> <ul style="list-style-type: none"> • Outline the objectives of writing a cover letter. • Describe the structure (various parts) of a résumé. • Prepare a cover letter and a résumé. <p>5.4 Report Writing (Factual Report, Routine Report), Meeting related communication</p> <ul style="list-style-type: none"> • Discuss the structure of a report. (Factual Report/Routine Report) • Prepare a factual/routine report on the given topic/situation. • Write a report (Incident/Accident/Visit Report) on the given situation. • Prepare notice, agenda and minutes of a meeting. <p>5.5 Paragraph/Essay writing related to the following topics:</p> <ol style="list-style-type: none"> a) Indian Maritime History: Pre-independence and Post-independence b) Significance of National Maritime Day of India c) The Sagarmala Project d) Ports of India e) Role of shipping on national economic development f) Maritime Training in India <ul style="list-style-type: none"> • How to draft a paragraph? • Write a paragraph/an essay on the given topic. 	<p>3</p> <p>2</p> <p>3</p> <p>4</p>	
06.	Human Factors: Shipping and Special Needs	6	2
	<p>6.1 Nature of the job and demands of the careers in the merchant navy</p> <ul style="list-style-type: none"> • Describe Nature of the job at sea. • Explain demands of the career – technical, practical, physical, emotional and psychological. • List Personal traits that will assist in effective functioning onboard. • List the essentials of personal hygiene. • Explain the importance of Physical fitness, health and personal hygiene onboard. • Write a note on the travel arrangements for joining a ship. 	2	

SN	Specific Learning Objectives	Lectures	Tutorials
	<p>6.2 Functions and responsibilities</p> <ul style="list-style-type: none"> • List the functions of Fleet Personnel Department, Technical Management Department, Commercial Management Department, Safety & Quality Management Department, and Designated Person Ashore. • Sketch shipboard organizational chart. • Explain the functions of Deck Department, Engine Department, and Saloon Department. • List/Describe the functions and responsibilities of shipboard staff: Master, Chief Officer, Second Officer, Third Officer, Deck Cadet, Bosun, Chief Engineer Officer, Second Engineer Officer, Third Engineer Officer, and Electro-Technical Officer. • Explain cadets' role onboard and expectations from them. 	4	

TEXT BOOKS

- 1) Rizvi, M Ashraf. *Effective Technical Communication*. McGraw Hill, 2012.
- 2) Kumar Sanjay and Pushp Lata. *Communication Skills: A Workbook*. Oxford University Press, 2018

RECOMMENDED BOOKS FOR REFERENCE:

- *English and Human Factors (IMU/BNA-017)*. Chennai: Indian Maritime University.
- Furber, Holden et al. *Maritime India*. Oxford University Press, 2004.
- Hariharan, K. V. *Shipping Business in India*. Sterling Book House, 2013.
- Kumar, Sanjay, and Pushp Lata. *English for Effective Communication*. Oxford University Press, 2014.
- M. Swan, *Practical English usage*, 4th ed. New York: Oxford University Press, 2016.
- Raman, Meenakshi, and Sangeeta Sharma. *Fundamentals of Technical Communication*. Oxford University Press, 2015.
- Sridharan, K. *Maritime History of India*. Ministry of Information and Broadcasting, 1982.

INDIAN MARITIME UNIVERSITY
B.Sc. Nautical Science

UG21T5102	Mathematics Paper-1	60 Hrs (45 Lecture + 15 Tutorial)	Credits – 4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Spherical Trigonometry	11	4
	1.1 Define: Great circle, small circle, pole, spherical angle, spherical triangle, right angled, quadrantal, oblique and symmetrical spherical triangle.	0.5	
	1.2 State: Properties of Spherical Triangle and oblique spherical triangle.	0.5	
	1.3 Explain: The Sine & Cosine formulae and the possible ambiguities due to their use.	0.5	
	1.4 Solve the examples by using Sine/Cosine rule	0.5	
	1.5 Define: General problem in Spherical Triangle, Haversine function, Oblique spherical triangle with problem type – AAA and SAS,	0.5	
	1.6 State: The advantage of Hav function.	0.5	
	1.7 Explain: The Haversine formula I and II	0.5	
	1.8 Understand the solution procedure for Oblique spherical triangles of both types by using Haversine formulas: I and II.	0.5	
	1.9 Solve the examples by using Haversine rule	1	
	1.10 Explains: Rules for Right-angled Spherical Triangle and Quadrantal Spherical Triangle.	0.5	
	1.11 Understand: Napier's Rule for circular parts.	0.5	
	1.12 Understand the Solution Procedure: Right angled spherical triangle and Quadrantal Spherical Triangle using Napier's Rules.	0.5	
	1.13 Solve the examples by Napier's rule	0.5	
	1.14 Define: Polar Triangle.	0.5	
	1.15 Understand: Supplemental theorem.	0.5	
	1.16 Solution Procedure: polar triangle	0.5	
	1.17 Identities of moderate difficulty	0.5	
	1.18 Solve the examples by polar triangle	1	
	1.19 Define: Ambiguous cases	0.5	
	1.20 Solution Procedure: Cot four-part Formula.	0.5	
	1.21 Solve the examples by cot four-part formula	0.5	
2	Differential calculus	11	4
	2.1 Define Successive differentiation and notation	0.5	
	2.2 Find the nth order derivatives of standard functions.		
	2.3 Find the nth order derivatives using trigonometric identities	0.5	
	2.4 Find the nth order derivatives using partial fractions		

SN	Specific Learning Objectives	Lectures	Tutorials
	2.5 State Leibnitz' Theorem. 2.6 Use Leibnitz' Theorem in problem solving		
	2.7 Define functions of several variables 2.8 Define partial derivatives and geometrical interpretation of it.	0.5	
	2.9 Find the first and higher order partial derivatives of given function 2.10 Define total differentials and Chain Rule	0.5	
	2.11 Solve problems using chain rule 2.12 Define Composite function and Implicit function 2.13 Solve problems based on composite and implicit functions	0.5	
	2.14 Define Homogeneous function 2.15 State Euler's theorem on homogeneous functions with two and three independent variables. 2.16 Use Euler's theorem to solve problems.	0.5	
	2.17 Define maxima, minima and saddle point of a function of two variables.	0.5	
	2.18 Find maxima, minima and saddle point of a given function of two variable.	0.5	
	2.19 Define Errors, relative error, percentage error and Approximations		
	2.20 Find Errors/ relative error/ percentage error / Approximations for the given function.	1	
	2.21 Define scalar point functions and fields. 2.22 Define gradient of a scalar point function.	0.5	
	2.23 Understand the geometrical interpretation of the gradient	0.5	
	2.24 Find the gradient of a given scalar point function. 2.25 Describe the geometrical interpretation of the gradient.	0.5	
	2.26 Find the directional derivative of a given scalar point function.	0.5	
	2.27 Define vector point functions and fields.	0.5	
	2.28 Define divergence and curl of a vector point function.	1	
	2.29 Understand the physical interpretation of the divergence and curl of a vector point function.	1	
	2.30 Find the divergence and curl of a vector point function.	1	
	2.31 Explain the physical interpretation of the divergence and curl of a vector point	0.5	
	2.32 Understand the concept of solenoidal and irrotational vector fields	0.5	
	2.33 Check whether the given vector field is a solenoidal vector field.		
	2.34 Check whether the given vector field is an irrotational vector field.	1	

SN	Specific Learning Objectives	Lectures	Tutorials
3	Integral Calculus	12	3
	3.1 Define Beta and Gamma functions	0.5	
		1.0	
	3.2 State and prove the following Properties		
	a) $\Gamma 1 = 1$		
	b) $\Gamma 0 = \infty$		
	c) $\frac{\Gamma 1}{2} = \sqrt{\pi}$		
	d) $\Gamma n+1 = \begin{cases} n! & \text{if } n \text{ is integer} \\ n\Gamma n & \text{if } n \text{ is noninteger} \end{cases}$		
	e) $\beta(m,n) = \beta(n,m)$		
	f) $\int_0^{\pi/2} \sin^p \theta \cdot \cos^q \theta d\theta = \frac{1}{2} \beta\left(\frac{p+1}{2}, \frac{q+1}{2}\right)$		
	g) Relation between Beta and Gamma		
	$\beta(m,n) = \frac{\Gamma m \Gamma n}{\Gamma m+n}$	1	
		1	
	3.3 Evaluate the given integral by using Beta function	0.5	
	3.4 Evaluate the given integral by using Gamma function	0.5	
	3.5 Define double Integral and its region of integration	0.5	
	3.6 Evaluate the given double integrals with given limits	0.5	
	3.7 Evaluate the given double integrals with given region of integration.	0.5	
	3.8 Change the order of the integration and evaluate the given double integration.	1	
		1	
	3.9 Solve the given double integral using polar coordinate	1	
	3.10 Define Triple Integral		
	3.11 Evaluate the given triple integrals with given limits	1	
	3.12 Evaluate the given triple integrals over the given solid.		
	3.13 Evaluate the given triple integral by using spherical polar coordinate	1	
		1	
	3.14 Evaluate the given triple integral by using cylindrical polar coordinate		
	3.15 Find the area bounded by the given curves by double integration.		
	3.16 Find the volume of the given solid.		
4	Linear Algebra	11	4
	4.1 Define rank of matrix	0.5	
	4.2 Define row echelon form of a matrix	0.5	
	4.3 Obtain the rank of given matrix by reducing it to the row echelon form.	1	
	4.4 Solve the examples on systems of nonhomogeneous equations.	2	
	4.5 Solve the examples on systems of homogeneous equations.	1	
	4.6 Define Kirchoffs current and voltage law.	0.5	
	4.7 Solve the given electrical network problem	0.5	

SN	Specific Learning Objectives	Lectures	Tutorials
	4.8 Solve the given traffic flow problem	0.5	
	4.9 Define Eigen values and Eigen vectors	0.5	
	4.10 Find the Eigen values and Eigen vectors of given matrix of order two.	0.5	
	4.11 Find the Eigen values and Eigen vectors of given matrix of order three.	0.5	
	4.12 Define Linearly independent and dependent vectors	0.25	
	4.13 Check whether the given set of vectors are linearly dependent or independent.	0.25	
	4.14 Define vector and inner product of vector in matrix form	0.25	
	4.15 Define Vector space, subspace and span of a set	0.25	
	4.16 Verify/Show that given set is a vector space.	0.25	
	4.17 Verify/Show that given set is a subspace.	0.25	
	4.18 Define Basis and dimension of vector space	0.25	
	4.19 Find the basis of row space/ column space of given matrix	0.25	

TEXT BOOKS

1. Spherical Trigonometry - Capt. H.Subramaniam
2. Higher Engineering Mathematics - Dr. Grewal,B.S

RECOMMENDED BOOKS FOR REFERENCE:

1. An introduction to Spherical Trigonometry - Clough-Smith J.H
2. A Text book of applied mathematics Vol.I - Wartikar, P.N.&Wartikar,J.N
3. Further Engineering Mathematics –K.A.Stroud
4. Advanced Engineering Mathematics – Dr. A.B. Mathur&Prof. V.P.Jaggi
5. K Hoffman and R Kunze, Linear Algebra, Pearson Education, 2nd Edition, 2005.
6. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India, 9th Edition, 2011

INDIAN MARITIME UNIVERSITY
B.Sc. Nautical Science

UG21T5103	Physics	45+15=60 Hrs	Credits – 4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Earth's Magnetism:	5	1
	1.1 Explain how Earth is a magnet.	0.5	
	1.2 Explain the magnetic elements of Earth.	0.5	
	1.3 Explain angle of declination and angle of dip.	1	
	1.4 Explain hard and soft magnetic materials.	1	
	1.5 Define terms such as Magnetic field, magnetic intensity, magnetic dipole, Permeability etc. [Application of above in Ships: <i>Magnetic compass</i>].	1	
2	Heat and Thermodynamics:	9	3
	2.1 Explain the Heat Transfer Mechanism - Conduction, Convection and Radiation.	1	
	2.2 Explain Expansion of solids, liquids and gases, Gas Laws [Application of above in Ships: <i>Coolers & condensers, application to liquid cargoes, Cargo tank vapour pressure & relief systems</i>]	1.5	
	2.3 Explain and Define Heat capacity, specific heat capacity, Sensible heat, Latent heat. [Application in Ships: <i>Volume correction factor to measurement of liquid cargoes, cargo heating, Meteorology</i>]	1.5	
	2.4 Explain and define First and Second law of Thermodynamics, Carnot cycle [Applications in Ships: <i>Internal Combustion Engines</i>] Explain Heat engine and refrigerator [Applications in ships: <i>Aircon & meat rooms, Basic IC engine</i>]	1.5	
	2.5 Explain and define Hygrometry, Relative and absolute humidity, Dew Point [<i>Condensation</i>], Effect on weather- [Applications in Ship: <i>Frost, Mist, Haze, Cloud Formations, Rain, Snow and Hail, Visibility</i>]	1.5	
	2.6 Explain Hygrometer- [Applications in Ships: <i>Wet, Dry and Hair, Whirling Psychrometers</i>] Care of Cargo [Applications in Ships: <i>Ship Sweat & Cargo Sweat</i>]	1	
	2.7 Explain and Define Vapour Pressures		

SN	Specific Learning Objectives	Lectures	Tutorials
	[Applications in Ships: <i>Volatile liquid cargo and fuel behaviour</i>].	1	
3	Light & Electromagnetic Waves:	9	3
	3.1 Explain the laws of reflection. Discuss the reflection taking place in plane and spherical mirror. [Applications in Ship: <i>Searchlight base, Wheelhouse windows are required to be inclined</i>]	1	
	3.2 State the principle and explain the working of Sextant. [Applications in Ship: <i>Heliograph, Sextant</i>].	1	
	3.3 Explain the laws of refraction. Discuss the refraction taking place in Lenses. [Applications in Ships: <i>Visible Sunrise when sun is below horizon, Refraction of light rays in Atmosphere</i>]	1	
	3.4 Explain the phenomenon of total internal reflection of light. Give its application in Mirage /Periscope/ Prism Binocular / Azimuth mirror. [Applications in Ships: <i>Azimuth Mirror, Periscope., Telescope, Prism, Binocular Retro Reflective Tapes, Reflectors, Radar Reflectors</i>]	1	
	3.5 Explain the Chromaticity of light. [Applications in Ships: <i>Ref Anx 1 of Colreg</i>]	1	
	3.6 Explain Electromagnetic Spectrum and describe its various parts in short. [Applications in Ships: <i>Effect of atmosphere on Radio wave propagation</i>]	1	
	3.7 Explain the bending of EM waves by Ionosphere. [Applications in Ships: <i>Transmission of MW & SW waves</i>]	1	
	3.8 Explain the propagation of Radio Waves. [Applications in Ships: <i>Naming of EM Bands based on frequency, Radar, SW Transmission</i>]	1	
	3.9 Explain the working of He-Ne laser and Optical Fiber. [Applications in Ships: <i>Tank Radar, Use of Optical Fiber in ODMCS</i>]		
4	Sound:	6	2
	4.1 Differentiate between Longitudinal and Transverse Waves with examples.	1	
	4.2 Discuss the factors which affect velocity of sound in seawater and in air. [Application in Ships: <i>Principle of Echo sounder, Fog signal propagation</i>]	2	
	4.3 Explain the characteristics of sound.	1	
	4.4 Explain the Doppler effect and discuss the eight cases related to Doppler effect. [Applications in Ship : <i>Doppler speed Log, GPS</i>]	2	
5	Mechanics and Hydromechanics:	11	3
	5.1 Explain Centre of mass and Centre of gravity, circular motion,	1	

SN	Specific Learning Objectives	Lectures	Tutorials
	<p>Moment of Inertia, Fly wheel, angular momentum, torque, conservation of angular momentum, [Applications in Ship: <i>Concept of gyroscope, propeller shaft flywheel, Ship stability – CoG, weight distribution</i>].</p> <p>5.2 Define Machines, Mechanical Advantage, velocity ratio, Efficiency. Explain Pulley - Differential wheel and axle pulley, Weston differential pulley and Gears. [Applications in Ship: <i>SWL 's, Lifting Appliances onboard</i>]</p> <p>5.3 Explain and apply Triangle and Parallelogram Law of forces [Applications in Ship: <i>Calculations of Loads in Crane, Derrick system, Mooring rope configuration, speed triangle of chart work</i>]</p> <p>5.4 Explain basic concepts of S.H.M. and its features, typical examples such as a pendulum [Applications in Ship: <i>Meta centric Radius of Rolling Ships, Relation between rolling period and meta-centric radius & GM</i>]</p> <p>5.5 Explain resonance with relation to critical revolutions of machinery and rolling [Applications in Ship: <i>Parametric rolling, Critical RPM of ships engine</i>]</p> <p>5.6 Explain Pascal law and its applications [Applications in Ship: <i>Liquid cargo systems, hydraulic motors</i>]</p> <p>5.7 Explain Total pressure / Thrust on immersed surfaces [Applications in Ship: <i>Stability Calculations</i>]</p> <p>5.8 State Law of Floatation, Archimedes principle and buoyancy [Applications in Ship: <i>How does Ship Float? WRF of Tanker Cals</i>]</p> <p>5.9 Explain Bernoulli's theorem and its applications [Applications on Ships: <i>Venturi-meter, Differential pressure transmitter, Eductor</i>]</p> <p>5.10 Explain Streamline and turbulence flow, Flow in pipe lines [Applications in Ships: <i>Ship structure, Propeller Wake</i>]</p> <p>5.11 Explain Momentum [Applications in Ships: <i>Ship's Speed Loaded ship vs ballast</i>]</p>	<p>1</p> <p>1.5</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1.5</p> <p>0.5</p> <p>0.5</p>	
6	Properties of Matter:	5	3
	<p>6.1 Explain Atmospheric Pressure, Barometer,</p> <p>6.2 Explain Elasticity, Modulus of elasticity, Hooke's Law [Applications in Ship: <i>Hull crack, Wire parting, Lifting gears over stressed</i>]</p> <p>6.3 Metallurgy – Explain Physical Property of Alloys, hard vs Brittle, Cast Iron v/s Mild steel vs High tensile steel, abrasiveness, annealing, welding</p> <p>6.4 Explain Cantilever, Bending of Beams, Shearing force, Rigidity [Applications in Ship: <i>Ship Constructions, stress in a ship</i>]</p> <p>6.5 Explain Air bubbles in liquid [Applications in Ships: <i>Pneumatic Level gauge, Cappuccino effect in bunkers</i>]</p> <p>6.6 Explain Viscosity and viscous flow, CST, Reynolds number, Density</p>	<p>0.5</p> <p>0.5</p> <p>1.5</p> <p>1</p> <p>0.5</p> <p>0.5</p>	

SN	Specific Learning Objectives	Lectures	Tutorials
	& change due to temperature [Applications in Ships: <i>Viscous cargo and fuel – relationship to temp, Oil & Gas Cargo</i>] 6.7 Explain Angle of Repose of Granular objects, Effect of ships roll on cargo with high angle of repose and low angle of repose [Application in Ships : <i>Bulk cargo Angle of Repose, shifting of cargo</i>]	0.5	

TEXT BOOKS

1.Engineering Physics by R. K Gaur

RECOMMENDED BOOKS FOR REFERENCE:

1. Advanced level physics: Nelkon & Parker
2. Applied physics: J H 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
B.Sc. Nautical Science

UG21T5104	Electronics	45+15= 60 Hrs	Credits-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Semiconductors and Diodes:	5	1
	1.1 Define types of Semiconductors	0.5	
	1.2 Explain construction and symbol of p-n junction diodes with their characteristics	0.5	
	1.3 Explain Half-wave and full wave bridge rectifiers	0.5	
	1.4 Define Ripple & capacitor filter	0.5	
	1.5 Explain construction and symbol of Zener Diode	0.5	
	1.6 Explain Zener diode as a voltage regulator	0.5	
	1.7 Explain construction and working of LDR and LED	0.5	
	1.8 Explain Photo Electric Cell	1	
	1.9 Applied numerical on half and full wave rectifier		
2	Transistors:	5	1
	2.1 Explain Bipolar-junction transistor	0.5	
	2.2 Draw and explain its characteristics	0.5	
	2.3 Explain transistor configurations	0.5	
	2.4 Define Transistor biasing	0.5	
	2.5 Define Current gain α and β of a transistor & relationship of α and β .	0.5	
	2.6 Explain working of transistor as a switch.	0.5	
	2.7 Draw and explain A.C and D.C load lines	0.5	
	2.8 Define operating point (Q point)	0.5	
	2.9 Explain Emitter bias, Base bias & Voltage divider bias, Bias Stabilization.	0.5	
	2.10 Applied Numerical on α and β		
3	Amplifiers:	6	2
	3.1 Understand the working of CE amplifier	1	
	3.2 Explain D.C and A.C equivalent circuit of CE amplifier	1	
	3.3 Explain Frequency response of transistor as an amplifier	0.5	
	3.4 Explain Cascading stages of amplifier	0.5	
	3.5 Explain Negative and positive feedback amplifiers	0.5	
	3.6 Classification of amplifiers, Class A, B and C	1	
	3.7 Explain the working of RC coupled amplifiers	0.5	
	3.8 Understand the working of Class-B push pull amplifier.	1	
4	Oscillators :	6	2
	4.1 Understand basic principle of LC tank circuit	0.5	
	4.2 Derive Barkhausen's criteria for oscillations	0.5	
	4.3 Understand the concept of voltage and current feedback	0.5	
	4.4 Study of different types of LC, RC and Crystal Oscillators	0.5	
	4.5 Explain working of phase shift oscillator	0.5	

SN	Specific Learning Objectives	Lectures	Tutorials
	4.6 Explain transistor Wein bridge oscillator 4.7 Understand the working of LC Oscillators-Hartley and Colpitts oscillators 4.8 Explain working of IC 555 Timer - Astable and Monostable Multivibrator 4.9 Applied Numericals	1 1 1 0.5	
5	Digital Electronics:	6	2
	5.1 Basic logic gates & its Types 5.2 Explain working of NAND gates, NOR gates and XOR logic gates 5.3 Development of logic circuits 5.4 Understand working of universal logic gate 5.5 Derive Boolean algebra 5.6 Derive De-Morgan's theorem 5.7 Simplification of logic equation using Boolean theorems 5.8 Explain working of Half adder, Full adder, Multiplexer and de multiplexer circuits. 5.9 Introduction of flip flop 5.10 Explain RS flip flop and JK flip flop.	0.5 0.5 0.5 0.5 0.5 0.5 0.5 1 0.5 1	
6	Modulation and Demodulation:	6	2
	6.1 Explain need of modulation 6.2 Working and derivation of Amplitude modulation and modulation index 6.3 Explain diode modulator 6.4 Working and derivation of Frequency modulation and modulation index 6.5 Derive side bands in F.M. 6.6 Applied Problems 6.7 Explain demodulation of A.M. Wave and Diode detector circuit 6.8 Define detection efficiency 6.9 Explain demodulation of F.M. wave and Frequency demodulator	0.5 1 0.5 1 0.5 0.5 0.5 0.5 1	
7	Radio Receivers and Satellite communication:	5	3
	7.1 Explain Straight and regenerative receivers 7.2 Working of tuned RF receivers 7.3 Concept and working of super heterodyne receivers 7.4 Explain AM receivers - communication receivers 7.5 Explain elements of RADAR system - Radar range, limitation of Radar, Radar altimeters and beacons 7.6 Working of Radio detection finding (RDF). 7.7 Explain in short satellite links, Orbits and inclination, Communication frequencies, domestic satellites, telemetry.	0.5 0.5 1 0.5 0.5 1 1	
8	Micro Processor & Programming:	6	2
	8.1 Introduction to microprocessor and 8085 microprocessor 8.2 Draw and explain Architecture of 8085 8.3 Explain Address and data bus, Control and status signal	0.5 1 0.5	

SN	Specific Learning Objectives	Lectures	Tutorials
	8.4 Study microprocessor instruction set	0.5	
	8.5 Study of programming techniques	1	
	8.6 Write simple assembly language programmes such as addition, subtraction, multiplication.	1	
	8.7 Explain Interfacing devices.	0.5	
	8.8 Explain applications of microprocessors.	1	

TEXT BOOKS

- 1) Fundamental Of Electrical Engineering & Electronics by B. L. Thereja
- 2) Principles of Electronics by V. K. Mehta

RECOMMENDED BOOKS FOR REFERENCE:

1. Communication electronics: ND Deshpande, DA Deshpande, PK Rangole, TMH.
2. Electronic communication system: G Kennedy, MGH
3. Electronic Principles-5thEd: Malvino
4. Electronic Devices and Circuit-PHI: Boylestad, Nashelsky
5. Operational amplifier and linear integrated circuits: R.A. Gaikwad
6. Electronic devices and circuits: A. Mottershead
7. Modern Digital Electronics: R P Jain, 4E-TMH.
8. Microprocessor architecture, programming and application with 8085, PI publication, By Ramesh Gaonkar.
9. Introductory Electronic Devices and Circuits 7th- Edition by Robert T. Paynter
10. Electronic Devices "Electron Flow Version" by Thomas L. Floyd
11. Fundamentals of Logic Design by Charles H. Roth, Jr. and Larry L. Kinney
12. Introduction to RADAR Systems by Merrill I. Skolnik

INDIAN MARITIME UNIVERSITY
B.Sc. Nautical Science

UG21T5105	General Ship Knowledge	45+20= 65 Hrs	Credit –4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Introduction	3	1
	1.1 Explain in brief Development of ocean-going Merchant Ships and Modern merchant ships 1.2 Explain existence of old Harbours and need of modern ports. 1.3 Discuss development of modern ports.	1 1 1	
2	Types of Ships	6	3
	2.1 Describe ships in general 2.2 Explain in brief different types of cargoes and typical stowage requirements 2.3 Explain basic features and purpose of various types of ships- Passenger ship, Ferries, General Cargo ship, Bulk Carrier, Container, Car Carrier, Ro-Ro, Crude Oil Tanker, Product Tanker, LPG, LNG, Passenger Ship and Cattle Carrier, Offshore ships, specialized vessels like seismic vessels, Hydrographic vessels, Oceanographic vessels, and Polar vessels.	1 2 3	
3	Definitions and Meanings:	2	2
	3.1 Define and explain marine terms - Length Over All, Length Between Perpendiculars, Breadth Extreme, Breadth Moulded, 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, Abeam, Right ahead, Right astern, Base Line, Bilge Radius, Bow, Stern and Trim.	2	
4	Load lines and Draught Markings	2	2
	4.1 Sketch and explain Deck Line, Plimsoll line and various other load line markings- T, S, W, TF, F & WNA. 4.2 Describe and explain Timber Loadline marks 4.3 Explain and demonstrate Reading draft	0.5 0.5 1	
5	Principal parts of the ship:	9	4
	5.1 Describe and locate parts of a ship on a diagram of Model - Bow, Stern, Shell plating, Double Bottom Tanks, Cargo Holds, Tween Decks, Deep tanks, Fore-peak and After Peak store rooms and tanks, Duct Keels. Forecastle deck, Poop deck, Main/Weather decks, Hatch covers, Cargo Gear, anchoring and mooring equipment, Mast House, Deck house, Bulbous Bow, Bow thrusters, Funnel and Boat deck.	9	
6	Machinery spaces:	2	1
	6.1 Describe Layout of Engine Room 6.2 Explain purpose and location of Engine Casing, sub-division of Engine Room, Steering Gear, Pump rooms, Workshops etc.	0.5 1.5	
7	Superstructure:	2	1

SN	Specific Learning Objectives	Lectures	Tutorials
	7.1 Describe layout of Superstructure 7.2 Explain purpose and location of Wheel House, accommodation spaces, cabins, galley, pantry, dining saloons, recreation rooms, various stores and lockers, cold storage spaces etc.	0.5 1.5	
8	General Layout, Midship section & Profile view:	4	1
	8.1 Explain layout, midship section and profile views of <ul style="list-style-type: none"> ○ General Cargo Ship, ○ Bulk Carrier, ○ Oil Tanker, ○ Container Ship, 	4	
9	Shell and Deck Plating	3	1
	9.1 Explain purpose of framing, frame spacing, shell plating 9.2 Explain numbering system of frames, hull and deck plating. 9.3 Describe Shell expansion plan and its use. 9.4 Demonstrate identification of plates with details on shell expansion plan. 9.5 Identify Sheer strake, garboard strake, Stealer.	1 0.5 0.5 0.5 0.5	
10	Bilge keels, Double bottom Tank, Peak tanks, Wing tanks and Bilges:	3	1
	10.1 Sketch & describe purpose of Bilge Keel, Double Bottom Tank, Peak tanks, Wing tanks and Bilges	3	
11	Sounding pipes, Air Pipes and Ventilators:	3	1
	11.1 Sketch & explain purpose of Sounding pipes, Air pipes, Ventilators 11.2 Sketch & explain various types of air pipes and ventilators	1.5 1.5	
12	Geographical Features affecting Shipping:	6	2
	12.1 Describe Climate, tides, wind, current, areas of bad weather, Time zone, International Dateline, Sea water density, Load line zones 12.2 Explain impact of Climate, tides, wind, current, areas of bad weather, Time zone, International Dateline, Sea water density, Load line zones on ships and shipping.	3 3	

TEXT BOOKS

1. Ship Construction sketches & notes – Kemp & Young

RECOMMENDED BOOKS FOR REFERENCE:

1. Reed's Ship Construction for Marine students-by E.A.Stokoe
2. Merchant Ship Construction– H.J.Pursey
3. Ship Construction-D J. Eyres
4. Merchant Ship Construction- Dr D.A.Taylor.

INDIAN MARITIME UNIVERSITY

SEMESTER I

UG 21 T5106	Terrestrial Navigation	45+30=75 Hrs	Credits-5
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Earth:	5	2
	1.1 Define Great circle, Smallcircle, Sphericalangle, Sphericaltriangle, poles of a great circle.	1	
	1.2 Define Earth poles, Equator and Meridians.	0.5	
	1.3 Describe the approximate polar and equatorial circumferences of the earth	0.5	
	1.4 Define latitude and Parallel of latitude, Prime meridian and longitude	0.5	
	1.5 Define difference of Latitude and difference of Longitude	0.5	
	1.6 Describe the earth as an ellipsoid	0.5	
	1.7 Define compression and states its value	0.5	
	1.8 Define international nautical mile, cable and Knot	0.5	
	1.9 Define Geographical mile; Statute mile, comparison of nautical mile with kilometer	0.5	
2	Compass Corrections:	7	6
	2.1 Describe the direction on the earth surface	0.5	
	2.2 Describe the direction of the ships head on gyro compass(gyro course)	0.5	
	2.3 Describe the direction of the ships head on the magnetic compass(compass course)	0.5	
	2.4 Define true magnetic and compass north	0.5	
	2.5 Find deviation and variation from tables and charts, Deviation cards, annual rate of change of magnetic variation.	0.5	
	2.6 Apply variation to the error of magnetic compass to find the deviation for the directions of ships head	0.5	
	2.7 Calculate true course from compass course	0.5	
	2.8 Calculate compass course from true course	0.5	
	2.9 Measure compass error using transit bearing	0.5	
	2.10 Apply compass error to the ships head and compass bearing to convert it to true.	0.5	
	2.11 State that the magnetic variation can be found using isogonal lines and charts.	0.5	
	2.12 Calculate compass error and gyro error, from transit bearing and bearing from any distant fixed objects.	1	
	2.13 Boxing of Compass		
3	Parallel and Plane Sailing:	7	6

SN	Specific Learning Objectives	Lectures	Tutorials
	3.1 Define departure and states the relationship to the difference of longitude	0.5	
	3.2 Define true course and Rhumb line	0.5	
	3.3 Derive the plane sailing formulae	0.5	
	3.4 Explain the relationship between departure and difference of longitude in cases involving a change of latitude by using mean latitude	0.5	
	3.5 use the plane sailing formula Departure ----- =cosine of latitude Diff of longitude	0.5	
	3.6 Calculate the distance between two positions on the same parallel of latitude	0.5	
	3.7 Calculate the difference of longitude for a given distance run along a parallel of latitude	0.5	
	3.8 Derive the final position after sailing along a parallel of latitude	0.5	
	3.9 Demonstrate the uses of the plane sailing formulae	0.5	
	3.10 Understand the meaning of, and can derive mean latitude.	0.5	
	3.11 Calculate the correct departure to use in a plane sailing problem	0.5	
	3.12 Calculate the course and distance between two positions, using the plane sailing formula.	0.5	
	3.13 Derive the information required in parallel and plane sailing problem, using a traverse table or calculator.	1	
		0.5	
4	Mercator Sailing:	7	6
	4.1 Demonstrate the basic knowledge of chart projection	1	
	4.2 Define natural scale of a chart.	0.5	
	4.3 Define meridional parts	0.5	
	4.4 Describe the requirements of chart appropriate for marine navigation	1	
	4.5 Understand the principles of construction of Mercator chart.	1	
	4.6 Describe the properties of the chart and the degree to which it meets the Navigational requirements and also its limitations	1	
	4.7 Latitude and longitudinal scales and conversion of one to the other. Relationship between D'long and DMP.	0.5	
	4.8 Explain how to measure the distance between two positions on a Mercator chart based on the latitude of the two positions.	0.5	
	4.9 Use the Mercator formula to calculate course and distance between two positions.	0.5	
	4.10 Use Mercator formula to calculate the final position, given the initial position, course and distance.	0.5	
5	Day's work:	8	4
	5.1 Calculate DR position or an estimated position by using the Plane sailing formula, given compass course and compass error, distance by log, estimated speed, tidal and current information and leeway.	8	
6	Great Circle and Composite G.C. Sailing:	7	4
	6.1 Demonstrate the understanding of great circle sailing including composite and limited latitude great circles.	1	
	6.2 Calculate initial and final course and the distance of great circle track	1	

SN	Specific Learning Objectives	Lectures	Tutorials
	6.3 Calculate composite great circles, vertex and position of intermediate points.	2	
	6.4 Principles of Gnomonic projection.	1	
	6.5 Describe the use of gnomonic chart for plotting the great circles between two points	1	
	6.6 Explain the procedure to transfer a great circle from a Gnomonic chart to a Mercator chart.	1	
7	Maritime Geography:	4	2
	7.1 Locate ocean, continents, seas, canals, straits, navigable rivers, major ports of the world and major ocean routes	4	

TEXT BOOKS

- 1.Principles of Navigation by Capt. S.S.S Rewari& Capt. T.K.Joseph
- 2.Practical Navigation by Capt. H Subramaniam

RECOMMENDED BOOKS FOR REFERENCE:

1. Principal of Navigation by Capt. P.M. Sarma
2. The Admiralty Manual of Navigation: Principles of Navigation: Vol. 1- Nautical Institute
3. NAV Basics: The Earth, the sailings, Tides & Passage Planning Vol.1- Witherby Seamanship International Ltd.
4. Nicholls's Concise Guide to the Navigation Examinations Vol. 2- Edward J Coolen
5. Oxford School Atlas

INDIAN MARITIME UNIVERSITY
SEMESTER I

UG 21 P5107	Physics Practical & Projects	60 Hrs. = 45+15 (9 X 5 Hrs. practical + Project-15 Hrs.)	Credits-2
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SN	Specific Learning Objective	Hours
1	Determine various magnetic elements using a dip circle	5
	1.1 Explain magnetic elements and their variation.	1
	1.2 Explain procedure to find the various magnetic elements using dip circle	2
	1.3 Perform the experiment and write down the observation table	1
	1.4 Assessment	1
2	Magnetic Retentivity in Hard Iron & Soft Iron	5
	2.1 Explain the difference between Hard Iron & Soft Iron	1
	2.2 Explain Retentivity in Hard Iron & Soft Iron.	1
	2.3 Explain the procedure to calculate the Retentivity in Hard Iron & Soft Iron	1
	2.4 Write down the observation table	1
	2.5 Assessment	1
3	Determining Relative Humidity and effect of temperature on RH	5
	3.1 Define and Explain Relative Humidity	1.5
	3.2 Explain the effect of temperature on Relative humidity	1.5
	3.3 Explain the procedure to determine the Relative humidity	1
	3.4 Assessment	1
4	Determination of wavelength of laser by diffraction method	5
	4.1 Define wavelength	0.5
	4.2 Explain Diffraction and Diffraction grating	1.5
	4.3 Explain the procedure to determine the wavelength of laser by diffraction method	1
	4.4 Perform the experiment and write the observation table	1
	4.5 Assessment	1
5	Determine the velocity of sound in air using a CRO	5
	5.1 Define Wavelength and frequency	0.5
	5.2 Explain the basic functions of CRO	1
	5.3 Explain the procedure to determine the frequency and wavelength	1
		1

SN	Specific Learning Objective	Hours
	5.4 Perform the practical and write the observation table	0.5
	5.5 Calculate the velocity of sound by using formula	1
	5.6 Assessment	
6	Moment of inertia of a flywheel and frictional torque.	5
	6.1 Define moment of inertia and frictional torque	0.5
	6.2 Explain the procedure to calculate moment of inertia and frictional torque of flywheel	2
	6.3 Perform the experiment and write down the observation table	1
	6.4 Calculate the moment of inertia and frictional torque by using formula	0.5
	6.5 Assessment	1
7	Determination of mechanical advantage, velocity ratio and efficiency of a Weston differential pulley.	5
	7.1 Define the terms mechanical advantage, velocity ratio and efficiency as applied to lifting machines.	0.5
	7.2 Study the relation between the MA, VR and Efficiency.	0.5
	7.3 Verify the formula to calculate the velocity ratio of Weston differential pulley.	1
	7.4 Explain the procedure to calculate MA,VR, Efficiency.	1
	7.5 Perform the practical and write down the observation table.	1
	7.6 Assessment	1
8	Determination of Y : Single Cantilever loaded at one end	5
	8.1 Explain Elasticity and Modulus of elasticity.	0.5
	8.2 Define Cantilever beam.	0.5
	8.3 Explain the procedure to find the Y of Single Cantilever loaded at one end.	2
	8.4 Perform the practical and write down the observation table	1
	8.5 Assessment	1
9	Determination of angle of repose of grains and friction	5
	9.1 Define Friction and angle of repose	1
	9.2 Explain the procedure to find the angle of repose.	1.5
	9.3 Perform the practical and write the observation table	1.5
	9.4 Assessment	1
10	Project Work based on any of the concept as above.	15

INDIAN MARITIME UNIVERSITY

SEMESTER I

UG21P5108	Electronics (Practical)	45 Practcal+15 Project =60 Hrs	Credits-2
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SN	Specific Learning Objective	Hours
1	Class-B-push pull amplifier, frequencyresponse.	6
	1.1 Explain the working of Class B push pull amplifier.	0.5
	1.2 Connect the circuit as per the circuit diagram.	0.5
	1.3 performs the experiment as per procedure.	0.5
	1.4 Note down the readings.	0.5
	1.5 Do the calculations.	0.5
	1.6 Explain the working of frequency response of amplifier.	0.5
	1.7 Connect the circuit as per the circuit diagram	0.5
	1.8 performs the experiment as per procedure.	0.5
	1.9 Note down the readings.	0.5
	1.10 Do the calculations.	1
	1.11 Assessment	0.5
2	Op-Amp: Inverting and non-invertingamplifier.	6
	2.1 Explain the working of Inverting amplifier.	0.5
	2.2 Connect the circuit as per the circuit diagram.	0.5
	2.3 Performs the experiment as per procedure.	0.5
	2.4 Note down the readings.	0.5
	2.5 Do the calculations.	0.5
	2.6 Explain the working of Non - inverting amplifier.	0.5
	2.7 Connect the circuit as per the circuit diagram.	0.5
	2.8 Performs the experiment as per procedure.	0.5
	2.9 Note down the readings.	0.5
	2.10 Do the calculations.	1
	2.11 Assessment	0.5
3	Development of Logic Gates with Truth Table	6
	3.1 Explain the working of basic gates.	0.5
	3.2 Connect the circuit as per the circuit diagram.	0.5
	3.3 Performs the experiment as per procedure.	0.5
	3.4 Note down the readings.	0.5
	3.5 Do the calculations.	0.5
	3.6 Explain the working of Universal gates.	0.5
	3.7 Connect the circuit as per the circuit diagram.	0.5
	3.8 Performs the experiment as per procedure.	0.5
	3.9 Note down the readings.	0.5
	3.10 Do the calculations.	1
	3.11 Assessment	0.5
4	Hartley and Colpitt'soscillator	6
	4.1 Explain the working of Hartley Oscillator.	0.5
	4.2 Connect the circuit as per the circuit diagram.	0.5
	4.3 Performs the experiment as per procedure.	0.5

SN	Specific Learning Objective	Hours
	4.4 Note down the readings.	0.5
	4.5 Do the calculations.	0.5
	4.6 Explain the working of Colpitt's Oscillator.	0.5
	4.7 Connect the circuit as per the circuit diagram.	0.5
	4.8 Performs the experiment as per procedure.	0.5
	4.9 Note down the readings.	0.5
	4.10 Do the calculations.	1
	4.11 Assessment	0.5
5	Half wave and Full wave rectifier using capacitor filter.	6
	5.1 Explain the working of Half wave Rectifier.	0.5
	5.2 Connect the circuit as per the circuit diagram.	0.5
	5.3 Performs the experiment as per procedure.	0.5
	5.4 Note down the readings.	0.5
	5.5 Do the calculations.	0.5
	5.6 Explain the working of Full wave Rectifier.	0.5
	5.7 Connect the circuit as per the circuit diagram.	0.5
	5.8 Performs the experiment as per procedure.	0.5
	5.9 Note down the readings.	0.5
	5.10 Do the calculations.	1
	5.11 Assessment.	0.5
6	Study of IC 555 Timer & its types.	5
	6.1 Explain the working of Monostable Multivibrator.	0.30
	6.2 Connect the circuit as per the circuit diagram.	0.20
	6.3 Performs the experiment as per procedure.	0.20
	6.4 Note down the readings.	0.20
	6.5 Do the calculations.	0.30
	6.6 Explain the working of Astable Multivibrator.	0.30
	6.7 Connect the circuit as per the circuit diagram.	0.20
	6.8 Performs the experiment as per procedure.	0.20
	6.9 Note down the readings.	0.20
	6.10 Do the calculations.	0.30
	6.11 Assessment.	0.5
7	To study the characteristics of LED and LDR	5
	6.1 Explain the working of LED.	0.30
	6.2 Connect the circuit as per the circuit diagram.	0.20
	6.3 Performs the experiment as per procedure.	0.20
	6.4 Note down the readings.	0.20
	6.5 Do the calculations.	0.30
	6.6 Explain the working of LDR.	0.30
	6.7 Connect the circuit as per the circuit diagram.	0.20
	6.8 Performs the experiment as per procedure.	0.20
	6.9 Note down the readings.	0.20
	6.10 Do the calculations.	0.30
	6.11 Assessment.	0.5
8	To study characteristics of a Zener diode and its use as Voltage Regulator	5
	8.1 Explain the working of Zener diode in forward bias.	0.30
	8.2 Connect the circuit as per the circuit diagram.	0.20
	8.3 Performs the experiment as per procedure.	0.20

SN	Specific Learning Objective	Hours
	8.4 Note down the readings.	0.20
	8.5 Do the calculations.	0.30
	8.6 Explain the working Zener diode in reverse bias.	0.30
	8.7 Connect the circuit as per the circuit diagram.	0.20
	8.8 Performs the experiment as per procedure.	0.20
	8.9 Note down the readings.	0.20
	8.10 Do the calculations.	0.30
	8.11 Assessment.	0.5
9	Project Work based on Application of above	15
	9.1 Literature Survey.	
	9.2 Design the circuit.	
	9.3 Build a permanent circuit.	
	9.4 Finish the project	
	9.5 Assessment	

SN	Specific Learning Objectives	Lectures	Tutorials
5	<u>Positive Attitude</u>	4	1
	5.1 Explain how to build a positive image in front of prospective employers	0.5	
	5.2 Describe behavioral skills	1	
	5.3 Explain how to develop rapport	0.5	
	5.4 Define friendliness	0.5	
	5.5 Define Humour	0.5	
	5.6 Explain how to build networking	0.5	
	5.7 Resilience – What it is and how to build it.	1.5	

TEXT BOOKS

1.Managing Soft Skills For Personality Developement-B.N.Ghosh.

RECOMMENDED BOOKS FOR REFERENCE:

1.Soft Skills-Dr K.Alex

INDIAN MARITIME UNIVERSITY**SEMESTER II****Semester-II Courses**

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5201	Applied Mathematics	45	15	60	4
2	UG21T5202	Applied Physics & Electricity	45	15	60	4
3	UG21T5203	Computer Science	45	20	65	4
4	UG21T5204	Ship Construction	45	15	60	4
5	UG21T5205	Ship Operation Technology	45	15	60	4
6	UG21T5206	Environmental Studies	60	20	80	5
7	UG21P5207	Applied Physics & Electricity (Practical)	45	-	45	2
8	UG21P5208	Computer Science (Practical)	60	-	60	2
9	UG21P5209	English Communication Lab	30	-	30	1
		Total			520	30

INDIAN MARITIME UNIVERSITY

SEMESTER II

UG 21 T5201	Applied Mathematics	45+15=60 Hrs	Credit-4
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SN	Specific Learning Objective	Lectures	Tutorials
1	Fourier series	11	4
	1.1 Define Inner product, Periodic function, Orthogonal function	0.5	
	1.2 State Dirichlet's conditions for Fourier Series expansion.	0.5	
	1.3 State Euler's formulae.	0.5	
	1.4 State Fourier Series in different interval ($\alpha < x < \alpha+2\pi$)	0.5	
	1.5 Find the Fourier Series for the function in the interval $0 < x < 2\pi$.	0.5	
	1.6 Define functions having points of discontinuity	0.5	
	1.7 Find the F. S. expansion of given function having points of discontinuity.	1	
	1.8 State Fourier series for functions having arbitrary period (change of interval)	0.5	
	1.9 Expand F.S. In different interval (change of interval) for given function.	1	
	1.10 Define Even and Odd functions, Expansion of even and odd function.	0.5	
	1.11 Find F.S for given even/odd function	0.5	
	1.12 Define Sine series and Cosine series	1	
	1.13 Express the function as a half-range sine /cosine series.	1	
	1.14 State Fourier Integral theorem.	1	
	1.15 Find the Fourier integral representation of the function.	0.5	
	1.16 Find the Fourier cosine integral of the function.	0.5	
	1.17 Find the Fourier sine integral of the function.	0.5	
2	Laplace Transform	11	4
	2.1 Define Laplace Transform	0.5	
	2.2 Apply the definition of LT to transforms of elementary functions	1	
	2.3 Solve problems by using Laplace transform of standard functions	1	
	2.4 State different properties (linearity, shifting, transforms of derivatives and integrals, multiplication by division by t) of Laplace Transforms	1	
	2.5 Find the LT of given function using different properties	1	
	2.6 Evaluate the integrals by LT.	0.5	
	2.7 Determine the Inverse LT of standard function.	1	
	2.8 Use the method of Partial fraction to find the ILT of given function.	1	
	2.9 Describe different properties (linearity, shifting, transforms of derivatives and integrals, multiplication by s^n , division by s) of Inverse Laplace Transforms.	0.5	
	2.10 Find the Inverse Laplace transform of given function using different properties	1	
	2.11 State Convolution theorem.	0.5	

SN	Specific Learning Objective	Lectures	Tutorials
	2.12 Apply convolution theorem to evaluate the Inverse function. 2.13 State working procedure to solve a linear differential equation with constant coefficients by transform method. 2.14 Solve by method of transform the differential equation.	1 1	
3	Statistical Methods	11	4
	3.1 Find the mean using direct method for grouped data. 3.2 Find the mean using step deviation method for grouped data. 3.3 Find mean, median, and mode of given data. 3.4 Define Range, quartile deviation, mean deviation, standard deviation. 3.5 Calculate mean and standard deviation for the given data. 3.6 Calculate the coefficient of variation for combined groups. 3.7 Calculate the coefficient of correlation using direct method. 3.8 Find lines of regression of y on x and x on y using least square methods. 3.9 Find the correlation coefficient from the following data. 3.10 Find the rank correlation coefficient from the following data	1 1 2 1 1 1 1 1 1 1	
4	Numerical Methods	12	3
	4.1 Find a root of given equation by using Bisection method 4.2 Find the real root of the given equation by using Method of False Position 4.3 Find by Newton's method, the real root of the given equation 4.4 Evaluate the given expression by using deductions from the Newton –Raphson formula 4.5 Define Forward differences, Backward differences, Central differences, Divided differences 4.6 Explain Differences of polynomials. 4.7 Define Other difference operators: Taylor's operator – D, shift operator E, averaging operator, 4.8 Evaluate the forward difference of given function. 4.9 Construct the table of differences for the given data 4.10 Evaluate the backward difference of given function 4.11 Find the missing term from the table 4.12 State Newton's forward and backward difference interpolation formulas and calculate the given value. 4.13 Find the polynomial evaluating the data 4.14 Evaluate using Lagrange's interpolation formula 4.15 Evaluate the given definite integral by using Trapezoidal rule 4.16 Evaluate the given definite integral by using Simpson's rules. 4.17 Obtain a solution of given ODE using Picard's method (initial value problem) 4.18 Solve the given Ode using Euler's method (one step method) 4.19 Solve the given ODE using Runge-Kutta method.	1 1 1 1 1 0.5 1 1 1 0.5 0.5 1.5 0.5 1 0.5 1 1 1 1	

TEXT BOOKS

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

RECOMMENDED BOOKS FOR REFERENCE:

2. A Text book of applied mathematics Vol.I - Wartikar, P.N.&Wartikar, J.N
3. Further Engineering Mathematics –K.A.Stroud
4. Advanced Engineering Mathematics – Dr. A.B. Mathur&Prof. V.P.Jaggi
5. K Hoffman and R Kunze, Linear Algebra, Pearson Education, 2nd Edition, 2005
6. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India, 9thEdition, 2011

INDIAN MARITIME UNIVERSITY

SEMESTER II

UG21T5202	Applied Physics & Electricity	45+15=60 Hrs	Credit-4
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SN	Specific Learning Objective	Lectures	Tutorials
1	Electromagnetic Induction:	6	2
	1.1 Describe relation between magnetism and electricity, Production of Electro-magnetic induction and current.	3	
	1.2 Describe Faraday-Lenz's Law, Self and Mutual inductance and their coefficients, coupling coefficients.	3	
2	A.C. Circuits:	6	2
	2.1 Describe AC and DC voltage, Resistances and capacitors in series and parallel, Impedance, static electricity precaution and earthing insulators, [Shipboard Application: <i>electrostatic charge by petroleum and precaution</i>]	3	
	2.2 Describe A.C. Fundamentals, Series and Parallel RLC circuits, Resonance frequency, Power, Power factor, Q factor and Applied Numerical.	3	
3	Electrical Bridge Circuits:	6	2
	3.1 Describe Bridge circuits, Wheatstone Bridge, [<i>Application of Wheatstone Bridge in Gas Measuring Instruments</i>]	3	
	3.2 Explain definition of Q of coil.	1	
	3.3 Applied Problems.	2	
4	Network Theorems and its applications:	5	1
	4.1 Describe Kirchoff's Law, Classification of Network elements, Constant Voltage and Current Source.	5	
5	Generators and Motors:	11	4
	5.1 Describe principle and working of AC generator, AC motor, induction motor, DC generator, DC motor, R.M.S. value, series and shunt type DC motor.	9	
	5.2 Describe heating effect of current, heaters, fuses, thermoelectric effect.	3	
6	Instrumentation:	11	4
	6.1 Describe Calibration, Accuracy, Precision, Methods of measurement of temperature, pressure, Fluid flow, venture tube, sound levelmeter, Thermister and its application as heat sensors, transducers. [Shipboard application of above]	11	

TEXT BOOKS

- 1) Basic Electrical Engineering- B.L.Thereja

RECOMMENDED BOOKS FOR REFERENCE:

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

INDIAN MARITIME UNIVERSITY

SEMESTER II

UG21T5203	Computer Science	45+20 =65 Hrs	Credit-4
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SN	Specific Learning Objective	Lectures	Tutorials
1	Computer Arithmetic	5	2
	1.1 Understand Binary, octal, decimal & hexadecimal number Systems & mutual conversion.	1.5	
	1.2 Solve Addition, Subtraction, Multiplication, Division, 1's & 2's complement method of subtraction in binary only.	2	
	1.3 Solve Binary codes: BCD numbers, Excess – 3 code, ASCII code, EBCDIC code Gray code.	1.5	
2	Computer Memory	3	2
	2.1 Explain in details Main Memory, Secondary Memory, Backup Memory, Cache Memory, Real and Virtual Memory.	2	
	2.2 Explain in details System Software and Programming Techniques: Machine language, Assembly language, Low level and High level Languages, Compiler, Assembler, and Interpreter.	1	
3	E- Commerce	3	1
	3.1 Explain in detail IT and business, E-commerce: Concepts Electronic Communication, Internet and intranets.	1	
	3.2 Explain in detail how EDI to E-commerce. Concerns for E-commerce Growth.	1	
	3.3 Explain in detail how Cyber Cash, Dig cash.	1	
4	MS Word MS Excel and MS PowerPoint	18	5
	4.1 Explain in detail how Create workbooks, working with rows, columns, cells and Worksheets.	1	
	4.2 Explain in detail how Insert pictures and graphics. Format cells.	1	
	4.3 Explain in detail how Use conditional formatting on data in cells,	1	
	4.4 Demonstrate Advanced Calculations Create formulas, employ the function wizard, add comments, Create charts	1	
	4.5 Demonstrate Use spelling and grammar checks in the document.	1	
	4.6 Demonstrate Use “Headers and Footers”.	1	
	4.7 Demonstrate Insert symbols and pictures.	1	
	4.8 Demonstrate Create tables in MS-Word.	1	
	4.9 Explain in details Use formulas in MS –WORD Mail merge, Embedding Excel to WORD.	1	
	4.10 Demonstrate Create a presentation: Create a slide, Add new slides,	1	
	4.11 Demonstrate Insert pictures, Format text, Format pictures, and Preview a presentation.	1	
	4.12 Demonstrate Insert tables and charts, Employ design templates, employ a master slide, and rearrange slides.	2	

SN	Specific Learning Objective	Lectures	Tutorials
	4.13 Animate text, animate graphics, create slide transitions, Advance slides automatically, Preparing Live Presentations, Make presentation portable.	5	
5	Python	16	10
	5.1 Explain in details Python operators, datatypes	1	
	5.2 Explain in details condition statements	5	
	5.3 Explain in details Loop control statement	5	
	5.4 Explain in details different types function or methods in python	2	
	5.5 Explain , demonstrate file handling using python	2	

TEXT BOOKS

RECOMMENDED BOOKS FOR REFERENCE:

1. Information Technology for management: Henry Lucas, Tata Mc-Graw Hills
2. The Complete E-Commerce Book: Design, Build, and Maintain a Successful Web-Based Business: Janice Reynolds
3. MS Office 2007 By Gary Shelly, Thomas Cashman
4. Computer Fundamentals and Programming in C, Pradip Dey, Manas Ghosh.
5. Basics of Computer Science- Behrouz Forouzan, Firouz Maosharraf.
6. Introducing Python- Modern Computing in Simple Packages – Bill Lubanovic, O,,Reilly Publication
7. Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress
8. Practical Programming: An Introduction to Computer Science Using Python 3, Paul Gries, et al., Pragmatic Bookshelf, 2/E 2014
9. Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication Learning with Python “, Green Tea Press, 2002.
10. Computer Concepts and Fundamentals of Programming By Ganesh Ingle.

INDIAN MARITIME UNIVERSITY

SEMESTER II

UG21T5204	Ship Construction	45+15=60 Hrs	Credit-4
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SN	Specific Learning Objective	Lectures	Tutorials
1	Frames, Beams and Beam knees	4	1
	1.1 Sketch & describe Frames, Beams and Beam knees 1.2 Explain Longitudinal & transverse framing, 1.3 Explain importance of Beams and Beam knees 1.4 Sketch Beams and Beam knees 1.5 Explain Combined system of framing on transverse sections of the ship.	1 1 0.5 0.5 1	
2	Water Tight Bulkheads	2	1
	2.1 Explain functions, construction and stiffening of water tight bulkheads including collision bulkheads, Corrugated bulkhead.	2	
3	Bilge keels, Ballast tanks, bilges	5	2
	3.1 Describe and sketch Bilge Keels. 3.2 Describe and sketch Double Bottom Tanks. 3.3 Describe and sketch Fore Peak and After Peak Tanks. 3.4 Describe and sketch Wing tanks and Bilges.	1 1 2 1	
4	Deck Opening	4	1
	4.1 Explain Construction, stiffening & closing arrangement of openings on deck & Superstructures, 4.2 Explain weather-tightness of Hatches, 4.3 Explain openings in RORO ships, Oil, Chemical & Gas tankers.	1.5 0.5 2	
5	Anchor, Chain and Mooring Arrangements:	6	2
	5.1 Describe Chain lockers and attachment of Cables, 5.2 Sketch and describe the Construction of Hawse pipes, Spurling Pipes & their securing arrangements. 5.3 Explain Typical mooring / anchoring arrangement in forecastle showing the Leads of mooring 5.4 Describe Roller, multi angle, pedestal and panama fair lead 5.5 Explain Mooring bitts showing their attachment to the decks 5.6 Explain Cable stopper	1 1 1 1 1 1	
6	Sounding Pipes, Air Pipes and Ventilators –	4	1
	6.1 Sketch and describe the construction of Sounding pipes, 6.2 Sketch and describe the construction of Air Pipes, 6.3 Sketch and describe the construction of Ventilators.	1 2 1	
7	Pump & Piping Arrangement	4	1

SN	Specific Learning Objective	Lectures	Tutorials
	7.1 Explain General Pumping arrangements, 7.2 Describe Bilge & Ballast line system, 7.3 Explain Pumping arrangement on tankers. 7.4 Explain Hold drainage systems and related structure Bilge piping system, strum box, and Non-return valves.	1 1 1 1	
8	Special Doors on Cargo Vessels	3	1
	8.1 Explain Methods adopted to maintain integrity of divisions & openings in the hull including STERN DOOR, SIDE DOOR & BOW DOORS, 8.2 Describe Ro-Ro ship problems.	2 1	
9	Rudder Arrangement & Stern Frame	5	2
	9.1 Describe types of rudder 9.2 Sketch and explain Balanced & Semi balanced Rudders, 9.3 Describe the Construction & Support Arrangement of rudders 9.4 Sketch and describe Stern Frame. 9.5 Describe Transom stern showing connections to the stern frame 9.6 Explain the purpose of rudder carrier, pintles and rudder trunking. 9.7 Explain Arrangement of watertight gland around the rudder stock.	0.5 1 0.5 1 1 0.5 0.5	
10	Propellers & Propeller Shaft:	4	1
	10.1 Draw Simple sketch of Propeller & Propeller shaft, Stern Tube & adjacent structures. 10.2 Explain terms Boss, Rake, Skew, Face, Back, Tip, Radius, Pitch 10.3 Explain Controllable pitch propeller.	1.5 1 0.5	
11	Welding	4	2
	11.1 Describe Welding process and its predominant use in ship construction. 11.2 Discuss Advantages of welding over riveting in ship construction. 11.3 Explain General ideas of Electric Arc welding equipment, coated electrodes, and methods used. 11.4 Explain methods used for Gas welding, and Gas cutting. 11.5 Explain Precaution while welding. 11.6 Describe Testing and inspection of welds, 11.7 Explain Stresses set up due to welding and defects in welding.	0.5 0.5 0.5 0.5 0.5 0.5 1	

TEXT BOOKS

1. Ship construction - D J Eyres

RECOMMENDED BOOKS FOR REFERENCE:

1. Ship Construction sketch's & notes by Kemp&Young - Kemp & Young
2. Merchant Ship Construction by H.J.Pursey
3. Reed's ship construction for marine students by E.A.Stokoe
4. Merchant Ship Construction – Dr. D.A.Taylor

INDIAN MARITIME UNIVERSITY

SEMESTER II

UG21T5205	Ship Operation Technology	45+15=60 Hrs	Credit-4
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SN	Specific Learning Objective	Lectures	Tutorials
1	General: Parts of ship, watches, PPE	4	1
	1.1 List names of various parts of ship.	2	
	1.2 State names and timing of watches.	0.5	
	1.3 List Personal Protective Equipment (PPE) – Boiler suits, Face Masks, Safety Harness, Ear Mufflers, Chemical Suits, Hand Gloves, Safety goggles, Safety helmet, Safety Shoes.	1.5	
2	Rope Work	11	4
2	2.1 State types of material used in construction of Ropes - Natural fibres, Synthetic fibres, HMP Ropes.	1	
	2.2 Explain different lays of rope.	1	
	2.3 Describe different types of fibre ropes and compare the strength and elasticity of the ropes.	1	
	2.4 Care and maintenance of fibre Ropes.	0.5	
	2.5 State the damage caused by surging.	0.5	
	2.6 Explain marline, Twine, spun, lead lines. Knots, Bends, Hitches & Whippings.	1	
	2.7 Explain different types of Mooring ropes and their advantages/disadvantages.	1.5	
	2.8 Explain the grades of steel used for making Wire ropes, construction of wire ropes, advantage of a fibre heart and factors determining flexibility,	1.5	
	2.9 State meaning of 6/12, 6/24, 6/37 types of wire ropes, Non-rotating wire rope, Plastic covered wire rope.	1	
	2.10 Explain, Care and maintenance of wire ropes,	0.5	
	2.11 Method of measuring size of ropes, wires and chains.	0.5	
	2.12 Explain use of Chain/rope stoppers.	1	
3	Flags and Halyards	6	2
	3.1 Define meaning of Bunting.	0.5	
	3.2 Explain how to dress the ship	0.5	
	3.3 Explain Halyard at the dip, Close up, Half mast, Hoist, Fly, Tackline.	1	
	3.4 Explain Courtesy flag, Flags A-Z and Numeral pendants, Jack flag, Quarantine flag, Pilot flag, Blue Peter.	2	
	3.5 State the location of Jack Staff, Ensign staff.	0.5	
	3.6 What flags are hoisted from these part of ship and When.	0.5	
	3.7 State type of Ensigns.	0.5	
	3.8 State that there can be penalty for not using or wrongly using an Ensign.	0.5	
4	Code of Safe Working Practices:	19	6
	4.1 State the contents of code of safe working practices for merchant seamen	0.5	
	4.2 List the precautions while entering confined / enclosed space	0.5	
	4.3 Describe procedure for Rescue from enclosed spaces	1	

SN	Specific Learning Objective	Lectures	Tutorials
	4.4 Explain procedure of manual lifting and carrying of weights	0.5	
	4.5 List the precautions while working aloft and over side	1	
	4.6 List the safety precautions while painting, during the use of personnel basket and while on mooring stations.	1	
	4.7 List the precautions while painting funnel, main mast	1	
	4.8 List precautions while repairing radar.	0.5	
	4.9 List precautions while operating hatch covers, using portable ladder.	1	
	4.10 Explain method of guarding of openings on deck.	0.5	
	4.11 List precautions while using hand tools.	1	
	4.12 Marking of obstructions on the passage way on deck.	1	
	4.13 List the safety precautions whilst walking/working on deck.	0.5	
	4.14 Explain standard crane signals.	0.5	
	4.15 List safety precautions while anchoring.	0.5	
	4.16 List the safety precautions while entering battery room and paint room.	1	
	4.17 List precaution while using bosun's chair and stages, rigging gangway and pilot ladder.	1	
	4.18 List the precautions while using electric, pneumatic and hydraulic (power) tools and appliances.	1	
	4.19 List the precautions while working with compressed air, chipping machines, spray painting machine.	1	
	4.20 List precautions while cleaning holds using high pressure (water jet) machines.	1	
	4.21 Describe safe bunkering practices.	1	
	4.22 Procedure to carry out risk assessment.	1	
	4.23 Importance of various Check list.	1	
5	Safety Committee Meeting:	5	2
5	5.1 Explain Conduct of Safety Committee meetings.	1	
	5.2 State Role of Safety committee and Safety Officer in maintaining safety standards on board.	2	
	5.3 Explain importance of personnel health and hygiene on board ship.	2	
	5.4 Explain different types of permits - hot work permit, cold work Permit, entry into enclosed space permit, working aloft permit, and working overside permit, electrical isolation permit, lockout and tag out.	3	

TEXT BOOKS

1. Seamanship Technique-D.J.House

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
6. Seamanship-Capt V.K.Bhandarkar

INDIAN MARITIME UNIVERSITY

SEMESTER II

UG21T5206	Environmental Studies	60+20=80 Hrs	Credit-5
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SN	Specific Learning Objectives	Lectures	Tutorials
1	The Multidisciplinary nature of Environmental Studies:	2	1
	1.1 Definition, Scope and importance, Need for public awareness	2	
2	Natural Resources:	7	2
	2.1 Describe renewable and non-renewable resources: Natural resources and associated problems.	2	
	a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.	1	
	b) Water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems.	1	
	c) Mineral resources: Use and exploitation, environmental effect of extracting and using mineral resources, case studies.	1	
	d) Food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.	1	
	e) Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy source. Case studies.	1	
	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.	1	
3	Ecosystems :	5	1
	3.1 Describe 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.	3	
	3.2 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)	3	
4	Biodiversity and its conservation :	7	2
	4.1 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 vs wildlife conflicts,	6	
	4.2 Endangered and endemic species of India,	1	
	4.3 Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	1	
5	Environmental Pollution :	7	2
	5.1 Definition: causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards.	2	

SN	Specific Learning Objectives	Lectures	Tutorials
	5.2 Solid waste Management: Causes, effect and control measures of urban and industrial wastes.	2	
	5.3 Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.	4	
6	Social Issues and the Environment :	6	2
	6.1 From Unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management,	1	
	6.2 Resettlement and rehabilitation of people: its problems and concerns. Case studies.	1	
	6.3 Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion. Nuclear accidents and holocaust. Case studies.	2	
	6.4 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.	3	
7	Human Population and the Environment :	5	1
	7.1 Population growth, variation among nations, Population explosion – Family Welfare Programme, environmental and Human health, human rights, Value Education, HIV / AIDS, Women and child Welfare,	4	
	7.2 Role of Information Technology in Environment and human health, Case Studies.	2	
8	Field work: (One field visit)	5	1
	8.1 Visit to a local area and a) document environmental assets-river/ forest/ grassland/ hill/ mountain. b) document pollution at Urban / rural / Industrial / agriculture area c) study of common plants, insects, birds, d) study simple eco systems-pond, river, hill slopes, etc.	5	
9	Earth's Atmosphere :	4	1
	9.1 Describe the composition of the earth's atmosphere, mentioning dry air and its constituents, water vapour and aerosols.	1	
	9.2 Draw a typical vertical temperature profile through the lower 100 km of the earth's atmosphere. Define 'troposphere', 'tropopause', 'stratosphere', 'stratopause', 'mesosphere', 'mesopause' and 'thermosphere. Describe the main features of the troposphere.	1	
	9.3 Describe the importance of the sun as the principal energy source for atmospheric processes. Describe the nature of solar radiation (scattering, reflection and absorption). Explain the effect on insolation of a variation in latitude. Explain the effect on insolation of a variation in the sun's declination. Explain the effect on insolation of a variation in the length of daylight.	1.5	
	9.4 Explain the Greenhouse effect and global warming. Explain heat exchange process (conduction, convection and radiation). Explain radiation budget of the earth/atmosphere system.	0.5	
	9.5 Explain environmental lapse rate and inversion. Explain Diurnal, seasonal and geographical variation of temperature, Dry Adiabatic Lapse Rate (DALR) and Saturated Adiabatic Lapse Rate (SALR), Saturation; Evaporation, Condensation, Latent Heat, and Vapour Pressure.	1.5	
	9.6 Explain Ozone depletion and air pollution.	0.5	

SN	Specific Learning Objectives	Lectures	Tutorials
10	Atmospheric Pressure:	3	1
	<p>10.1 State that pressure equals force per unit area. State that the atmosphere exerts a pressure on any surface placed within it. State that the atmospheric pressure on a unit area of a surface is equal to the weight of the “air column” extending from that surface to the outer fringes of the atmosphere. State that atmospheric pressure decreases with height above sea level. State that atmospheric pressure acts in all directions.</p> <p>10.2 State that the basic unit of pressure is N/m². State that 1 millibar = 1/1000 bar = 102 N/m² State that the atmospheric pressure at sea level normally varies between about 940 mbar and 1050 mbar. State that the average pressure at sea level is 1013.2 mbar. State that the surface pressure rises if air is added to the ‘column’ above the surface, and vice versa.</p> <p>10.3 Define ‘isobar, Diurnal variation of pressure, Barometric tendency, Pressure Gradient.</p>	<p>1</p> <p>1</p> <p>1</p>	
11	Wind:	5	4
	<p>11.1 Define ‘wind’ Describe the Beaufort scale of wind force. Explain qualitatively the pressure gradient force. Explain qualitatively the Coriolis (geostrophic) force and cyclostrophic winds. Explain the surface wind circulation around high- and low-pressure centres.</p> <p>11.2 Explain Buys-Ballot’s Law. Explain the method of estimating the strength of the wind from the appearance of the sea surface, using the Beaufort wind scale.</p> <p>11.3 List the factors, other than the wind speed, which affect the appearance of the sea surface.</p> <p>11.4 Explain the differences between apparent and true wind. Determine the true wind velocity by using a vector diagram, given the apparent wind and the ship’s course and speed.</p> <p>11.5 Describe the method of estimating the wind direction from the appearance of the sea surface.</p> <p>11.6 Explain interpretation of wind rose.</p>	<p>1</p> <p>1</p> <p>1</p> <p>2</p> <p>0.5</p> <p>0.5</p>	
12	Cloud and Precipitation:	4	2
	<p>12.1 State that clouds form when air containing water vapour rises, cools adiabatically and becomes saturated. Describe the need for and define condensation nuclei.</p> <p>12.2 State that a cloud can consist of ice crystals, supercooled water droplets, water droplets or any combination of these.</p> <p>12.3 List and describes the ten basic cloud types. Describe the probable base heights of the ten principal cloud types.</p> <p>12.4 Define ‘precipitation’, ‘rain’, ‘drizzle’, ‘hail’, ‘snow’ and ‘sleet’, Dew.</p>	<p>1</p> <p>1</p> <p>2</p> <p>1</p>	

TEXT BOOKS

1. Marine Meteorology- Capt. H. Subramaniam
2. Textbook of Environmental Studies for UG Courses-Erach Bharucha

RECOMMENDED BOOKS FOR REFERENCE:

1. Meteorology for Mariners – HMSO
2. Meteorology for seafarers – Frampton, R. M.
3. Meteorology Demystified :self-teaching guide – Gibilisco Stan
4. Meteorology for Sea –Sanderson Ray
5. Mariners Handbook (NP 100) – Admiralty
6. Cloud types for Observers – HMSO
7. Agarwal, K.C.2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
8. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380013, India , Email: mapin@icenet.net(R)
9. Brunner R.C.,1989, Hazardous Waste Incineration, McGraw Hill Inc.480p.
10. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
11. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001,Environmental Encyclopedia, JaicoPubl, Mumbai, 1196p.
12. De A. K., Environmental Chemistry, Wiley Eastern Ltd.
13. Down to Earth, Centre for Science and Environment (R)
14. Gleick, H. P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security.Stockholm Env.Institute.Oxford Univ. Press 473p.
15. Hawkins R.E, Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
16. 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. 60
17. Mckinney, M.L. & School R.M. 1996. Environmental Science system & Solutions, Web enhanced edition. 6396p.
18. Mhaskar A.K, Matter Hazardous, Techno-Science Publications (TB)
19. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
20. Odum, E.P.1971. Fundamental of Ecology.W.B.Saunders Co. USA 574p.
21. Rao M N. &Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
22. Sharma B.K., 2001. Environmental Chemistry.Goel Publ. House, Meerut
23. Survey of the Environment, The Hindu (M)
24. Townsend C., Harper J. and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
25. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R)
26. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications (TB)
27. Wagner K.D. ,1998. Environmental Management.W.B. Saunders Co. Philadelphia, USA 499p.

INDIAN MARITIME UNIVERSITY

SEMESTER II

UG21P5207	Applied Physics & Electricity (Practical)	Total 45 Hrs (09 X 5hrs Practical)	Credit- 2
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SN	Specific Learning Objective	Hours
1	Verification of KVL &KCL:	5
	1.1 Introduction to basics of electrical circuits	0.5
	1.2 Define terms related to electrical circuits (like Node, Branch, Loop, Mesh etc.).	0.5
	1.3 State and explain the KVL	
	1.4 State and explain the KCL	0.5
	1.5 Performance of KVL and KCL experiments on practical setup	0.5
	1.6 Verification of KVL and KCL Law theoretically and practically	1
	1.7 Applications of KVL and KCL in different electrical and electronics circuits	0.5
	1.8 Assessment	0.5
		1
2	To find the ratio of inductance value of a coil having air core and ironcore:	5
	2.1 Define the parameters of choke coil	0.5
	2.2 Explain the basic action of choke coil	0.5
	2.3 Explain the active and reactive power of circuit	0.5
	2.4 Explain the construction of choke coil for Air and Iron core	0.5
	2.5 Performance of choke coil experiments on practical setup	0.5
	2.6 Calculate the different parameters of choke coil (like pf, impedance, power etc.)	0.5
	2.7 Explain the operation of 3 ammeter method	0.5
	2.8 Application of choke coil in circuit	0.5
	2.9 Assessment	1
3	Study of R-L-C series resonancecircuit:	5
	3.1 Define the R, L and C parameters of circuit	0.5
	3.2 Explain the combinations of RL, RC and RLC type series circuits	0.5
	3.3 Derive the formulae for the RLC series circuit	0.5
	3.4 Explain the relationship between L and C against frequency (nature of graph)	0.5
	3.5 Series RLC circuit at resonance condition (includes current, phase angle BW etc.)	0.5
	3.6 Calculate the different parameters of series circuit (R, X _L , X _C , pf, power etc.)	0.5
	3.7 Verify the RLC series resonance condition and find out resonance frequency	0.5
	3.8 Application of RLC Series circuit	0.5
	3.9 Assessment	1
4	Study of R-L-C parallel resonancecircuit:	5
	4.1 Define the R, L and C parameters of circuit	0.5
	4.2 Explain the combinations of RL, RC and RLC type parallel circuits	0.5
	4.3 Derive the formulae for the RLC parallel circuit	0.5
	4.4 Explain the relationship between L and C against frequency (nature of graph)	0.5
	4.5 Parallel RLC circuit at resonance condition (includes current, phase angle BW etc.)	0.5
	4.6 Calculate the different parameters of parallel circuit (R, X _L , X _C , pf, power etc.)	0.5
	4.7 Verify the RLC parallel resonance condition and find out resonance frequency	0.5
	4.8 Application of RLC parallel circuit	0.5
	4.9 Assessment	1

SN	Specific Learning Objective	Hours
5	Wheatstone Bridge:	5
	5.1 Define the resistance and classified it	0.5
	5.2 Explain the Wheatstone bridge arrangement	0.5
	5.3 Derive the formula for the bridge circuit	0.5
	5.4 Performance of experiment to find the unknown resistance of different wires	1.5
	5.5 Applications of Wheatstone bridge circuit	0.5
	5.6 Assessment	1
6	Heating Effect of Current, Use of Fuses:	5
	6.1 Define the basic terms of electricity (like current, voltage, resistance etc.)	0.5
	6.2 Explain the factors on which heating effect of electric current depends.	0.5
	6.3 Demonstrate the heating effect of electric current with application	1
	6.4 Define Fuse and its types	0.5
	6.5 Construction of different types of fuse	0.5
	6.6 Working of fuse in LV and HV circuits	0.5
	6.7 Applications of fuse in different appliances	0.5
	6.8 Assessment	1
7	Fluid Flow Method – Determine Viscosity:	5
	4.1 Define fluid flow	0.5
	4.2 Explain the different types of fluids	1
	4.3 Type of fluid flow	0.5
	4.4 Explain the properties of fluid	0.5
	4.5 Determine the viscosity of fluid by using formula	0.5
	4.6 Application to determine the Viscosity of fluid	1.0
	4.7 Assessment	1
8	Study of Venturimeter:	5
	8.1 Define importance of flow measurement	0.5
	8.2 Define Venturimeter	0.5
	8.3 Compare Venturimeter with other flow meters (like Orifice and Rotameter)	0.5
	8.4 Explain the working principle of Venturimeter	0.5
	8.5 Explain the construction of Venturimeter	0.5
	8.6 Perform the experiment on Venturimeter apparatus	0.5
	8.7 Calculate the theoretical and practical value of discharge and discharge coefficient	0.5
	8.8 Application of Venturimeter in different field	0.5
	8.9 Assessment	1
9	Use of thermister as temperature / heatsensor:	5
	9.1 Define the temperature sensors	0.5
	9.2 Explain the factors consider while selecting the temperature sensors	0.5
	9.3 Comparison between thermister and thermocouple type heat sensors	0.5
	9.4 Explain the types of thermistors according to resistance change (like NTC & PTC)	0.5
	9.5 Performance of thermister experiment to find the temperature of hot water.	0.5
	9.6 Draw a graph between resistance Vs temperature change	0.5
	9.7 Compare the characteristics curve of thermister with RTD type temperature sensor	0.5
	9.8 Application of thermister in different fields	0.5
	9.9 Assessment	1

INDIAN MARITIME UNIVERSITY

SEMESTER II

UG21P5208	Computer Science Practical	60Hrs	Credit-2
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SN	Specific Learning Objectives	Hours
1	MS Word	10
	1.4 Explain in detail Use “Formatting Toolbar”. 1.5 Explain in detail Use spelling and grammar checks in the document. 1.6 Explain in detail Use “Headers and Footers”. 1.7 Explain in detail Insert symbols and pictures. 1.8 Explain in detail Create tables in MS-Word. 1.9 Explain in detail Use formulas in MS –WORD Mailmerge, Embedding Excel to WORD.	1 1 1 1 1 2 3
2	MS Excel	25
	2.1 Explain in detail and demonstrate Create workbooks, working with rows, columns, cells and Worksheets. 2.2 Explain in detail and demonstrate Insert pictures and graphics. Format cells. 2.3 Explain in detail and demonstrate flashfill autofill functionality 2.4 Explain in detail and demonstrate Use conditional formatting on data in cells, 2.5 Explain in detail and demonstrate Perform Basic Calculations 2.6 Explain in detail and demonstrate Advanced Calculations – Create formulas, employ the function wizard, 2.7 Explain in detail and demonstrate Add comments, Create charts 2.8 Explain in detail and demonstrate VLOOKUP and data sorting 2.9 Explain in detail and demonstrate use of macros 2.10 Explain in detail and demonstrate data analysis tool pack 2.11 Explain in detail and demonstrate conditional formatting 2.12 Explain in detail and demonstrate advance excel functions 2.13 Explain in detail and demonstrate excel as database.	1 1 2 2 1 2 2 2 2 2 2 2 2
3	MS Power Point	5
	3.1 Explain in detail and demonstrate Create a presentation: Create a slide, Add new slides, 3.2 Explain in detail and demonstrate Insert pictures, Format text, Format pictures, and Preview a presentation. 3.3 Explain in detail and demonstrate 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.	1 2 2

SN	Specific Learning Objectives	Hours
4	MS Access	5
	4.1 Explain in detail and demonstrate Working with Database Objects: Tour of a Table Adding, Editing and Deleting Records,	1
	4.2 Explain in detail and demonstrate Tour of a Form, Tour of a Query, Tour of a Report, Previewing and Printing a Database.	1
	4.3 Explain in detail and demonstrate Object Selecting Data Cutting, Copying and Pasting, Data Creating a Query, sorting a Query Using AND and OR Operators in a Query	1
	4.4 Explain in detail and demonstrate Creating a Form with the Form Wizard, Creating a Report with the Report Wizard.	2
5	Python	15
	5.1 Explain in detail and demonstrate Python operators, data types	2
	5.2 Explain in detail and demonstrate condition statements	4
	5.3 Explain in detail and demonstrate Loop control statement	5
	5.4 Explain in detail and demonstrate different types function or methods in python	2
	5.5 Explain in detail and demonstrate file handling using python to trace longitude and latitude using IP address	2

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SEMESTER II

UG21P5209	English Communication Lab	30 Hrs	Credit-1
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SN	Specific Learning Objectives	Hours
1	Introduction to English Phonology	4
	1.1 Speech Sounds- Vowels and Consonants <ul style="list-style-type: none"> • Describe the term ‘phonology’ and its application in communication. • List the speech sounds with one example of each. • Classify the speech sounds of English. • Differentiate between a consonant sound and a vowel sound. • Describe the following terms with examples: Consonant, Monophthong, and Diphthong. • Match the sounds with words. • Identify English sounds. 	2
	1.2 Consonant Clusters, Word Stress, Intonation, Sentence Stress <ul style="list-style-type: none"> • Describe the following terms with examples: Syllable, Consonant clusters, Word stress, Intonation, and Sentence Stress. • Transcribe the phonetics into words and vice versa. 	2
02.	Introduction to SMCP and English Language among Multilingual Crew:	6
	2.1 Maritime English <ul style="list-style-type: none"> • Define Maritime English and explain its features. • Compare General English and Maritime English. • Define the terms related to maritime English. • Match the terms (Maritime industry-specific vocabulary) with their meaning. 	
	2.2 Standard Marine Communication Phrases (SMCP): <ul style="list-style-type: none"> • Explain the importance of SMCP in maritime practice. • Describe the position of SMCP in Maritime Education and Training. • List the spelling of letters, Message Markers, Distress, Urgency and Safety Signals. • Illustrate the application of Corrections, Readiness, Repetition, Numbers, Positions, Bearings, Courses, Distances, Speed, Time, and Geographical Names • List and describe the Ambiguous words in SMCP. 	
3	Developing vocabulary	4
	3.1 One-word Substitutes, Prefixes, Suffixes, Idioms, Phrases <ul style="list-style-type: none"> • Find the error(s) in the sentence/paragraph. • Underline the error(s) in the sentence/paragraph and rewrite. • Select the correct option. • Select the wrong pair from the given pairs. 	4

SN	Specific Learning Objectives	Hours
	<ul style="list-style-type: none"> • Fill the gap(s) in the sentence/paragraph. (Cloze test) • Match Part-A with Part-B. 	
4	Developing Listening Skills	4
	<p>4.1 Listening training: speeches of people of different backgrounds and regions, preferably native speakers of English</p> <ul style="list-style-type: none"> • Listen to a speech and analyse it. (Tone, diction, and pronunciation) • Compare the speeches made by the speakers of different backgrounds and regions. <p>4.2 Listening exercises: listening for general content, listening to fill up information, Intensive listening, listening for specific information</p> <ul style="list-style-type: none"> • Listen to an audio clip and answer the questions. • Listen to an audio clip for different purposes (for general content, for filling up information, for intensive listening, for specific information, etc.). 	<p>2</p> <p>2</p>
5	Developing Speaking Skills:	12
	<p>5.1 Speaking activities in various contexts: Describing objects/situations/people, Making Requests and Seeking Permissions, Giving Directions and Guidelines, Agreeing and Disagreeing, Extempore Speeches, Welcome Speech, and Vote of thanks</p> <ul style="list-style-type: none"> • Describe and discuss an object, a situation, a person. • Compose and make a conversation on a given situation/topic. • Make a speech on a given topic. • Prepare a welcome note/vote of thanks for an event. <p>5.2 Making a Presentation: individual and group presentation, Content Structuring, Preparation & Planning</p> <ul style="list-style-type: none"> • Define the importance of body language in a presentation • Plan and make a group presentation on a given topic. • Explain communicating ideas/views to seniors/peer group/subordinates. • Explain Norms and etiquettes of public speaking. <p>5.3 Preparation of CV, Facing Interview</p> <ul style="list-style-type: none"> • Prepare CV. • Explain the process for an interview. • Answering frequently asked questions in a job interview • Organise and participate in a mock interview. <p>5.4 Group Communication: Group Discussion (GD), Role Play</p> <ul style="list-style-type: none"> • State purpose of Group Discussion and its objectives. • List and name types of Group Discussion- Issue-based, Abstract, Role Play, and Case Study. • Compare Group Discussion and debate. • Participate in role-play activities. 	<p>3</p> <p>3</p> <p>3</p> <p>3</p>
6	Book Review	

TEXT BOOKS

1. Kumar, Sanjay, and Pushp Lata. *Communication Skills: A Workbook*. Oxford University Press, 2018.
2. Managing Softskills for Personality development by B.N.Ghosh

RECOMMENDED BOOKS FOR REFERENCE:

1. Softskills –Dr K.Alex
2. Balasubramanian, T. *English Phonetics for Indian Students*. Laxmi Publications, 2018.
3. Hancock, Mark. *English Pronunciation in Use: Intermediate*. Cambridge University Press, 2009.
4. Hewings, Martin. *English Pronunciation In Use: Advanced*. Cambridge University Press, 2007.
5. Jones, Daniel. *Cambridge English Pronouncing Dictionary*. Cambridge University Press, 2012.
6. Koneru, Aruna. *Professional Speaking Skills*. Oxford University Press, 2015.
7. Lowndes, Leil. *How to Talk to Anyone*. HarperElement, 2014.
8. Phillips, Sam. *3000 Idioms and Phrases*. Goodwill Publishing House, 2020.
9. Tanka, Judith, and Lida R. Baker. *Interactions 2: Listening/Speaking*. Tata Mcgraw Hill Education Pvt. Ltd, 2011.

INDIAN MARITIME UNIVERSITY

SEMESTER III

Semester-III Courses

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5301	Celestial Navigation Paper –I	45	15	60	4
2	UG21T5302	Ship Stability Paper – I	45	15	60	4
3	UG21T5303	Marine Engineering, Automation & Control Systems Paper –I	45	15	60	4
4	UG21T5304	Chart Work & Collision Prevention Regulations	45	15	60	4
5	UG21T5305	Cargo Handling & Stowage Paper –I	45	15	60	4
6	UG21T5306	Bridge Equipment & Watch keeping Paper –I	45	15	60	4
7	UG21P5307	Seamanship Lab - I (Practical)	60	-	60	2
8	UG21P5308	Marine Engineering Workshop - I (Practical)	60	-	60	2
9	UG21T5309	Soft Skills-II	15	5	20	1
10	UG21E5310	Artificial Intelligence	15	5	20	1
11	UG21E5311	Machine Learning	15	5	20	1
12	UG21E5312					
		Total			540	31

INDIAN MARITIME UNIVERSITY

SEMESTER III

UG21T5301	Celestial Navigation Paper -I	45+15=60 Hrs	Credits-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Celestial Sphere and Equinoctial System of Coordinates:	7	2
	1.1 Describe the celestial sphere.	0.5	
	1.2 Explain the apparent annual motion of sun and the concept of ecliptic.	0.5	
	1.3 Define celestial poles, celestial meridian, equinoctial, Vertical circles, Prime vertical and obliquity of ecliptic	1	
	1.4 State the equinoctial as fixed reference plane and the direction of first point of Aries as reference direction (ignoring the effect of precession)	0.5	
	1.5 Describe the equinoctial system of coordinates.	1	
	1.6 Calculation based on the above.	3.5	
2	Solar System:	8	2
	2.1 State the composition and dimensions of the Solar System.	0.5	
	2.2 Explain Kepler's laws of planetary motion.	0.5	
	2.3 Name inferior and superior planet.	0.5	
	2.4 Describe the earths elliptical orbit and state approximate aphelion and perihelion distance and date.	0.5	
	2.5 Explain the eccentricity of earth's orbit.	0.5	
	2.6 Describe the inclination of earth's axis to the plane of orbit and the stability of the axis (ignoring precession) and its effect on the seasons.	0.5	
	2.7 State the date of solstice and equinoxes.	0.5	
	2.8 Explain the concept of earths axial rotation giving day and night.	1	
	2.9 Explain the varying length of daylight throughout the year.	0.5	
	2.10 Explain the daylight and darkness condition in various latitudes at the solstice and equinoxes.	0.5	
	2.11 Describe the significance of tropic of Cancer and Capricorn and of Arctic and Antarctic circles.	0.5	
	2.12 Earth and Moon system; Phases of moon; Solar and lunar eclipses; Condition necessary for occurrence of solar or lunar eclipse; Umbra and Penumbra.	2	
3	Hour Angle and Time:	10	3
	3.1 Describe the concept of earths axial rotation causing change in hours angle of the body	1	
	3.2 Define Greenwich hour angle (GHA), Local hour angle (LHA), sidereal hour angle, declination, longitude and explain their relationship.	1.5	
	3.3 Define Time and hour angle, Greenwich time, Zone time, Standard time, GMT, LMT, relationship between longitude and time.	1.5	
	3.4 Describe the rate of change of GHA of sun and Aries, Polar distance and Right Ascension (RA).	0.5	
	3.5 Position of heavenly body on celestial sphere by its declination and GHA or by its altitude and azimuth.	1	
	3.6 Identify the tabulation of SHA, GHA and declination (d and v corrections) in Nautical almanac for all celestial bodies.	0.5	
	3.7 Determine the geographical position of a body for any given GMT.	1	
	3.8 Calculation based on above.	3	

SN	Specific Learning Objectives	Lectures	Tutorials
4	Altitude Corrections:	5	2
	4.1 Define sextant altitude. Demonstrate how to retrieve and return the sextant into the storage box. Demonstrate how to read a sextant. Show how to correct a sextant into which has been introduced one or more of errors of perpendicularity, side error or index error. Demonstrate how to find the index error of the sextant by the horizon. Describe how to find index error of the sextant by the sun	1	
	4.2 Demonstrate use of sextant for taking horizontal and vertical angles.	0.5	
	4.3 Describe the purpose of altitude correction. Define visible, sensible and rational horizons. Define observed altitude and true altitude	0.5	
	4.4 Define dip, refraction, semi-diameter and parallax and explains their causes.	0.5	
	4.5 Illustrates the effect of terrestrial refraction on dip and the distance of the sea horizon.	0.5	
	4.6 Demonstrate the use of altitude and low altitude correction tables in nautical almanac.	0.5	
	4.7 Obtain the true zenith distance from the true altitude of the body.	0.5	
	4.8 Calculation based on above.	1	
5	Daily Motion and Horizontal System of Coordinates:	4	1
	5.1 Define Rational horizon, Zenith and Nadir, elevated pole and depressed pole.	1	
	5.2 Define the observers upper and lower celestial meridian.	0.5	
	5.3 Explain the true and apparent motion of bodies.	0.5	
	5.4 Explain the relationship between azimuth and quadrantal bearings and 360 degrees' notation bearing.	1	
	5.5 Recognise the parts of PZX triangle. Draw figure on the plane of rational horizon and of the observer's celestial meridian to illustrate navigational problems and principles.	1	
6	Latitude by Meridian Altitude:	7	2
	6.1 Apply the zenith distance of a body when it is on observer's meridian to the declination of the body to obtain observers latitude.	0.5	
	6.2 Apply these correctly when declination and latitude have same name and different name.	0.5	
	6.3 Describe the relationship between altitudes of elevated pole and the latitude of the observer.	0.5	
	6.4 Find the value of polar distance of the body, using its declination.	0.5	
	6.5 Apply the polar distance to the true altitude of the body at lower transit to find the altitude of the elevated pole and the latitude.	1	
	6.6 Define a position line/position circle.	0.5	
	6.7 Describe the direction of the position line through the observer when taking a meridian altitude.	0.5	
	6.8 Time of the meridian passage of Sun.	0.5	
	6.9 Calculation of latitude by meridian altitude of Sun.	2.5	
7	Nautical Almanac:	4	3
	7.1 Describe the information contained in general in the Nautical Almanac and in detail the daily pages.	0.5	
	7.2 Use the table of correction and incremental correction in Nautical Almanac.	1	
	7.3 Find the LHA of the body, given the date, GMT and longitude of the observer.	0.5	
	7.4 Find the LHA of Aries, given the date, GMT and longitude of the observer.	0.5	

SN	Specific Learning Objectives	Lectures	Tutorials
	7.5 Explain what is meant by sidereal hour angle of a star and obtains it from the Nautical Almanac.	0.5	
	7.6 Derive LHA of a star from the LHA of Aries and SHA of the star.		
	7.7 Demonstrate the uses of the information in Nautical Almanac to obtain the LMT of meridian passage of the body to the nearest minute and interpolates for the observer's longitude when necessary.	0.5 0.5	

TEXT BOOKS

1. Principles of Navigation by Capt. S.S.S Rewari & Capt. T.K. Joseph
2. Practical Navigation by Capt. H. Subramaniam
3. Nautical Almanac

RECOMMENDED BOOKS FOR REFERENCE:

1. The Admiralty Manual of Navigation: Principles of Navigation: Vol. 1- Nautical Institute
2. The Admiralty Manual of Navigation: Astro Navigation Vol. 2- Nautical Institute
3. Navigation Guide Vol. 2: Celestial Navigation- Alexander Simpson
4. Practical Navigation for Officers of the Watch- Frost, A
5. NAV Basics: Ocean Offshore and Celestial Navigation Vol.2- Witherby Seamanship International Ltd.
6. Nories Nautical Tables

INDIAN MARITIME UNIVERSITY

SEMESTER III

UG21T5302	Ship Stability Paper - I	45+15=60 Hrs	Credit-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Laws of flotation:	3	1
	1.1 Explain Archimedes Principle & Principle of flotation.	0.25	
	1.2 Compute underwater volumes of regular geometrical shapes and solve numerical on flotation.	0.5	
	1.3 Define Centre of Buoyancy as the geometric centre of the underwater volume & the upthrust by the water is known as Buoyancy.	0.25	
	1.4 Define Reserve buoyancy as the above water enclosed volume which provides buoyancy in case vessel becomes heavier.	0.5	
	1.5 Define Load Displacement, Present displacement, Light displacement, Deadweight, Deadweight aboard & Deadweight available.	0.5	
	1.6 Show mathematically Deadweight = Load displacement – Light displacement, Deadweight Available = Load displacement – Present displacement & Deadweight aboard = Present displacement – Light displacement.	0.5	
	1.7 Explain how the draft of a vessel changes due to change of density.	0.5	
2	Stability Terminology:	3	1
	2.1 Sketch and define TPC. Show that $TPC = \text{density} \times A/100$	0.25	
	2.2 Define Fresh Water Allowance (FWA). Show that FWA in cm can be calculated using formula $W/40$ TPC.	0.25	
	2.3 Define Dock Water Allowance (DWA).	0.25	
	2.4 Calculate TPC, FWA & DWA in various densities.	0.5	
	2.5 Sketch & define Block co-efficient (Cb), Water-plane coefficient (Cw), Mid-ship Coefficient (Cm), Prismatic Coefficient (Cp).	0.5	
	2.6 Show the relationship between Cp, Cb & Cm.	0.25	
	2.7 Calculate TPC given maximum Length, breadth of water plane, density of water & Cw.	0.5	
	2.8 Calculate Displacement given maximum length, breadth, draft and density of water & Cb.	0.5	

SN	Specific Learning Objectives	Lectures	Tutorials
3	Centre of Gravity :	4	2
	3.1 Define Centre of gravity of ship and factors affecting the same.	0.5	
	3.2 State that COG on a ship can be pinpointed if the 3 references are known. Distance from Keel, Distance from Aft perpendicular (or midships) & distance from fore and aft centre line.	0.5	
	3.3 Calculate movement of COG when only one operation is carried out using GG1 formula.	1	
	3.4 Calculate KG of a Ship when multiple operations are carried out using moments about the keel.	1	
	3.5 Determine the position of the longitudinal centre of gravity (LCG) of a ship for different conditions of load & ballast using moments about the Aft Perpendicular.	1	
	3.6 Explain the effect on the position of centre of gravity of a ship by adding, removing and/or shifting weights.	1	
4	Centre of Buoyancy & Centre of Flotation	3	1
	4.1 Define Centre of buoyancy and factors affecting the same.	0.5	
	4.2 State that COB on a ship can be pinpointed if the 3 references are known. Distance from Keel, Distance from Aft perpendicular (or midships) & distance from fore and aft centre line.	0.5	
	4.3 Define Longitudinal Centre of Buoyancy (LCB) & factors affecting their positions.	0.5	
	4.4 Calculate KB & LCB of a ship with regular geometrical shapes.	1	
	4.5 Define Centre of Floatation and factors affecting its position.	0.5	
5	Density, Draft & Displacement:	2	
	5.1 Construct Displacement, TPC & Deadweight curves to scale for a given data.	1	
	5.2 Use displacement and TPC curves to determine weights of cargo or ballast from draughts or freeboards.	1	
6	Transverse Statical Stability:	3	1
	6.1 Draw the midship diagram for a box shaped vessel & show Keel, COB, COG, Metacentre, Metacentric height, righting lever.	0.5	
	6.2 Explain Righting Moment can be calculated as a product of displacement & Righting Lever.	0.5	
	6.3 State the Wall sided Formula for calculating Righting lever for large angles of heel.	0.5	

SN	Specific Learning Objectives	Lectures	Tutorials
	6.4 Calculate Moment of Statical Stability for small as well as large angles of heel.	1	
	6.5 Define Stiff and Tender ships. Compare and contrast the various characteristics of stiff and tender ships.	0.5	
7	Equilibrium of Ships:	2	
	7.1 Define Stable, unstable and neutral equilibrium	0.5	
	7.2 Sketch the midship transverse section of a box shaped vessel to show Stable equilibrium.	0.5	
	7.3 Sketch the midship transverse section of a box shaped vessel to show Unstable equilibrium.	0.5	
	7.4 Sketch the midship transverse section of a box shaped vessel to show neutral equilibrium.	0.5	
8	Free Surface effect:	4	2
	8.1 Sketch the midship transverse section of a heeled ship & explain Free Surface Effect.	1	
	8.2 State formula for calculating Free Surface correction (FSC) due to single slack tank.	0.5	
	8.3 State formula for calculating Free Surface correction (FSC) due to multiple slack tanks.	0.5	
	8.4 State formula for calculating Free Surface Correction (FSC) when tanks are subdivided into identical compartments.	0.5	
	8.5 Calculate FSC due to slack tanks and compute GM (fluid).	1.5	
9	List:	6	2
	9.1 Define List as the transverse inclination caused when the COG of the ship is off the centre line.	0.5	
	9.2 State the difference between and list & heel.	0.5	
	9.3 Sketch the midship transverse section of a listed ship and show $\tan \Theta = GG_1/GM$	0.5	
	9.4 State that the GM considered for calculating List will always be GM(Fluid)	0.5	
	9.5 Calculate List while Loading, Discharging and/or shifting weights.	1.5	
	9.6 Explain procedure to correct List by loading, discharging or shifting weights.	0.5	
	9.7 Solve numerical for correction of List.	2	

SN	Specific Learning Objectives	Lectures	Tutorials
10	M.V. HINDSHIP:	15	5
	10.1 Demonstrate the use of Ship and Hydrostatic particulars of M.V. Hindship.	2	
	10.2 Apply knowledge of above topics & calculate numerical from 1 to 43 from M.V.Hindship.	13	

TEXT BOOKS

- 1.Ship Stability at the Operational Level- Capt. Subramaniam H
2. Stability, trim and cargo calculations on M.V. Hindship and Oil Tankers- Capt. Joseph & Capt. Rewari
3. Stability Table Trim & stability particulars of M.V. Hindship (Stability tables)-Bhandarkar Publication.

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

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SEMESTER III

UG21T5303	Marine Engineering, Automation & Control Systems Paper –I	45+15 =60 Hrs	Credits-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Strength of Materials:	6	2
	1.1 Explain Hook’s Law	0.5	
	1.2 Explain stress and strain.	1	
	1.3 Define and explain Tensile, Compressive and Shear forces	1.5	
	1.4 Explain Failure of materials under Tension, compression, shear & fatigue	2	
	1.5 Relate the Strength of Materials with marine engineering examples	1	
2	Materials Science:	8	2
	2.1 Explain the following terms Hardness, Ductility, Malleability, Melting Point etc.,	0.5	
	2.2 Name common engineering materials. Various metals & alloys. Properties & uses.	1	
	2.3 Explain ceramics & What are the uses of ceramics?	1	
	2.4 Explain elementary metallurgy of steels.	1	
	2.5 Explain Steel production- smelting & refining.	1.5	
	2.6 What are the different types of steel & their uses?	1.5	
	2.7 Explain the heat treatment of steels.	1.5	
3	Electrical Engineering Science:	10	5
	3.1 Describe the maintenance procedure of batteries.	0.5	
	3.2 Understand the purpose & operation of purifier drive.	1	
	3.3 Explain the Navigation light circuit with indicators / alarms & alternative power supply.	1	
	3.4 Name the services supplied from emergency generator.	0.5	
	3.5 With diagram, explain procedure for starting emergency generator manually.	1	
	3.6 Explain the Parallel running of Gens and procedure & importance of load sharing	1	
	3.7 Differentiate the prime movers e.g. Diesel engine and steam turbines	1	
	3.8 Explain the working principle of Step up/down Transformers.	1	
	3.9 Understand transformer efficiency and describe the maintenance & care of transformer	1	
	3.10 Understand the purposes and use of Main switch boards & power distribution boards.	0.5	
	3.11 Name the various Circuit breakers and understand it’s applications	0.5	
	3.12 Understand the following: - operation of measuring instruments. Overload trip, short circuit trip, fuses and other protections.	1	
4	Layout of Engine Room:	2	
	4.1 Explain the classification of ship as per propulsion plant.	0.5	
	4.2 Explain the position of main propulsion plant in various type of ships.	0.5	
	4.3 Describe various pumps/machineries and their positions as found in the engine room of a ship.	0.5	

SN	Specific Learning Objectives	Lectures	Tutorials
	4.4 List the function of various machineries/equipment in the Engine Room.		
5	Fresh water from sea water:	2	1
	5.1 Explain the requirements of production of FW on board.	0.25	
	5.2 Describe the methods for making fresh water- steam, flash and reverse osmosis type plant.	0.75	
	5.3 Describe the methods of making water potable.	0.5	
	5.4 Describe a domestic fresh water and sanitary water hydrophore system	0.5	
6	Compressed Air:	2	
	6.1 Explain the use of compressed air on board.	0.5	
	6.2 Describe a compressed air plant as found on a ship.	0.5	
	6.3 Describe the air bottle and mountings	0.5	
	6.4 Safety precautions while working with compressed air.	0.5	
7	Types of Marine Boiler:	3	1
	7.1 Describe the construction of a Smoke tube and water tube boiler. List and explain the function of different mountings on the boilers.	1	
	7.2 Explain the use of boiler on board.	0.25	
	7.3 Describe the purpose of feed water system and the chemical treatment carried out on a ship.	1	
	7.4 Describe a waste heat recovery boiler and circulating system.	0.5	
	7.5 Explain the safety features on and around the boiler.	0.25	
8	Refrigeration & Air conditioning:	2	1
	8.1 Explain the principles of refrigeration.	0.5	
	8.2 Describe a basic refrigeration compression cycle	0.5	
	8.3 Describe the components of a ref plant and their operation.	1	
9	Pumps & Pumping Systems:	3	1
	9.1 Explain the working principle of different pumps.	1	
	9.2 Explain the suitability of different pumps for specific purposes.	0.25	
	9.3 Describe a submersible pump and a hydraulic aggregate pump (Framo pump).	0.75	
	9.4 Describe a fire mains and requirement of main and emergency fire pump.	0.5	
	9.5 Describe a typical bilge and ballast system for a ship.	0.5	
10	Steering:	4	1
	10.1 Describe types of steering gear.	0.5	
	10.2 Describe Ram type & Rotary vane steering gear.	0.5	
	10.3 Explain the SOLAS requirements pertaining to steering gear.	0.5	
	10.4 Explain the mechanics of a ship turning by use of rudder.	0.5	
	10.5 Describe telemotor and hunting gear. Telemotor -hyd & electric type.	1	
	10.6 Describe electric steering gear.	0.5	
	10.7 Requirements of emergency steering.	0.5	
11	Hydraulic systems:	3	1
	11.1 Explain a simple circuit diagram for linear & rotary motion.	1	
	11.2 Explain ram & rotary vane actuators.	0.5	
	11.3 Explain the maintenances required for the system.	1	
	11.4 Explain the necessity of cooling/heating of hydraulic oil.	0.5	

TEXT BOOKS

1. Basic Marine Engineering-T.K.Grover

RECOMMENDED BOOKS FOR REFERENCE:

1. Strength of Materials - Ryder
2. General Engineering Knowledge for Engineer - Reeds Vol.-8
3. Marine and offshore pumping and piping systems - Crawford
4. Engineering Drawing - Reeds
5. General Engineering Knowledge for Engineer - Reeds Vol.-12
6. Basic Electro Technology - Reeds Vol.-6
7. Marine Electrical Equipment & Practice - McGeorge
8. Materials for Marine Machinery - Fredrick & Capper
9. Basic Marine Engineering- J.K. Dhar

INDIAN MARITIME UNIVERSITY

SEMESTER III

UG21T5304	Chart Work & Collision Prevention Regulations Chart No. BA 813	45+15=60 Hrs	Credits-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Familiarization with Charts and Chart Catalogue	7	3
	1.1 Recognizes the following on the chart – <ul style="list-style-type: none"> ● Chart Title ● Chart Number ● Scale of the Chart ● Date of Publication ● Edition Number / Date ● Details of Publisher / Hydrographic Office ● Source Data 	2	
	1.2 Lists out the different types of Charts (Navigational& Thematic) <ul style="list-style-type: none"> ● Small scale – Ocean Charts ● Large Scale – Coastal and harbour charts ● Routeing Charts ● Routeing Guides ● Plan Charts 	2	
	1.3 Describes Mercator and Gnomonic Chart Projections and states the uses and advantages of both	1.5	
	1.4 Recognizes a Chart catalogue (Indian / Admiralty) and defines a Chart Folio.	0.5	
	1.5 Determines the Charts required for a voyage using the Chart Catalogue	1	
2	Obtain Information from Charts	7	3
	2.1 Chart Datum – <ol style="list-style-type: none"> a. Explains the importance of Chart datum b. Recalls the reference points and the units for heights and depths marked on the chart c. Describes Depth and height contours d. Identifies the nature of the sea bottom and discusses the importance of this information 	1	
	2.2 Lights (All) – <ol style="list-style-type: none"> a. Describes the characteristics of the light b. Describe Geographical range of a Light c. Explain Nominal Range of a Light d. Recall the difference between when a “light is first sighted” and a “light is first raised” e. Calculate the sighting of a light using the Luminous Range Diagram 	1	
	2.3 Lights (Select) <ol style="list-style-type: none"> a. Identifies Leading Lights b. States the use of Leading lights c. Identifies Sector lights d. States the advantages of Sector lights 	1	

SN	Specific Learning Objectives	Lectures	Tutorials
	<p>e. Demonstrates the use of Clearing Bearings</p> <p>2.4 Traffic Separation Schemes</p> <p>a. Identifies the established direction of Traffic Flow</p> <p>b. Identifies the Traffic lanes</p> <p>c. Identifies the Traffic Separation Zones</p> <p>d. Identifies the Inshore Traffic Zone</p> <p>e. Identifies points on land</p> <p>f. Identifies Radar Responsive (conspicuous) Targets</p> <p>2.5 Compass Rose & Distance Scale</p> <p>a. Identifies the Compass Rose on the Chart</p> <p>b. Calculates the variation at the place</p> <p>c. Measures the Distance between 2 points on the chart</p> <p>d. Discuss why the adjacent latitude scale should be used for measuring distances</p> <p>2.6 Identifies the 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</p>	<p>1</p> <p>1</p> <p>2</p>	
3	Chart Correction & Updates	4	1
	<p>3.1 Describes the contents and explain the use of</p> <p>a. Annual Summary of Notices to Mariners</p> <p>b. Cumulative Notices to Mariners</p> <p>c. Weekly Notices to Mariners</p> <p>3.2 Demonstrates the procedure of Chart correction as per Admiralty Publication NP 294 including</p> <p>a. Use of Tracings</p> <p>b. Carrying out correction of Blocks</p> <p>c. Correction of T&P notices</p> <p>d. Recording the updates in NP 133 A</p> <p>3.3 Describes the process of checking newly received charts for the last correction done including finding the date the chart was last brought up to date</p>	<p>1</p> <p>2</p> <p>1</p>	
4	Chart Work Exercises	14	4
	<p>4.1 Determines the latitude and longitude of any point on the chart by use of</p> <p>a. Parallel rulers,</p> <p>b. Set Squares and</p> <p>c. Dividers.</p> <p>4.2 Demonstrates plotting position on the chart by means of</p> <p>a. Latitude & Longitude</p> <p>b. Bearing & Distance off from a Navigational mark</p> <p>c. Compass bearings of two or more shore objects</p> <p>4.3 Calculates the Compass Errors including</p> <p>a. Defines True, Magnetic and Compass North</p> <p>b. Defines Variation and Deviation</p>	<p>2</p> <p>2</p> <p>2</p>	

SN	Specific Learning Objectives	Lectures	Tutorials
	<ul style="list-style-type: none"> c. Computes Variation from the Chart d. Computes Deviation from the Deviation table e. Gyro Error f. Applying the compass error to ship's head and compass bearing to convert to true <p>4.4 Uses Transit bearings to determine compass error</p> <p>4.5 Identifies vessel's position and Compass error using</p> <ul style="list-style-type: none"> a. Two Horizontal Sextant Angles b. One Range and One Horizontal Sextant Angle c. One Bearing and One Horizontal Sextant Angle <p>4.6 Determines vessels position from Raising and dipping of lights</p> <p>4.7 Determines the Compass Course and distance between any two points on the chart</p> <p>4.8 Plots a course to pass a lighthouse at a given distance and bow angle including beam bearing and special angles</p>	<p>1</p> <p>2</p> <p>2</p> <p>1</p> <p>2</p>	
5	Conduct of vessels in any condition of Visibility, In sight of one another and in Restricted Visibility (Rule 1-19)	13	4
	<p><u>Collision Prevention Regulations – Rule 1 to 19</u></p> <p>5.1 Explains that the OOW is responsible for navigating safely, with particular regard to avoiding collision and stranding and with reference to STCW Chapter VIII</p> <p>5.2 Explains that the IRPCS(COLREGS) is a convention and must be mandatorily applied</p> <p>5.3 States & Explains all the general definitions, which apply throughout the Rules</p> <p>5.4 Distinguishes between ‘Underway’ and ‘Making way’</p> <p>5.5 Explains the importance of maintaining a proper lookout</p> <p>5.6 States the factors to be taken into account in determining Safe Speed</p> <p>5.7 Describes how the use of Radar affects determination of Safe Speed</p> <p>5.8 Explains what is meant by ‘Risk of Collision’</p> <p>5.9 Describes how the Radar Equipment is used to determine whether Risk of Collision exists</p> <p>5.10 Explains the dangers of making assumptions on the basis of scanty information, citing examples from clear weather as well as use of radar</p> <p>5.11 States the benefit of long range scanning and systematic planning</p> <p>5.12 Explains how failure to plot the target ship may lead to a lack of appreciation of a developing situation</p> <p>5.13 Explains the following actions to avoid collision referred to in Rule 8</p> <ul style="list-style-type: none"> a. Positive action b. In ample time c. Large enough to be readily apparent d. Alteration of course alone e. Passing at a safe distance f. Checking the effectiveness of the action taken g. Reduction of speed h. Taking all way off 	13	

SN	Specific Learning Objectives	Lectures	Tutorials
	<p>i. Finally past and clear</p> <p>5.14 Describes how ‘proper and effective action’ and ‘within a distance appropriate to the prevailing circumstances and conditions’ may be interpreted</p> <p>5.15 Defines the terms ‘Narrow Channel’ and ‘Fairway’</p> <p>5.16 Describes how to proceed along a narrow channel or fairway</p> <p>5.17 List out the restrictions on crossing a narrow channel or fairway</p> <p>5.18 Describes the procedure for overtaking in a narrow channel</p> <p>5.19 Describes the actions to be taken while nearing a bend in a narrow channel</p> <p>5.20 Defines ‘Traffic lane’, ‘Separation Line’, ‘Separation Zone’ and ‘Inshore Traffic Zone’</p> <p>5.21 Demonstrates how to Navigate in a TSS with reference to</p> <ol style="list-style-type: none"> a. Entering and Leaving the TSS b. Entering and Leaving the Traffic Lanes c. Crossing lanes d. The use of Inshore Traffic Zones e. Crossing separation lines or entering separation zones other than when crossing, joining or leaving a lane <p>5.22 Lists the requirements for vessels while in or near a TSS</p> <ol style="list-style-type: none"> a. Navigating in areas near the termination b. Anchoring c. Engaged in Fishing d. Not using the TSS <p>5.23 States that a vessel of less than 20 m or a sailing vessel must not impede the safe passage of a power driven vessel when following a traffic lane.</p> <p>5.24 Explains how to decide when a vessel is an overtaking vessel</p> <p>5.25 Explains the application of Rules 14 & 15</p> <p>5.26 Explains how to decide when to take avoiding actions as Stand-on Vessel</p> <p>5.27 Explains the action which may / must be taken by Stand-on Vessel</p> <p>5.28 Describes Rule 18 – responsibility between vessels and its application</p> <p>5.29 Describes Rule 19 in his own words</p> <p>5.30 States that under rule 19 there is no ‘Give-way’ and no ‘Stand-on’ vessel</p> <p>5.31 States that this rule applies not only ‘IN’ but also ‘NEAR AN AREA’ of Restricted Visibility</p> <p>5.32 States the actions to be taken upon detection of vessel forward of the beam in restricted visibility</p> <p>5.33 States the actions to be taken upon detection of vessel abeam or abaft the beam in restricted visibility</p> <p>5.34 Explains the following terms with reference to rule 19</p> <ol style="list-style-type: none"> a. A vessel that detect by radar alone the presence of another vessel b. Reduce speed to minimum at which she can be kept on her course c. Take all way off d. Navigate with extreme caution until the danger of collision is over 		

TEXT BOOKS

1. Chart Work for Mariners- Puri, S.K.
2. IMO Rules of the Road – Bhandarkar Publications

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. International Lights, Shapes and Sound Signals – D. A. Moore
6. A guide to the Collision Avoidance Rules – Cockcroft and Lameijer
7. International Code of Signals - HMSO
8. Collisions and their causes- Cahill, Richard
9. International Regulations for Preventing Collisions at sea- Nautical Press
10. Mariner's Guide to preventing collision- Capt. Yashwant Chhabra

INDIAN MARITIME UNIVERSITY

SEMESTER III

UG21T5305	Cargo Handling & Stowage Paper –I	45+15=60 Hrs	Credits-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Introduction in brief to types of ships and cargo/ General Introduction to Dry Cargo ships	2	1
	1.1 General cargo ship, types of general cargoes, e.g. bales,boxes,bags, crates, cases, pallets.	2	
	1.2 Bulk carrier, examples of bulk cargoes and method of loading by Conveyor and discharging by Grab.	1	
2	Basic Aspects of Cargo Operations	5	2
	2.1 Importance of cargo care to economical operation of ships and care of cargo on board ships.	0.5	
	2.2 The hazard of fire and its prevention, control and extinction in cargo operations. Interaction between cargoes and the resultant contamination and tainting.	1	
	2.3 Stowage and handling to prevent breaking, chafing, crushing.	0.5	
	2.4 Sea water damage, importance of structural integrity and Hatch cover water tightness.	0.5	
	2.5 Bale and Grain Capacity; Stowage factor, Broken stowage; Load density; Cargo density; Ullage and soundings; Deadweight and displacement.	1	
	2.6 Ballasting and deballasting operations Duties of the Officer on Cargo Watch; Checks prior ballasting and deballasting.	1	
	2.7 Log Book Entries.	0.5	
3	Cargo Gear, Cargo gear Inspection, their use, Care and Maintenance	7	3
	3.1 Explain that Cargo gear should be visually inspected before the start of cargo.	1	
	3.2 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. Explain why the load on cargo gear should never exceed its safe working load. Care of ropes and wire used for cargo gear. Maintenance of wire ropes. When to condemn a wire rope.	2	
	3.3 Slings: Types of slings used for lifting cargo of different types. Use of snotters, canvas slings, vehicle slings, trays, pallets, nets, hooks and slings.	1	
	3.4 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.	1	
	3.5 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.	1	
	3.6 Cargo hooks & Shackles: Swivels, shackles, hooks and marking.	1	

SN	Specific Learning Objectives	Lectures	Tutorials
4	Segregation, Separation and Securing of Cargoes	6	2
	4.1 Segregation of different cargoes with reference to dangerous goods, dry, wet, delicate, dirty, valuable cargo.	1	
	4.2 Separation between parcels of cargo for different ports. Separation of cargoes by natural bulkheads or artificial divisions.	1	
	4.3 Dunnage and its uses to increase friction, prevent damage from sweat and in separating cargoes. Shifting boards.	1	
	4.4 Shifting of cargo, toppling, and methods of securing to prevent the same viz. blocking, chocking and lashing.	1	
	4.5 Methods of blocking, lashing, shoring and trimming cargo. Method of securing heavy loads, vehicles, containers.	1	
	4.6 List Contents of Lashing Code and Cargo Securing Manual. Purpose of Lashing Code and Cargo Securing Manual.	1	
5	Ventilation and Control of Sweat	4	1
	5.1 Need for ventilation of cargo spaces.	0.5	
	5.2 Ship sweat and cargo sweat, and differentiate between them. Factors affecting sweat.	1	
	5.3 Control of sweat by ventilation, Operation of ventilation system	0.5	
	5.4 Cargoes requiring special ventilation due to emission of gases, absorption of oxygen, dust, release of moisture.	1	
	5.5 Temperature variations leading to sweat damage, ship and cargo sweat. Monitoring of dew-point temperature and ventilation to prevent sweat.	1	
6	Cranes	4	1
	6.1 The working of Cranes, various safety limits and markings.	1	
	6.2 Testing of cranes – static, dynamic test.	0.5	
	6.3 Hoisting, lowering and securing a crane as per manual.	0.5	
	6.4 Operational checks to be done on ship's cargo gear before handing over to stevedores including checks on limit cutouts.	1	
	6.5 Entries to be made in Chain Register.	0.5	
	6.6 Familiarisation with Crane operation Signals.	0.5	
7	Cargo work Calculations	6	2
	7.1 Safe working load (SWL); Breaking strength; Proof Load; Factor of Safety	0.5	
	7.2 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.	2	
	7.3 Calculation of cargo quantities given height, area or volume of hold, stowage factor, broken stowage, load density, bale or grain capacity.	3	
	7.4 Effect of Load lines on cargo loadables.	0.5	
8	Handling and Maintenance of Hatch-covers	4	1
	8.1 Types of hatches. Hatch coaming uses. Opening and closing of chain-pull and hydraulic hatch covers. Closing arrangements. Battening down a hatch. Maintenance of hatch covers: Precautions to be taken whilst operating hatch covers.	1.5	
	8.2 Importance of compression bars and sealing gaskets for maintaining weather tightness. Need to check hydraulic system for leakages.	0.5	
	8.3 Maintenance and use of side cleats and cross-joint wedge mechanism Importance of clear drainage channels and drain holes.	0.5	
	8.4 Importance and Methods of testing weather tightness of hatch covers.	1	
		0.5	

SN	Specific Learning Objectives	Lectures	Tutorials
	8.5 Procedure for securing hatches in open position to guard against accidental movement. State that ships are responsible for closing hatches when notice of completion of work for the day is given by the stevedores.		
9	Cargo-handling Safety and Precautions	3	1
	9.1 Inspection of cargo gear prior work.	0.5	
	9.2 Precautions during cargo operations while using cargo gear. Effective communication during loading and discharging.	0.5	
	9.3 Precautions to be taken when using forklifts, bulldozers, grabs and other heavy gear on board in the tween decks or holds.	1	
	9.4 Dock labour regulations pertaining to cargo handling covering dust, personal protection and awareness of moving parts of machinery.	1	
10	General Cargo Ship - Stowage Plan	4	1
	10.1 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. Broken stowage must be taken into account when estimating the number of packages of given size which can be loaded into a space. (Practical Exercise to be conducted)	4	

TEXT BOOKS

1. Cargo Work for Ship officer – Capt Errol Fernandes
2. Cargo Work for Maritime Operation- D.J. House

RECOMMENDED BOOKS FOR REFERENCE:

1. Cargo Work – Kemp and Young
2. Cargo Works – Taylor
3. Cargo Notes- DhananjaySwadi

INDIAN MARITIME UNIVERSITY

SEMESTER III

UG21T5306	Bridge Equipment & Watch keeping Paper –I	45+15=60 Hrs	Credits-4
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Section A – Bridge Equipment

Hours- 34

SN	Specific Learning Objectives	Lectures	Tutorials
1	Lay out of Bridge and Integrated Bridge:	3	1
	1.1 Sketch the layout of the Bridge with its Navigational Equipment	0.5	
	1.2 Introduction to various Navigational Equipment	1.5	
	1.3 Introduction to Integrated Bridge Systems.	1	
2	Sextant:	1	1
	2.1 Sketch and explain the principle of Sextant	0.5	
	2.2 Explain the parts of a sextant	0.5	
3	Magnetic Compass:	3	1
	3.1 Explain the magnetism of the earth and magnetic poles,	0.25	
	3.2 Describe the marking of lubber line and its purpose,	0.25	
	3.3 Describe the binnacle and arrangement of correcting devices provided	0.5	
	3.4 List the Compass points and explain True and Magnetic north, Magnetic variation and changes in its annual value, Isogonals, Magnetic compass error & naming convention, Variation & Deviation, Course & Bearing	0.75	
	3.5 Describe the conversion of compass course to true course and vice versa using deviation card	0.5	
	3.6 State the importance of comparing of compasses, checking of compass error regularly & on major changes of heading, precautions to be observed while taking compass bearings	0.25	
	3.7 Describe the use and care of magnetic compasses and their practical limitations.	0.5	
4	Tele-motor, Helm Orders and Internal Communications:	2	1
	4.1 Demonstrate clear, concise communication and acknowledgement at all times in a seaman like manner with due regards to Standard Marine Communication Phrases.	1	
	4.2 Describe the various methods to call the Master to the bridge.	0.5	
	4.3 Explain the inter-switching of Follow-up & Non Follow-up and Emergency Steering system	0.5	
5	Speed Log	2	1
	5.1 State the difference between ground reference speed and water reference speed.	0.5	
	5.2 Explain: Principle, Errors & Limitations of Electro-Magnetic log and Doppler speed log.	0.75	
	5.3 Sketch & explain with the help of a Block Diagram how is a ship's speed transmitted to remote displays and how an indication of distance run is derived from a speed log.	0.75	
6	Echo Sounder:	4	1
	6.1 Describe the basic principles of marine echo-sounding equipment	0.5	
	6.2 Identifies the main components on a simple block diagram of an echo-sounder, and states the function of each	1	

SN	Specific Learning Objectives	Lectures	Tutorials
	6.3 Describe the accepted value of the velocity of sound in seawater and the limits within which the true value may lie	1	
	6.4 Describe the physical factors which affect the velocity sound in seawater	0.5	
	6.5 Differentiates between range and phase, and explains the dangers of using the wrong phase.	1	
7	Steering control systems	6	2
	7.1 Explain the principle of an automatic pilot system	0.5	
	7.2 Explain the functions of the manual settings	0.5	
	7.3 Describe the procedures for changeover from automatic to manual steering and vice versa	0.5	
	7.4 Explain what is meant by an adaptive automatic pilot and briefly explain how it functions	0.5	
	7.5 Describe the course monitor and the off-course alarm	0.5	
	7.6 Describe the operation of the course recorder log	0.5	
	7.7 State that the automatic pilot should be included in the steering gear testing prior to the ship's departure	0.5	
	7.8 Explain the regulation regarding the use of the automatic pilot	0.5	
	7.9 Explain in the recommendation on performance, standards for automatic pilots	0.5	
	7.10 Explain the need for regular checking of the automatic pilot to ensure that it is steering the correct course	0.5	
	7.11 State that the automatic pilot should be tested manually at least once per watch	0.25	
	7.12 Describe the factors to take into account regarding the changeover to manual control of steering in order to deal with a potentially hazardous situation	0.5	
	7.13 Explain Wheel House posters and the use of Rate of Turn Indicator (ROTI)	0.25	
8	Other Equipment in the Wheel House	4	1
	8.1 Describe the Electric telegraph and explain its operation.	1	
	8.2 Describe the use & care of the Day Light Signalling Lamp and explain the reasons for considering it an emergency source of power.	1	
	8.3 Describe Sound Signalling Equipment as in Part-D of IRPCS 1972.	1	
	8.4 Describe the use, care and precautions while operating wipers & Clean View Screen (CVS)	1	

Section B – Watchkeeping

Hours- 26

SN	Specific Learning Objectives	Lectures	Tutorials
1	Keeping a safe navigational watch :	5	2
	1.1 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,	0.5	
	1.2 states that the officer of the watch is responsible for navigating safely, with particular regard to avoiding collision and stranding	0.5	
	1.3 describes the principles to be observed in keeping a navigational watch as set out in section A-VIII of the STCW Code regarding:	2	
	. navigation		
	. navigational equipment		
	. navigational duties and responsibilities		

SN	Specific Learning Objectives	Lectures	Tutorials
	<ul style="list-style-type: none"> . handing over and taking over the watch . lookout . navigation with a pilot embarked . protection of the marine environment . Bridge Navigation Watch Alarm system . blind pilotage technique . general principles for ship reporting systems and with VTs procedures <p>1.4 describes the recommendation on operational guidance for officers in charge of a navigational watch contained in chapter VIII, section A-VIII/2 of the STCW Code:</p> <ul style="list-style-type: none"> . maintenance of an efficient lookout . the use of engines and sound signalling apparatus . taking over the navigational watch . periodic checks of navigational equipment . compliance with SOLAS V/19 regarding the use of the automatic pilot and the changeover to manual steering and vice versa . electronic navigational aids . the use of radar . navigation in coastal waters . conduct of the watch in clear weather . actions to take in restricted visibility . the circumstances in which the officer of the watch should call the master . navigation with a pilot embarked . briefing of watchkeeping personnel . describes the duties of the officer of the watch while at anchor . lists the entries which should be made in the logbook. 	2	
2	Handing over and taking over watch:	2	
	2.1 Describe the procedure for handing over and taking over Bridge Watches.	2	
3	Bridge manning levels:	3	
	3.1 Explain the circumstances in which the Officer On Watch (OOW) should call the Master	1	
	1.5 The responsibilities of OOW when in-charge of navigational watch and Extra lookout requirement	1	
	1.6 Navigation duties with Pilot embarked	1	
4	Keeping a safe navigational watch as per Section A-VIII/2 and B-VIII/2 of International Standards of Training, Certification & Watch-keeping for Seafarers, 1978 as amended (STCW Convention):	3	1
	4.1 Describe the principles to be observed while keeping a safe navigational watch & lookout.	3	
5	Record keeping and Entries in logbook:	3	1
	5.8 Explain the importance of recording all relevant information in Logbooks,	1	
	5.9 monitoring of navigational instruments, recording their performance and other relevant details,	0.5	
	5.10 recording all movements & activities related to the navigation of the ship & voyage records,	0.5	
	5.11 record keeping of different kinds of logs during ocean passages, coastal		

SN	Specific Learning Objectives	Lectures	Tutorials
	navigation & in port as per the company's ISM/SMS & IMO Guidelines for recording of events related to Navigation Res A. 916 (22)	1	
6	Keeping an effective anchor watch:	2	1
	6.1 State the importance of beam bearings, use of Global Position Fixing System (GPS) and Radar during anchor watch.	1.0	
	6.2 Explain a Turning Circle in relation to length of vessel and length of cable used and the swinging of vessel anchored to tide/wind.	0.5	
	6.3 State the indications of anchor dragging and the use of shapes, lights and sound signals as per IRPCS 1972.	0.5	
7	Pilot embarking & disembarking:	2	1
	7.1 Explain the importance of compliance with safe procedures for embarking and disembarking of Pilots and Pilot transfer arrangements, as per SOLAS, & its upkeep.	2.0	

TEXT BOOKS

1. Bridge Equipment, Charts & Publication Nutshell Series Book 5- Capt. H. Subramaniam
2. Modern electronic Navigation Aids- Bhatia and Sinha
3. Nautical watch Keeping – Capt. H. Subramaniam

RECOMMENDED BOOKS FOR REFERENCE:

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

INDIAN MARITIME UNIVERSITY

SEMESTER III

UG21P5307	Seamanship Lab –I (Practical)	60 Hrs	Credits-2
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SN	Specific Learning Objective	Hours
1	Seamanship	39
	1.1 Demonstrate taking soundings and ullage to find quantity of liquid in a tank using Calibration Table.	2
	1.2 Demonstrate taking hold temperature. Demonstrate measurement of dock water density and temperature.	2
	1.3 Demonstrate and conduct practice on the use of various types of cordage, fibre and wire ropes used on the ship. Natural fibre rope, synthetic fibre rope, wire rope – construction, care and lay, measuring the size of rope.	2
	1.4 Identify between right hand lay and left hand lay ropes	1
	1.5 Demonstrate and conduct practice on various types of whippings.	2
	1.6 Demonstrate and conduct practice on various types of knots, bends and hitches.	2
	1.7 Practical usage of knots and understanding where each knot is used.	2
	1.8 Opening a new coil & coiling of ropes.	1
	1.9 Demonstrate Fibre Rope eye splice, short splice, back splice.	2
	1.10 Demonstrate the method of connecting a heaving line / messenger line to a hawser.	2
	1.11 Demonstrate the method of belaying and racking a wire rope.	2
	1.12 Demonstrate the method of securing oil drums and other loose gear.	2
	1.13 Demonstrate the use of bulldog grips and bottle screws / turnbuckles in joining wires.	2
	1.14 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.	2
	1.15 Demonstrate the method of joining two mooring hawsers. To transfer rope from mooring winch to bollards and making fast.	2
	1.16 Demonstrate the method of belaying rope to cleats and Stag horn.	2
	1.17 Conduct Practical exercises in reading draft marks.	2
	1.18 Demonstrate the use of various power tools such as pneumatic/ electrical chipping and de-scaling tools and precautions needed.	5
	1.19 Demonstrate hazards associated with the use of portable ladders onboard.	1
	1.20 Demonstrate understanding of different manual lifting techniques for heavy weights.	1
2	Stage, Bosun’s Chair, Pilot Ladder and Mast Work	10
	2.1 Safety procedure involved in working aloft on stage and a Bosun’s chair	2
	2.2 Demonstrate the ability to climb a ship’s mast	2
	2.3 Demonstrate ability to climb downstairs in accommodation and ladders. Show the procedure to carry objects up or down the ladders or stairs.	2
	2.4 Learn and Demonstrate how a 'Pilot Ladder' can be rigged up according to the relevant rule requirements.	2
	2.5 Demonstrate how to climb up a 'Pilot Ladder' after taking all due safety.	2

3	Identify various parts of ship using ships Plans	2
4	Demonstrate enclosed space entry procedure	2
5	Demonstrate use of permits	2
6	Interpretation of MSDS to identify hazards of chemicals/paints	1
7	Identify various parts of ship using ships Plans	2
8	Demonstrate enclosed space entry procedure	2

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SEMESTER III

UG21P5308	Marine Engineering Workshop - I (Practical)	60 Hrs	Credits-2
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	Specific Learning Objective	Hours
1	Basic Marine Workshop	5
	1.1 Practice Cutting, Filing, and preparation of level surfaces on metals. Drilling, tapping, reamer operations.	1
	1.2 Shaping, drilling, grinding operations.	1
	1.3 Edge preparation on steel objects for welding. Welding of simple joints.	0.5
	1.4 Removal and fittings of ball bearing.	0.5
	1.5 Overhaul of valves, practice fittings on pipelines.	1
	1.6 Competency – Cuttings & planning, Dove tail joints.	1
2	Fitting Workshop	10
	<ul style="list-style-type: none"> • Demonstrate the ability to perform at least four basic fitting jobs of given dimension by using proper hand tools such as files, hacksaw, chisel, hammer, etc. (group activity of 2-3 cadets). • Demonstrate the use of feeler gauge, thread gauge, screw gauge, Vernier calliper, on the above said job. • Identify various spanners, nuts and bolts, Allen screws, studs and their use. • Demonstrate the use of grinding machine including portable grinders and drilling machine on the above said job. 	10
3	Welding Shop	10
	3.1 Demonstrate the safety precautions to be observed while welding including earthing.	1
	3.2 Identify the arc and gas welding tools and welding kits.	1
	3.3 Identify ferrous and non-ferrous metals.	1
	3.4 Demonstrate the ability to carry out oxyacetylene gas cutting. (group activity of 4-5 cadets).	3
	3.5 Connect the arc welding kit and select the current /electrode to carry out arc welding. (group activity of 4-5 cadets).	3
	3.6 Demonstrate the ability to carry out arc bead welding. (group activity of 4-5 cadets).	2
4	Electrical Shop	10
	4.1 Identify electrical insulated hand tools.	1
	4.2 Demonstrate the ability to identify electrical conductors (Wires and Cables).	1
	4.3 Identify the electrical accessories such as fuse, circuit breakers, choke, starters, etc. and demonstrates the use of it in electrical circuits.	3
	4.4 Assemble a tube light fitting by using tube fittings and test it.	1
	4.5 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).	2
	4.6 Identify safety precautions to take to avoid shock and to rescue a person from electrical shock location. (Instructor demonstration for a group of 5 cadets).	1
	4.7 Demonstrate the use of relay in electrical/ electronic circuits.	1
5	Plumbing Shop	10
	5.1 Identify plumbing hand tools such as pipe wrench, dies, pipe benders, hacksaw,	1

	Specific Learning Objective	Hours
	pipe vice, spanners, etc. (ship specific).	
	5.2 Identify leak stopping material such as Teflon, sealant, jubilee clips, ermeto couplings and demonstrate their use.	1
	5.3 Demonstrate the procedures to cut threads on pipes by selecting appropriate die. (Group activity of 2-3 cadets).	2
	5.4 Demonstrate the ability to identify different pipes, pipe material and methods to join the pipes.	1
	5.5 Identify various taps, cocks and valves used in sanitary System, demonstrate ability to repair them (ship specific).	1
	5.6 Identify various plumbing accessories such as ‘T’ joint, socket, reducer, adapter, etc. used in pipe fitting and demonstrate its use.	1
	5.7 Cut the gasket as per sketch by selecting appropriate material and tools.	1
	5.8 Demonstrate the ability to clear choked pipes in accommodation plumbing system by using appropriate tool / choke clearing material.	2
6	Carpentry Shop	5
	6.1 Identify carpentry hand tools such as chisel, jack plane, augur, mortisegauge, etc.	0.5
	6.2 Identify various wood for specific purposes treatment materials.	0.25
	6.3 Identify various wood jointing material using adhesive, nails, screwsetc.	0.25
	6.4 Demonstrate the ability to execute wood jointing (group activity of 2-3 cadets)	1.5
	6.5 Demonstrate the ability to make a cement box; wooden box as perdrawing by using appropriate tools, wood jointing method and wood jointing material / adhesives (group activity of 4-5 cadets)	1.5
	6.6 Use clamps/ cement box to arrest a leak. (Instructor demonstration forgroup of 20 cadets)	0.5
	6.7 Use of fibreglass repair kits. (Instructor demonstration for group of 20cadets)	0.5
7	Machinery Maintenance	10
	7.1 Identify various fasteners such as nut and bolts, allen screws, studs and demonstrates its use.	1
	7.2 Identify valves and cocks used onboard.	3
	7.3 Overhaul a globe valve and butterfly valve by using appropriate tools and gaskets (group activity of 2-3 cadets)	3
	7.4 Demonstrate the procedure to carry out greasing and Oiling pumps and Motor by using grease gun, oilcans and pneumatic grease gun.	3

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SEMESTER III

UG21T5309	Soft Skills –II	15+5=20 Hrs	Credit-1
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SN	Specific Learning Objective	Lectures	Tutorials
1	Behavioural Science:	4	1
	1.1 Define Behavioural Science.	0.5	
	1.2 Describe the following approaches to understanding human behavior: <ul style="list-style-type: none"> • Biological perspective • Behavioural perspective • Psychoanalytic perspective • Cognitive Developmental perspective • Humanistic perspective 	1	
	1.3 Clarify different approaches to understanding human behavior through case study.	1	
	1.4 Explain the relevance and applicability of behavior science through some examples/case study.	0.5	
	1.5 Safety Based Behaviors	1	
2	Self-esteem:	4	1
	2.1 Define Self-esteem.	0.5	
	2.2 What are the factors affecting self-esteem?	1	
	2.3 What are various signs of Low and High Self-Esteem?	1	
	2.4 How to measure your self esteem	0.5	
	2.5 Explain the importance of Self-esteem at work.	1	
3	Teamwork skills (Outdoor Activities- may be conducted):	7	3
	<ul style="list-style-type: none"> • Collaboration • Group facilitating • Team building • Teamwork 	7	

TEXT BOOKS

1.Managing Softskills for Personality development by B.N.Ghosh

RECOMMENDED BOOKS FOR REFERENCE:

1. Influence: The Psychology of Persuasion by Robert B Cialdini (Harper Business)
2. The Laws of Human Nature by Robert Greene (Profile Books)
3. Theories and Models in Applied Behavioural Science by J William Pfeiffer (Pfeiffer Wiley)
4. Effective Small Group and Team Communication by Judith D. Hoover (Wadsworth Publishing Co Inc)
5. Softskills –Dr K.Alex

SEMESTER III

UG21E5310	Artificial Intelligence-AI	15+5 =20 Hrs	Credit-1
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Fundamentals of Artificial Intelligence :	8	2
	1.1 Define and describe Artificial Intelligence	1	
	1.2 Explain and Describe Philosophy of AI. Goals of AI.	1	
	1.3 Describe Contributes to AI. AI Technique.	1	
	1.4 Explain Applications of AI. History of AI.	1	
	1.5 What is Intelligence? Explain Types of Intelligence.	2	
	1.6 Define Human and Machine Intelligence.	1	
	1.7 Explain and understand research areas of AI. AI vs ML vs DL,	1	
2	Artificial Intelligence and Marine industry	7	3
	2.1 Understand Capabilities of Expert Systems.	0.5	
	2.2 Explain Components of Expert Systems.	0.5	
	2.3 Explain and analyze User Interface. Expert Systems	1	
	Limitations.	1	
	2.4 Explain Applications of Expert System in marine field.	1.5	
	2.5 Explain in details Challenges of Artificial Intelligence in autonomous ships.	2.5	

TEXT BOOKS

1. Artificial Intelligence and Machine Learning by Chandra S.S.V

RECOMMENDED BOOKS FOR REFERENCE:

1. Machine Learning, Tom Mitchell, McGraw , 1997, 0-07-042807-7
2. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hill
3. Stuart Russell & Peter Norvig: "Artificial Intelligence: A Modern Approach", Pearson Education, 2nd Edition.
4. Jacek M. Zurada, "Introduction to Artificial neural System", JAICO publishing house, 2002
5. Ivan Bratko : "Prolog Programming For Artificial Intelligence" , 2nd Edition Addison Wesley, 1990.
6. Eugene, Charniak, Drew Mcdermott: "Introduction to Artificial Intelligence.", Addison Wesley
7. Patterson: "Introduction to AI and Expert Systems", PHI
8. Nilsson : "Principles of Artificial Intelligence", Morgan Kaufmann.
9. Carl Townsend, "Introduction to turbo Prolog", Paperback, 1987

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SEMESTER III

UG21E5311	Machine Learning- ML	15+5=20 Hrs	Credit-1
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Fundamentals of Machine learning (ML) :	5	2
	1.1 What is machine learning and its applications	1	
	1.2 Explain and understand research areas of AI.	1	
	1.3 Distinguish between AI vs ML vs DL	1	
	1.4 Explain in detail neural networks	2	
4	Machine Learning and Marine industry	10	3
	4.1 Analyse and explain Learning by experience, Supervised Learning, Unsupervised Learning, Competitive learning,	1	
	4.2 Explain various rules of learning Examples on Neural network learning.	1	
	4.3 Explain and analyse types of Artificial Neural Networks. Working of ANNs.	2	
	4.4 Explain Applications of Neural Networks. AI training.	0.5	
	4.5 Explain in detail Machine learning architecture in autonomous ships and overview of its working.	4	
	4.6 Explain in details Challenges of Machine learning in autonomous ships	1.5	

TEXT BOOKS

1. Artificial Intelligence and Machine Learning by Chandra S.S.V

RECOMMENDED BOOKS FOR REFERENCE:

1. Tom Mitchell , Machine Learning, , McGraw , 1997, 0-07-042807-7
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT press, 2004.
3. Jacek M. Zurada, "Introduction to Artificial neural System, JAICO publishing house, 2002
4. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition, Oreilly publication
5. Oliver Theobald, Machine Learning For Absolute Beginners: A Plain English Introduction , Second Edition

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SEMESTER IV

Semester-IV Courses

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5401	Celestial Navigation Paper – II	45	15	60	4
2	UG21T5402	Ship Stability Paper – II	45	15	60	4
3	UG21T5403	Cargo Handling & Stowage Paper –II	45	15	60	4
4	UG21T5404	Marine Engineering, Automation & Control Systems Paper –II	45	15	60	4
5	UG21T5405	Meteorology	45	15	60	4
6	UG21T5406	Critical Thinking and Leadership & Soft Skills	45	15	60	4
7	UG21P5407	Seamanship Lab - II (Practical)	60	-	60	2
8	UG21P5408	Marine Engineering Workshop - II (Practical)	60	-	60	2
9	UG21E5409	Cyber Security	15	5	20	1
10	UG21E5410	Internet of Things	15	5	20	1
11	UG21E5411	Blockchain Technology	15	5	20	1
12	UG21E5412					
		Total			540	31

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SEMESTER IV

UG21T5401	Celestial Navigation Paper - II	45+15=60Hrs	Credits-4
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SN	Specific Learning Objective	Lectures	Tutorials
1	Star Identification:	2	
	1.1 Recognition of important stars with reference to stellar constellations and stellar magnitudes.	2	
2	Hour Angle and Time:	7	3
	2.1 Describe the apparent solar day and state the relationship between LHA (sun) and LAT, Solar time, Solar day, apparent sun, mean sun, and Sidereal time.	1 0.5	
	2.2 Define sidereal day and state that it is a fixed time interval.		
	2.3 Explain the reasons for the suns irregular rate of change of SHA and hence the necessity to adopt the astronomical sun for time keeping purpose.	1	
	2.4 Describe the equation of time (ET) and its component.	0.5	
	2.5 Determine the ET from the almanac and its sign of application.	0.5	
	2.6 Define Zone Time, Standard Time and International Date Line.	0.5	
	2.7 Explain how to alter the ships time during a passage with increasing or decreasing longitude.	1.5	
	2.8 Demonstrate the use of time signal.	0.5	
	2.9 Calculation based on above.	1	
3	Amplitude and Azimuth:	8	2
	3.1 Calculate Sunrise and Sunset time using Nautical Almanac.	1.5	
	3.2 Determine the observed altitude of the sun when the true altitude is zero.	0.5	
	3.3 Derive formula "Sin amp= Sin decl. sec lat.	1	
	3.4 Obtain from tables or by calculation, using observers DR position and information from Nautical Almanac, True bearing of the heavenly body on rising and setting i.e solves an amplitude problem.	2	
	3.5 Obtain the azimuth of the body from tables, or by formula or calculation using GMT of observation, information from the Nautical Almanac, LHA of the body and observers DR position.	1.5	
	3.6 Obtain the error of magnetic compass or gyrocompass by comparing the compass bearing of the body with the true azimuth of the body obtained at the time of observation.	1.5	

SN	Specific Learning Objective	Lectures	Tutorials
4	Pole Star Observations:	6	2
	4.1 Identify Polaris	0.5	
	4.2 Identify certain major constellations and navigational stars' movement relative to Polaris and the movement of Polaris with the change of latitude.	1	
	4.3 Describe the relationship between the altitude of the Polaris and the observer's latitude.	0.5	
	4.4 Obtain the corrections $1^{\circ}, +a_0, +a_1, +a_2$ from polestar tables in Nautical Almanac and apply them to the altitude of Polaris to find the latitude of the observer.	1	
	4.5 Find the true azimuth of the Polaris from tables and the direction of the Position line.	1	
	4.6 Calculation based on the above.	2	
5	Position Fixing:	16	6
	5.1 Define Geographical Position and Circle of Position.	1	
	5.2 Determine the direction of position line through an observer and a position through which it passes. True Azimuth of a body and relationship with position line.	2	
	5.3 Define and evaluates co-latitude, polar distance and zenith distance and uses them as sides of PZX triangle.	1	
	5.4 Solve the PZX triangle to find the calculated zenith distance of the body when it is out of meridian.	2	
	5.5 Position fixing by long by Chron, Intercept, EX-Meridian(Sun) methods of sight calculation.	7	
	5.6 Position finding by simultaneous & staggered observations.	3	
6	Twilights:	6	2
	6.1 Define Twilights- civil, nautical and astronomical;	0.5	
	6.2 Explain conditions necessary for twilight all night;	0.5	
	6.3 Calculate twilight timings;	1	
	6.4 Define a circumpolar body, what conditions are necessary for a body to be circumpolar.	1	
	6.5 Calculations based on above	3	

TEXT BOOKS

1. Principles of Navigation by Capt. S.S.S Rewari & Capt. T.K. Joseph
2. Practical Navigation by Capt. H. Subramaniam
3. Nautical Almanac

RECOMMENDED BOOKS FOR REFERENCE:

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

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SEMESTER IV

UG21T5402	Ship Stability Paper – II	45+15=60 Hrs	Credits-4
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SN	Specific Learning Objective	Lectures	Tutorials
1	Trim :	6	2
	1.1 Explain the theory of Trim, Changes in the position of COG & COB, Role of COF in change of trim, Trimming Moment & MCTC.	1	
	1.2 Calculate Changes of drafts & Trim due to Loading, discharging & shifting weights and find final drafts F & A.	2	
	1.3 Calculate amount to be loaded, discharged or shifted to achieve desired drafts.	1	
	1.4 Calculate amount loaded, discharged or shifted to keep aft draft constant.	1	
	1.5 Calculate final F & A drafts using Trim Tables.	1	
2	Effect of change of density on Trim:	3	1
	2.1 Understand the theory behind Change of underwater volume, Bodily sinkage or rise due to change in density.	0.5	
	2.2 Calculate location of COG, COB & COF, Change of Trimming Moment, Change of trim due to change of density for a box shaped vessel while going from SW to FW and vice versa.	1.5	
	2.3 Calculate F & A drafts due to change of density for box shaped vessel and for a vessel for which hydrostatic particulars are provided.	1	
3	Curve of Statical Stability and Cross Curves:	5	1
	3.1 Understand how to use cross curves of stability and compute value of GZ for given displacement & KG.	1	
	3.2 Understand KN Cross curves of stability or tables & obtain GZ using formula $GZ = KN - KG \sin \Theta$	0.5	
	3.3 State that the KG used in formula for finding GZ using KN values is the corrected KG after application of FSC.	0.5	
	3.4 Construct GZ curve using GZ values as obtained from cross curves.	0.5	
	3.5 Using the GZ curve obtain Max GZ & the angle at which occurs, Range of Stability, Angle of vanishing stability, Angle at which deck edge immersion takes place & Initial GM.	0.5	
	3.6 Understand the GZ curve for a listed vessel and a vessel at her angle of loll.	1	
	3.7 Obtain Dynamical Stability by computing area under the GZ curve up to given angle using Simpson's rules.	1	
4	Righting Moment Calculations:	2	1
	4.1 Use Wall sided formula to obtain GZ value at moderate and large angles of heel.	0.5	
	4.2 Use Atwood's formula to obtain GZ value at moderate and large angles of heel.	0.5	
	4.3 Use KN values to obtain GZ at moderate and large values of heel.	0.5	
	4.4 Calculate Righting Moment after obtaining GZ values by any of the aforesaid methods by multiplying the GZ with displacement of the vessel.	0.5	

SN	Specific Learning Objective	Lectures	Tutorials
5	Simpson's Rule:	6	2
	5.1 State Simpson's First Rule, Second Rule & Third Rule.	2	
	5.2 Calculate areas, volumes, TPC, load displacement, centroids for areas & volumes using Simpson's Rule.	2	
	5.3 Calculate areas, volumes, centroids using combination of Simpson's Rules when number of ordinates cannot be used singularly by any of the Rules.	2	
6	Stability of Ships loading Grain:	5	1
	6.1 Define Grain, Angle of Repose, and Volumetric heeling moment.	0.5	
	6.2 Explain the Hazards associated with respect to ship stability during carriage of grain in bulk.	0.5	
	6.3 Describe Document of Authorization.	0.5	
	6.4 Sketch and describe the stability criteria for grain cargo as per part B of chapter VI of SOLAS 74.	0.5	
	6.5 Construct the GZ curve for grain laden vessel using KN values for various angles of heel.	1	
	6.6 Construct the heeling arm curve by obtaining value of λ_0 & λ_{40}	0.5	
	6.7 Obtain the angle of heel due to assumed shift of grain by the point of intersection of the GZ curve and heeling arm curve.	0.5	
	6.8 Determine by Stability calculations whether the ship satisfies the requirements of Stability criteria as specified in chapter VI of SOLAS 74.	1	
7	Angle of Loll:	2	1
	7.1 Define "Angle of Loll"	0.25	
	7.2 Explain in detail with diagrams, how a vessel takes to angle of loll.	0.5	
	7.3 Explain the danger to a ship at the angle of loll.	0.25	
	7.4 Explain the Remedial Actions for Angle of Loll giving reasons for the ballasting sequence to rectify same.	0.5	
	7.5 Calculate the value of angle of loll using the formula: $\text{Tan}\Theta = \sqrt{-2GM/BM}$	0.5	
8	Derivation of the Formulae:	6	1
	8.1 Derive the formula for calculating TPC.	0.5	
	8.2 Derive the formula for calculating FWA	0.5	
	8.3 Derive the formula for calculating MCTC.	0.5	
	8.4 Derive the formula for calculating BM (Transverse)	1.0	
	8.5 Derive the Wall sided formula for calculating GZ at moderate or large angles of heel.	1.0	
	8.6 Derive the Atwood's formula for calculating GZ at moderate or large angles of heel.	1.0	
	8.7 Derive the formula for calculating Angle of loll.	0.5	
	8.8 Derive the formula for calculating virtual loss of GM during dry docking.	0.5	
	8.9 Derive the formula for calculating virtual loss of GM due to Free Surface Effect.	0.5	
9	Hydrostatic Curves and Tables of M.V. HINDSHIP:	10	5
	1.1 Apply knowledge of above topics & solve numerical 44 to 67 from Text book- "Stability, Trim and cargo calculations on M.V.Hindship & Oil Tankers."	10	

TEXT BOOKS

1. Ship Stability for Masters & / Mates - C.B. Barrass and D.R. Derrett
2. Stability, trim and cargo calculations on M.V. Hindship and Oil Tankers- Capt. Joseph & Capt. Rewari
3. Stability Table for Trim & stability particulars of M.V. Hindship (Stability tables)-Bhandarkar Publication.

RECOMMENDED BOOKS FOR REFERENCE:

1. Ship Stability at the Operational Level- Subramaniam H
2. Ship Stability for Mates & Masters - Martin A. Rhodes
3. IMO - Grain Code

INDIAN MARITIME UNIVERSITY

SEMESTER IV

UG21T5403	Cargo Handling & Stowage Paper –II	45+15=60 Hrs	Credits-4
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SN	Specific Learning Objective	Lectures	Tutorials
1	Inspection and Preparation of Holds	4	1
	1.1 Need for inspection of holds after discharge and before loading, Importance of cleaning holds, Items to be inspected during hold cleaning, Items to be inspected prior loading cargo in holds. Log book Entries of cleaning.	2	
	1.2 Use of dunnage, type & size of dunnage, Disposal of dunnage as per MARPOL	0.5	
	1.3 Importance of checking bilge suction, Method of checking bilge Suction, Use of deodorising wash.	1	
	1.4 Blanking of ballast lines in holds- (Ballast holds used for heavy ballast)	0.5	
2	Deck Cargo	4	1
	2.1 Deck Cargoes; Types of Deck Cargo; Hazards of storing cargoes on deck.	1	
	2.2 Principles while storing deck cargo- states that stowage should leave safe access to essential equipments and space needed for normal operation of the ship such as- sounding pipes, devices for the remote operation of valves, mooring arrangements, firefighting and life-saving equipment, crew accommodation and working spaces, Protection for the crew (Guard rails). Efficient means of securing of deck cargoes.	1.5	
	2.3 Need of battening of hatch cover before loading deck cargo, Dangerous Cargoes not permitted below deck. Maximum permissible load, Unobstructed view from the navigating bridge.	1	
	2.4 Actions in the event of encountering heavy weather with Deck Cargo.	0.5	
3	Dock Labour Regulations	6	2
	3.1 Competent person, authorized person, responsible person, loose gear, lifting appliance. Duties and powers of the Dock Safety Inspector.	2	
	3.2 Annual thorough examination of cargo gear; Maintenance of cargo gear	0.5	
	3.3 Markings of ship's lifting appliances and cargo gear	0.5	
	3.4 Requirements for initial and periodical testing of cargo gear and annealing; Register of lifting appliances and cargo handling gear (Chain Register).	2	

SN	Specific Learning Objective	Lectures	Tutorials
	3.5 Precautions to be taken when using forklifts, bulldozers, grabs and other heavy gear on board. The requirements of guarding dangerous parts of the machinery.	1	
4	Bulk Cargoes, Draft Survey & Calculations of Bulk cargo Loaded	12	4
	<p>4.1 Definitions & Terminology employed with Bulk Cargoes: (Angle of repose, moisture migration, flow moisture point, flow state, transportable moisture limit, dry and wet shift, spontaneous combustion, Concentrates, Trimming)</p> <p>4.2 Types of Bulk Cargoes: Hygroscopic Cargoes, Heavy density cargoes, Cargoes liable to shift/ liquefy, Cargoes liable to spontaneous combustion.</p> <p>4.3 Classification of cargoes as per IMSBC Code.</p> <p>4.4 Main hazards and precautions with the shipment of bulk solids (Ores, Concentrates, HBI/DRI)</p> <p>4.5 Documentation required prior loading.</p> <p>4.6 Hazards associated with and precautions to be taken whilst loading/ carrying high density cargoes, Maximum allowable weight for single and adjacent holds, Water Ingress Alarm</p> <p>4.7 Hazards associated with bulk cargoes and precautions prior, during and after loading of: Coal, Sulphur, iron ore and urea.</p> <p>4.8 Protection of deck machinery from dust.</p> <p>4.9 BLU Code: Purpose and objectives of Bulk carrier loading and unloading, Ship Shore check list as per BLU code. Material hazardous in Bulk.</p> <p>4.10 MSDS Sheets; Cargo stow plan; Precautions to be taken prior entering cargo holds when pesticides are used for fumigation;</p> <p>4.11 Use of Loadicator for stowage Plan, Trimming of Bulk Cargo, Draft Survey and calculation of cargo quantity.</p>	<p>2</p> <p>0.5</p> <p>0.5</p> <p>1</p> <p>0.5</p> <p>1</p> <p>1.5</p> <p>0.5</p> <p>1</p> <p>0.5</p> <p>3</p>	
5	Grain Cargoes (SOLAS Ch. VI, IMO Grain Code)	5	2
	<p>5.1 Contents of Grain Code, Definition of Grain, Filled and Partly filled compartments, Trimmed and untrimmed cargo, Specially suitable compartment.</p> <p>5.2 Preparation of holds for carriage of grain cargo especially for insect or rodent infestation; Pre loading inspections/surveys;</p>	<p>1.5</p> <p>0.5</p>	

SN	Specific Learning Objective	Lectures	Tutorials
	<p>5.3 Grain Cargo Hazards, Securing of free grain surface in filled and partly filled compartments, Separation of different grain cargoes loaded in same compartment; Use of Shifting boards Bundling arrangements and Saucering.</p> <p>5.4 Document of Authorisation, Grain loading stability criteria for ships with and without a DoA, Contents of Grain loading booklet.</p> <p>5.5 Methods to reduce Grain heeling moments in order to meet Grain stability criteria.</p>	<p>1.5</p> <p>1</p> <p>0.5</p>	
6	Inspections of cargo spaces, hatch covers and ballast tanks	2	1
	<p>6.1 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.</p> <p>6.2 Actions to be taken to avoid the detrimental effects on bulk carriers of corrosion, fatigue and inadequate cargo handling.</p>	<p>1.5</p> <p>0.5</p>	
7	Timber	4	1
	<p>7.1 Contents of Code of safe working practices for ships carrying timber deck cargoes. Stowage and securing of deck timber cargoes.</p> <p>7.2 Hazards involved with the carriage of deck timber cargo. Effect on stability due to absorption of water or ice accretion.</p> <p>7.3 Need for regular inspection of lashing arrangements. Need for controlling height of deck cargo.</p> <p>7.4 Need for provision of walkways and access to the top of the cargo. Action if cargo is lost overboard.</p> <p>7.5 Stability criteria to be fulfilled.</p> <p>7.6 Rolling period test for determining ship's stability and limitations of the method.</p>	<p>1</p> <p>1</p> <p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.5</p>	
8	Procedures for Receiving, Tallying and Delivering Cargo	3	1
	<p>8.1 Mate's receipts</p> <p>8.2 Bill of Lading (Information available and different types of B/L) Charter Parties</p> <p>8.3 Note of protest, Cargo claims.</p> <p>8.4 Third party damage</p>	<p>0.5</p> <p>1</p> <p>0.5</p> <p>1</p>	
9	Dangerous Goods in Packaged Form (SOLAS Ch. VII, IMDG Code and MARPOL Annex III)	5	2

SN	Specific Learning Objective	Lectures	Tutorials
	9.1 Definitions: (Dangerous Goods, Harmful Substances, UN No, IMDG Code) Classification of IMDG cargo, Marking & Labelling of DG Cargo, Structure of IMDG Code, Primary Hazard Class & Secondary Hazard Class.	2	
	9.2 Use of IMDG Code and cargo information obtained from the same - UN No., General Index, MFAG, EmS	1	
	9.3 Compatibility and segregation, Use of segregation table Precautions when handling dangerous goods, Dangerous cargo manifest,	1	
	9.4 Inspections before loading dangerous goods, Construction of magazine for carriage of explosives, Limitations on carriage of explosives.	0.5	
	9.5 Precautions during stowage, handling, loading and carriage of explosives	0.5	

TEXT BOOKS

1. Cargo Work for Ship officer – Capt Errol Fernandes
2. Cargo Work for Maritime Operation- D.J. House

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- Dhananjay Swadi
6. IMDG Code Vol I, II & Supplement
7. IMO Grain Code, IMSBC Code & BLU Code

INDIAN MARITIME UNIVERSITY

SEMESTER IV

UG21T5404	Marine engineering, Automation & Control systems Paper –II	45+15=60 Hrs	Credits-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Internal Combustion Engine	5	1
	1.6 Explain types of engines	0.5	
	1.7 Explain requirement of main and auxiliary engine on board	0.5	
	1.8 Explain cycles of operation of two stroke diesel engine	0.5	
	1.9 Explain cycles of operation of four stroke diesel engine	0.5	
	1.10 Explain p-v diagrams of two stroke diesel engine and its significance	1	
	1.11 Explain p-v diagrams of four stroke diesel engine and its significance	1	
	1.12 Describe the components of diesel engine	1	
2	Marine Engineering Auxiliaries	10	4
	2.1 Describe the properties of different types of fuels used on board ship	0.5	
	2.2 Calculate bunker fuel required for the voyage and speed for a given daily consumption	0.5	
	2.3 Explain with diagram the working principle of impulse and reaction turbine, gas turbine and steam turbine	1	
	2.4 Describe the systems of turbines as prime mover for cargo pumping operations of tankers	1	
	2.5 Describe fixed pitched and variable pitch propellers.	0.5	
	2.6 Define pitch, pitch angle, real and apparent slips, propeller efficiency	0.5	
	2.7 Calculate propeller pitch, slip and efficiency	0.5	
	2.8 Explain with diagram the shafting arrangement from main engine to propeller	1	
	2.9 Explain with diagram the working of thrust block	0.5	
	2.10 Explain the effect of condition of hull on fuel consumption and propeller efficiency	0.5	
	2.11 Describe the safety requirements and features of cargo winch, windlass, lifeboat winch	1	
	2.12 Describe the safety requirements for hydraulic, pneumatic electric drives	0.5	
	2.13 Explain with diagram of the working of sewage treatment plant, bilge oil water separator and incinerator	1.5	
	2.14 Describe the regulations pertaining to ship concerned to air pollution from machinery exhausts, water pollution from discharge of sewage and oily bilges from machinery spaces	0.5	
3	Main Propulsion Units (IC Engines & Others)	8	3
	3.1 Define supercharging	0.25	
	3.2 Describe the process and different methods of scavenging	0.5	
	3.3 Describe different types of exhaust gas turbocharging arrangements (constant pressure and pulse type)	0.5	

	<p>3.4 Explain about scavenge fire, its indication and actions to be taken in the event of fire in the scavenge space</p> <p>3.5 Describe jacket water cooling system of main engine</p> <p>3.6 Describe sea water cooling system of main engine</p> <p>3.7 Describe lubricating oil system of main engine</p> <p>3.8 Describe fuel oil system of main engine</p> <p>3.9 explain functions of lubricating oil</p> <p>3.10 Describe the reasons of chemical treatment required for jacket water cooling system. Discuss various methods of chemical treatment.</p> <p>3.11 Describe starting air system of main engine</p> <p>3.12 Discuss limitations and care required on IC engine during manoeuvring and at full power</p> <p>3.13 Discuss warning up, starting, manoeuvring, reversing and full power running of the main engine</p> <p>3.14 Discuss purpose of turbocharger and procedures of turbo charger washing</p> <p>3.15 Define power weight ratio, specific fuel consumption, indicated horse power, brake horse power, frictional horse power, shaft power, delivered power, thrust power, effective power</p> <p>3.16 Define volumetric efficiency, mechanical efficiency, thermal efficiency, maximum continuous rating (MCR), heat balance sheet, major losses in IC engine</p>	<p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.25</p> <p>0.5</p> <p>0.5</p> <p>0.25</p> <p>0.5</p> <p>0.25</p> <p>0.5</p> <p>1</p> <p>1</p>	
4	Automation & Control Engineering	5	2
	<p>4.1 Explain the open loop and close loop control system</p> <p>4.2 Explain with sketch, a proportional controller</p> <p>4.3 Explain with sketch, a proportional and integral controller</p> <p>4.4 Explain pneumatic, hydraulic, electrical and electronic control system</p> <p>4.5 Describe main propulsion control system from bridge with controllable pitch propeller, bow thruster propulsive system</p> <p>4.6 Describe various arrangements necessary for appropriate and effective engineering watches to be maintained for the purpose of safety under normal circumstances and ums operations</p> <p>4.7 Explain the arrangements necessary to ensure a safe engineering watch is maintained when carrying dangerous cargo</p> <p>4.8 Define trim indicator, heel indicator, draft gauge, load and stress indicators</p> <p>4.9 Describe remote operation for loading, discharging and ballasting operations</p> <p>4.10 Define the function of information display, data logging, alarm system on board ship.</p>	<p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.5</p> <p>0.5</p>	
5	Safety Arrangements	3	1
	<p>5.1 Explain gas freeing, purging and inerting of a cargo tank</p> <p>5.2 Explain with diagram, inert gas production, generation from boiler exhaust gas</p> <p>5.3 Explain FSS code requirement for inert gas system</p> <p>5.4 Explain different measuring instruments for different gases such as o2 analyser, explosive meter, dragger pump, multi gas detector.</p>	<p>0.5</p> <p>1.5</p> <p>0.5</p> <p>1.5</p>	

6	Steering Gears	3	1
	6.1 Explain with diagram a two ram electro hydraulic steering gear	0.5	
	6.2 Explain with diagram a four ram electro hydraulic steering gear	0.5	
	6.3 Explain with diagram rotary vane steering.	0.5	
	6.4 Explain with diagram electric steering	0.5	
	6.5 Explain with diagram a variable delivery pump as used in electro hydraulic steering gear	0.5	
	6.6 State different rules and regulations of steering gear	0.25	
	6.7 Explain rudder drop allowance and jumping bar clearance	0.25	
7	Deck Machinery	3	1
	7.1 Explain with diagram the working of a windlass.	0.5	
	7.2 Explain with diagram the working of an automatic constant-tension mooring winch.	0.5	
	7.3 Explain with diagram the working of a simple cargo gear rigging arrangement and the use of winches in this arrangement.	1	
	7.4 Explain with diagram the working of the following: a cock, a globe valve, a gate valve and a butterfly valve.	0.5	
	7.5 Explain with diagram the working and signal control system of an air whistle.	0.5	
8	Pumps & Pumping Systems	3	
	8.1 Explain with diagram the working of different types of positive displacement pumps	0.5	
	8.2 Explain with diagram the working of different types of centrifugal pumps.	0.5	
	8.3 Explain the suitability of different pumps for specific purposes.	0.5	
	8.4 Explain with diagram a typical bilge and ballast system for a dry cargo ship.	1	
	8.5 Explain with diagram the pumping system of a gas carrier, chemical carrier and an oil tanker.		
9	Engine Room Watch Keeping & Equipment Operation	2	1
	9.6 Explain the watch keeping systems in E/R and its necessity	0.5	
	9.7 Explain periodic checks carried out in UMS.	0.5	
	9.8 List down the heavy weather precautions to be taken for steering, main propulsion and other machinery.	0.5	
	9.9 List down the safety checks to be carried out while in port, anchorage and at sea.	0.5	
10	Refrigeration, Air Conditioning & Ventilation	2	1
	10.1 Explain with diagram a vapour compression system	0.5	
	10.2 Explain desirable properties of a refrigerant	0.25	
	10.3 Explain with diagram the system of use of secondary refrigerant for cargo hold cooling	0.5	
	10.4 Explain a single duct air-conditioning system.	0.25	
	10.5 Explain the requirement of efficient ventilation system for a ship,	0.5	
11	Clean fuel and alternate fuel	1	
	11.1 Explain the need of clean and alternate fuel	0.5	
	11.2 What are the clean and alternate fuels used in shipping	0.5	

TEXT BOOKS

1. Basic marine engineering - T. K. Grover

RECOMMENDED BOOKS FOR REFERENCE:

1. Engineering drawing - reeds,
2. Motor engineering knowledge for marine engineers - Reeds Vol 12,
3. Basic electro technology - Reeds Vol 6,
4. Marine electrical equipment & practice –MC George,
5. Marine engineering practice Vol 2 part 17 slow speed diesel engines by institute of marine engineers (England),
6. Materials for marine machinery - Fredrick &Capper
7. Strength of materials - Ryder,
8. General engineering knowledge for engineer - Reeds Vol 8,
9. Marine and offshore pumping and piping systems - Crawford,
10. Basic marine engineering - J. K. Dhar

INDIAN MARITIME UNIVERSITY

SEMESTER IV

UG21T5405	Meteorology	45+15=60 Hrs	Credits-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Climatology:	6	2
	1.1 Wind and Pressure systems over the oceans.	0.5	
	1.2 Draw the mean surface pressure and wind distribution over the earth's surface.	0.5	
	1.3 Describe the characteristics and location of the doldrums, intertropical convergence zone, trade winds, subtropical oceanic highs, westerlies and polar easterlies	1	
	1.4 Apply the concept of horizontal temperature differences to a qualitative explanation of the formation of land and sea breezes	0.5	
	1.5 Explain the formation of anabatic and katabatic winds	0.5	
	1.6 List the regions of occurrence of anabatic and katabatic winds	0.5	
	1.7 Provide examples of local winds	0.5	
	1.8 General distribution of surface temperature, surface current, sea fog, pattern of clouds;	1	
	1.9 Describe a monsoon regime , monsoons of the Indian Ocean, China Sea, north coast of Australia, west coast of Africa and the north-east coast of Brazil	1	
2	Weather Systems:	5	2
	2.1 Define 'air mass'	0.25	
	2.2 Explain the formation of an air mass	0.25	
	2.3 Define 'source region'	0.25	
	2.4 Explain the characteristics required of a source region	0.5	
	2.5 Describe the source region characteristics of arctic, polar, tropical and equatorial air-mass types – defines 'warm front', 'cold front'	1	
	2.6 know the symbols for warm and cold fronts and identifies them on a weather map	0.25	
	2.7 Describe, with the aid of a diagram, the weather experienced during the passage of an idealized warm front	0.5	
	2.8 Describe, with the aid of a diagram, the weather experienced during the passage of an idealized cold front	0.5	

	2.9 Origin, life and movement of Frontal Depressions, Structure of Depressions. 2.10 Weather associated with cyclone, Anticyclone, Ridge, col, Trough and other pressure systems.	1 0.5	
3	Weather Reports:	5	1
	3.1 Describe the organization, functions and objectives of the World Meteorological Organization, Indian Meteorological Department.	0.5	
	3.2 Describe the sources of weather information available to shipping including internet and email	0.5	
	3.3 Weather reporting and recording procedures.	0.5	
	3.4 Describe the services provided for shipping by Meteorological Offices	0.5	
	3.5 Describe the appropriate weather bulletin (SAT-C) and the contents of each of its sections	0.5	
	3.6 Describe the types of information received by facsimile machine	0.5	
	3.7 Describe the services provided for storm warnings (At Port)	0.5	
	3.8 Explain the need for meteorological codes	0.5	
	3.9 Use the Ship's Code and Decode Book to code a ship's full report	0.5	
	3.10 Use the Ship's Code and Decode Book to decode a reduced report from a shore station.	0.5	
4	Weather Forecasting and Reporting System:	4	1
	4.1 Interpretation of symbols and isobaric patterns on weather charts and facsimile charts.	1	
	4.2 Cold and Warm Front, occlusion on a synoptic chart.	0.5	
	4.3 Interpretation of synoptic and prognostic charts to ascertain wind directions, areas of strong winds, cloud and precipitation areas, fog areas, ice, and areas of fine weather	0.5	
	4.4 Explain how weather observations at a ship can be used to improve the forecast derived from synoptic and prognostic charts	0.5	
	4.5 Evaluate the weather forecast information received.	0.5	
	4.6 Voluntary observing fleet under I.M.D; type and nature of information collected and International system of weather reporting.	0.5	
5	Ice on the Sea:	2	1
	5.1 Different types of ice, icebergs, limits of icebergs, accumulation of ice on ships	2	
6	Tropical Revolving Storms (TRS):	7	3
	6.1 Identify the Local names, seasons and areas affected;	0.25	
	6.2 Origin, structure, movement and lifespan of TRS; Weather associated with TRS;	0.25	

6.3	Definitions and nomenclature; Warning signs of an approaching TRS; Characteristics of TRS; Forecasting techniques;	0.25	
6.4	Action to be taken when the presence of TRS is confirmed;	0.25	
6.5	Cyclone tracking and warning bulletins under international conventions;	0.5	
6.6	Practical Rules for navigation for manoeuvring in the vicinity of TRS;	0.5	
6.7	Avoidance of storm centres and the dangerous quadrants; Ideal conditions for the formation of TRS;	0.5	
6.8	Comparison between a TRS and a temperate latitude depression;	0.5	
6.9	Avoiding TRS – 1-2-3 theory and sector theory	0.5	
6.10	Define ‘anticyclone’	0.25	
6.11	Draw a synoptic pattern of an anticyclone, for both northern and southern hemispheres, showing isobars and wind circulation	0.5	
6.12	Describe the weather associated with anticyclones	0.25	
6.13	Describe a ridge of high pressure	0.25	
6.14	Draw a synoptic pattern for a ridge, showing isobars and wind directions	0.25	
6.15	Describe a typical weather sequence during the passage of a ridge between depressions across the observer’s position	0.5	
6.16	Describe a col or a void between a convergence of pressure systems	0.5	
6.17	Draw a synoptic pattern for a col or a void between a convergence of pressure systems, showing isobars and wind directions	0.5	
6.18	Describe the weather associated with a col or a void between a convergence of pressure systems.	0.5	
7	Ocean Circulation System and Sub- Surface Circulation:	3	1
7.1	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.	3	
8	Oceanic Waves and Tides:	3	1
8.1	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. Relationship between tides and phases of moon.	3	
9	Sea Water:	2	
9.1	Properties of ocean water- Temperature, salinity, density - their relationship and measurement; and vertical and horizontal distribution	2	

10	Ship Borne Meteorological Instruments:	2	1
	10.1 Principle, use and operation of Aneroid Barometer, Barograph, Hygrometer, Hydrometer, Stevenson's screen, Whirling psychrometer, Anemometer.	2	
11	Visibility:	3	1
	11.1 State that visibility is reduced by the presence of particles in the atmosphere, near the earth's surface and define 'fog', 'mist' and 'haze'	0.5	
	11.2 Apply the concept of processes leading to supersaturation to a classification of fogs as mixing, cooling or evaporation fogs	0.5	
	11.3 Explain qualitatively the formation of radiation fog, mentioning areas, seasons and reasons for its dispersal	0.5	
	11.4 State the effect of pollution on the formation of radiation fog	0.25	
	11.5 Explain qualitatively the formation of advection fog, mentioning areas, seasons and reasons for dispersal	0.5	
	11.6 Explain qualitatively the conditions leading to the formation of sea smoke, and typical areas where sea smoke may be encountered	0.5	
	11.7 Describe methods of estimating the visibility at sea, by day and by night, and the difficulties involved	0.25	
12	Water Vapour:	3	1
	12.1 Define 'water vapour'	0.25	
	12.2 Describe the properties of water vapour in the atmosphere	0.25	
	12.3 Define 'evaporation', 'condensation', 'latent heat of vaporization'	0.5	
	12.4 Define 'saturated air'	0.5	
	12.5 Describe the processes of mixing, cooling and the evaporation of water vapour, by which a sample of air may be brought to saturation		
	12.6 Define 'dewpoint', 'absolute humidity', 'relative humidity'.	0.25	
	12.7 Define super cooling, and frost point.	0.25	
	12.8 Explain diurnal and seasonal variation of water vapour.	0.5	

TEXT BOOKS

1. Marine Meteorology – Capt. H. Subramaniam
2. Ships' Code and Decode Book- The Met. Office

RECOMMENDED BOOKS FOR REFERENCE:

1. Meteorology for Mariners- HMSO
2. Meteorology for Seafarers- Frampton, R.M
3. Meteorology Demystified: self-teaching guide- Gibilisco Stan
4. Dynamical Meteorology: an introductory selection- Atkinson, B.W.
5. Mariners Handbook (NP 100) - Admiralty
6. Cloud Types for Observers- HMSO

INDIAN MARITIME UNIVERSITY

SEMESTER IV

UG21T5406	Critical Thinking, Leadership & Soft Skills	45+15=60 Hrs	Credits-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Introduction to Critical Thinking	3	1
	1.1 What is an argument?	0.5	
	1.2 What isn't an argument?	0.5	
	1.3 Define Premises and Conclusions	0.5	
	1.4 Define Justifications	0.5	
	1.5 Define Explanations	1	
2	Types of Reasoning Skills	6	2
	2.1 Introduction to Deductive Reasoning	0.5	
	2.2 Explain Valid and invalid arguments	0.5	
	2.3 Explain Necessary and sufficient conditions	0.5	
	2.4 Introduction to Inductive Reasoning	0.5	
	2.5 Explain Argument by induction	0.5	
	2.6 Introduction to Abductive Reasoning	0.5	
	2.7 Explanations, theories and hypotheses	1	
	2.8 Correlation and causation	1	
	2.9 Introduction to Backward Induction	0.5	
	2.10 Introduction to Counterfactual Thinking	0.5	
3	Defining Problems and Making Decisions	3	1
	3.1 What is a Problem?	1	
	3.2 What is Decision-Making?	1	
	3.3. Decision-Making Style	1	
4	Problem Solving Techniques	4	1
	4.1 Basics of Incident Investigation, Root Cause Analysis and Apparent Cause Analysis	2	
	4.2 Explain the purpose of 8-D methodology to identify, correct and eliminate recurring problems	2	
5	Introduction to Leadership	3	2
	5.1 Comparing Management and Leadership	1	
	5.2 Define Autocratic Leadership	0.5	
	5.3 Define Democratic Leadership	0.5	
	5.4 Define Transactional Leadership	0.5	
	5.5 Define Transformational Leadership	0.5	
6	Leadership Mind and Heart	8	3
	6.1 What are Emotions?	1	
	6.2 List the Components of Emotional Intelligence	1	
	6.3 Explain Servant Leadership	1	
	6.4 Robert Tannenbaum and Warren Schmidt's Leadership Continuum Model	1	
	6.5 Milton Rokeach's Instrumental Values and End Values	1	
	6.6 The Vroom-Jago Contingency Model	1	
	6.7 List the Big Five Personality Dimensions – extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience	0.5	
	6.8 Explain Kelley's Styles of Followership	0.5	
	6.9 Define Charismatic Leadership and Coalitional Leadership		

7	Life Skills	7	2
	7.1 Reassess self-awareness	1.0	
	7.2 Infer empathy	0.5	
	7.3 Apply critical thinking	0.5	
	7.4 Apply creative thinking	0.5	
	7.5 Make decision in the workplace	1.0	
	7.6 Apply problem solving techniques	0.5	
	7.7 Express point of view effectively	0.5	
	7.8 Handle Interpersonal relationship	1.0	
	7.9 Manage stress at the workplace	0.5	
	7.10 Manage emotions	1.0	
8	Emotional Intelligence skills	7	2
	8.1-8.4 -Self-management –	2	
	8.1 Control impulsive feelings and behaviors		
	8.2 Take initiative		
	8.3 Follow through on commitments		
	8.4 Adapt to changing circumstances		
	8.5-8.7 Self-awareness –	1	
	8.5 Recognize own emotions and deduce its effect on thoughts and behavior		
	8.6 Recognize strengths and weaknesses		
	8.7 Demonstrate self-confidence		
	8.8-8.10 Social awareness –	2	
	8.8 Recognize emotional cues		
	8.9 Express socially comfortable feelings		
	8.10 Recognize the power dynamics in a group or organization		
	8.11-8.15 Relationship management –	2	
	2.11 Develop and maintain good relationships		
	2.12 Communicate using ABC (Accuracy, Brevity and Clarity)		
	2.13 Inspire and influence others		
	2.14 Work well in a team		
	2.15 Manage conflict		
9	Positive Psychology	5	1
	8.1 How to cultivate the five elements of positive psychology that create the foundation of a flourishing life: Positive Emotions, Engagement, Relationships, Meaning and Accomplishments.	2	
	8.2 How an attitude of gratitude can be developed.	1	

TEXT BOOKS

- 1.Managing Softskills for Personality development by B.N.Ghosh
- 2.Richard L. Daft, *Leadership*.

RECOMMENDED BOOKS FOR REFERENCE:

1. Daniel Kahneman, *Thinking, Fast and Slow*, Allen Lane, 2011.
2. Tom Chatfield, *Critical Thinking*, Sage Publications India Pvt. Ltd., 2018.
3. Chris S. P. Visser, *8-D Problem Solving Explained*, CreateSpace Independent Publishing Platform, 2017
4. L. N. V. Heuvel, D. K. Lorenzo, L. O. Jackson, W. E. Hanson, J. J. Rooney, D. A. Walker, *Root Cause Analysis Handbook*, Rothstein Associates Inc., 2008
5. Soft skills-Dr K.Alex.

INDIAN MARITIME UNIVERSITY

SEMESTER IV

UG21P5407	Seamanship Lab - II (Practical)	60 Hrs	Credits-2
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SN	Specific Learning Objective	Hours
1	Blocks , Tackles and container lashing	15
	1.1 Conduct practical exercise on the use of blocks, snatch blocks and the differential pulley (chain blocks).	3
	1.2 Demonstrate the method of reeving a threefold purchase. (Group activity of 2-3 cadets).	2
	1.3 Demonstrate overhauling of blocks.	3
	1.4 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).	4
	1.5 Demonstrate the use of container lashing gear. (Group activity of 2-3 cadets)	3
2	Flag work	10
	2.1 Identification of Nation flag of all countries using Interco, Recognition of House flag.	2
	2.2 Identification of flag denoting numbers and substitute flags,	2
	2.3 How to bend on or unbend a flag from halyard, breaking a flag at close up, Flag hoisting practice at colours and sunset.	2
	2.4 Practical usage of “International Code of Signals”.	4
3	Fire fighting	15
	3.1 Demonstrate use of various types of Fires and Extinguishers.	1
	3.2 Demonstrate refilling of Foam and DCP types Portable Fire Extinguishers,	1
	3.3 Demonstrate connecting coupling to fire hose using Copper Seizing wire	1
	3.4 Demonstrate handling charged fire hose.	1
	3.5 Demonstrate creating water wall with spray nozzle.	1
	3.6 Demonstrate donning of Fireman’s outfit.	1
	3.7 Demonstrate donning of EEBD for emergency escape.	1
	3.8 Demonstrate donning of Self Contained Breathing Apparatus and refilling the air bottles by compressor.	2
	3.9 Demonstrate entering a smoke filled compartment wearing breathing apparatus.	2
	3.10 Fire Fighting Drills requirement and demonstration,	2
	3.11 Demonstrate rendering first aid to a person injured during fire.	2
4	Life Saving Appliances	20
	4.1 Demonstrate the correct method of connecting Life raft painter, hydrostatic release unit (HRU) and weak link.	2
	4.2 Identify Life boat equipment and explain their uses.	2
	4.3 Identify parts of Life boat davit.	2
	4.4 Explain use, care and maintenance of Immersion suit, TPA and Life jacket.	2
	4.5 Identify different types of life buoy, their uses and maintenance.	1
	4.6 Explain changing of lifeboat falls end to end.	2
	4.7 Demonstrate Abandon ship drill.	2
	4.8 Demonstrate lifeboat launching and retrieval operation.	2

INDIAN MARITIME UNIVERSITY

SEMESTER IV

UG21P5408	Marine Engineering Workshop - II (Practical)	60 Hrs	Credits-2
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SN	Specific Learning Objective	Hours
1	Mechanical Drawing	10
	1.1 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.	6
	1.2 Discussion on ship's plans. Isometric views, cut/cross sections. Simple assembly drawings engineering drawing by free hand sketching.	4
2	Hydraulics Workshop	20
	2.1 Identify various components used in hydraulic system.	1
	2.2 Interpret basic hydraulic circuit diagrams. Explain with sketch the purpose and symbols of direction control valves and methods of their operation.	2
	2.3 Identify symbols of various accessories used in hydraulics such as heater, cooler and filters, pressure control valves and flow control valves, actuators and pumps.	2
	2.4 Use ermeto type couplings for joining pipes taking safety precautions.	1
	2.5 Execute common fault finding and rectification in hydraulic system taking safety precautions. (Group activity of 2-3 cadets).	2
	2.6 Use the hydraulic hand pump used for emergency operations in the hydraulic system taking safety precautions.	2
	2.7 Carry out air purging in the hydraulic system taking safety precautions.	2
	2.8 Tighten leaking hydraulic connections taking safety precautions.	2
	2.9 Demonstrate the procedure to clean and replace filters in the system taking safety precautions (group activity of 2-3 cadets).	2
	2.10 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).	2
	2.11 Demonstrate the understanding of working of hydraulic door closer taking safety precautions.	2
3	Pneumatics Work Shop	20
	3.1 Identify the various equipment operated by pneumatics such as pneumatics wrench, lights, grinders, drilling machines, spray painting machines etc.	2
	3.2 Identify various components used in pneumatics like relays, transmitters, actuators etc.	2
	3.3 Identify symbols used in pneumatics and how they are different than the hydraulics.	2
	3.4 Trace the simple pneumatic circuits	2
	3.5 Detect and rectify common faults in pneumatic circuits.	4
	3.6 Demonstrate the ability to clean compressed air filters including dryers (dehumidifier) (group activity of 2-3 cadets)	3
	3.7 Demonstrate the ability to overhaul the pneumatic tools / equipment such as pneumatic torque wrench (group activity of 4-5 cadets)	3
		4
4	Machining	10
	Practice sessions on -	
	4.1 Cutting, filing, preparation of level surface on metals	2

4.2 Drilling, tapping, reamer operations	2
4.3 Shaping, drilling, grinding operations	2
4.4 Thread cutting by taps and die	2
4.5 Thread cutting by lathe machine.	2

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SEMESTER IV

UG21E5409	Cyber Security	15+5 = 20 Hrs.	Credit-1
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SN	Specific Learning Objective	Lectures	Tutorials
1	Introduction to Cyber Security:	5	1
	1.8 Define and describe Cyber Security,	1	
	1.9 Define different cyber security terminology,	1	
	1.10 Explain types of cyber-attacks,	2	
	1.11 Explain types of hackers,	0.5	
	1.12 Explain different types of web.	0.5	
2	Cyber security key aspects:	5	2
	2.6 Define and explain Cyber Security Vulnerabilities and Cyber Security Safeguards.	1	
	2.7 Explain how to Securing Web Application, Services and Servers.	1 1	
	2.8 Explain in details Intrusion Detection and Prevention.		
	2.9 Define and explain in detail Cyberspace and the Law.	2	
3	Security protocol and implementation:	5	2
	3.1 Define and explain Cyber Forensics.	0.5	
	3.2 Explain and demonstrate General firewall settings.	0.5	
	3.3 Explain and understand different measures to protect against cyber fraud,	0.5	
	3.4 Analyse and explain Cyber-attacks, cyber netiquettes.	0.5	
	3.5 Analyse and understand Cyber security on board ship with cyber netiquettes	3	

TEXT BOOKS

1. Fundamentals of Cyber Security by Bhushan/Rathore/Jamshed

RECOMMENDED BOOKS FOR REFERENCE:

1. Cybersecurity ??? Attack and Defense Strategies: Infrastructure Security with Red Team and Blue Team Tactics by Erdal Ozkaya and Yuri Diogenes
2. Cybersecurity: the Beginner's Guide: A Comprehensive Guide to Getting Started in Cybersecurity, by Erdal Ozkaya. Packt Publishing
3. Cybersecurity Essentials, by Christopher Grow, Donald Short, Philip Craig, Charles J.
4. Cybersecurity for Beginners, by Raef Meeuwisse
5. Hacking: The Art of Exploitation (2nd Ed.) by Jon Erickson
6. The Art of Invisibility: The World's Most Famous Hacker Teaches You How to Be Safe in the Age of Big Brother and Big Data by Kevin Mitnick

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SEMESTER IV

UG21E5410	Internet Of Things (IoT)	15+5 =20 Hrs	Credit-1
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Introduction to IoT	3	2
	1.1 Describe technologies that led to evolution of IoT, 1.2 Define and explain IoT and M2M, IoT and Big Data. 1.3 Describe IoT Standards 1.4 Explain and understand requirement of international standard (case study) 1.5 Explain in details challenges in IoT with respect to marine domain	0.5 1 0.5 0.5 0.5	
2	Introduction and Maritime Industry	12	3
	2.3 Explain IoT standards in practice. Operating platforms /systems. 2.4 Explain IoT in everyday life, Internet of Everything, 2.5 Describe and explain IoT and Individual Privacy. 2.6 Explain different IoT application in shipping industries 2.7 IoT Cloud services -- SaaS, PaaS, IaaS	1 2 1 1 4 3	

TEXT BOOKS

1. Internet of Things and its Applications by Prof. Satish Jain, Shashi Singh .

RECOMMENDED BOOKS FOR REFERENCE:

- 1 The Internet of Things” by Samuel Greengard
- 2 Getting started with Internet of Things” by Cuno Pfister
- 3 Learning Internet of Things” by Peter Waher
- 4 Precision: Principles, Practices and Solutions for the Internet of Things” by Timothy Chou.
- 5 The Fourth Industrial Revolution by Klaus Schwab
- 6 The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies by Erik Brynjolfsson and Andrew McAfee

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SEMESTER IV

UG21E5411	Blockchain Technology-BCT	15+5=20 Hrs	Credit-1
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SN	Specific Learning Objectives	Lectures	Tutorials
	Introduction to BCT:	5	2
	1.1 Define Blockchain technology: Why, What, How.	1	
	1.2 Explain Technological and Cryptographic Elements in Blockchain.	1	
	1.3 Define and describe Blockchain Platforms. A decentralized society.	1	
	1.4 Describe the current state of the Blockchain landscape.	1	
	1.5 Describe Business applications and assessing blockchain.	1	
2	Block chain and Maritime Industry	10	3
	2.1 Explain Crypto-anarchism and Cypherpunks.	1	
	2.2 Explain and analyze hash cryptography, mining and consensus. Proof-of-Work and Stake-of-Work consensus, block mining, block tampering.	2.5	
	2.3 Explain in detail block chain architecture	2.5	
	2.4 Explain and understand The Limitations, Opportunities and Challenges of Blockchain in marine industry.	4	

TEXT BOOKS

1. Blockchain From Concept To Execution by DebajaniMohanty.

RECOMMENDED BOOKS FOR REFERENCE:

- 1 Blockchain: Blueprint for a new economy by Melanie Swan
- 2 Blockchain Revolution by Don and Alex Tapscott.
- 3 Cryptoassets by Chris Burniske and Jack Tatar
- 4 The Book of Satoshi by Phil Champagne
- 5 The Basics of Bitcoins and Blockchains by Antony Lewis
- 6 Blockchain Technology Explained: The Ultimate Beginner's Guide by Alan T. Norman
- 7 Blockchain Technology for Industry 4.0, Springer

INDIAN MARITIME UNIVERSITY**SEMESTER V****Semester-V Courses**

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5501	Coastal Navigation & Collision Prevention Regulations	45	20	65	4
2	UG21T5502	Naval Architecture Paper – I	45	20	65	4
3	UG21T5503	Life Saving & Fire Fighting Appliances	45	20	65	4
4	UG21T5504	Specialized Cargo Handling & Stowage	45	20	65	4
5	UG21T5505	Marine Environmental Protection	45	15	60	4
6	UG21T5506	Bridge Equipment & Watch keeping Paper -II	45	15	60	4
7	UG21P5507	Ship Operation Technology Lab (Practical)	60	-	60	2
8	UG21P5508	Navigation Lab I (Practical)	60	-	60	2
9	UG21T5509	Maritime Risk Management	15	5	20	1
10	UG21E5510					
11	UG21E5511					
12	UG21E5512					
		Total			520	29

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SEMESTER V

UG21T5501	Coastal Navigation & Collision Prevention Regulations BA Chart 5047/5048/2675	45+20=65 Hrs	Credits-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Position fixing	12	7
	1.1 Defines the following a. Set b. Rate c. Drift d. Leeway e. Dead Reckoning Position (DR) f. Estimated Position (EP) g. Observed position (Fix)	1	
	1.2 Defines the following h. Ships speed i. Effective speed j. Course and Distance made good k. Applied leeway	1	
	1.3 Calculates the following l. Course and Distance Made Good with a Tidal Stream / Current m. Course to Steer allowing for Current	2	
	1.4 Calculates the course to steer counteracting current and leeway including n. Time and distance off when landmark is abeam o. Time and distance off when a landmark is nearest	1	
	1.5 Calculates the estimated position allowing for current and leeway including p. Time and distance off when landmark is abeam q. Time and distance off when a landmark is nearest	2	
	1.6 Calculates the ships position by Running Fix, with or without current and Leeway	2	
	1.7 Astronomical Position Lines r. Recalls the theory of Position lines in case of ‘Long by Chron’, ‘Intercept’ and ‘Merpass’ s. Plots the Astronomical Position Lines and obtains a position using it and a Terrestrial Position Line / Circle	1	
	1.8 Calculates vessel’s position using a Transferred Position Circle with current and leeway	2	
2	Tide	6	3
	2.1 Describes the Basic Tidal theory including the cause and effect of Spring tide and Neap Tide	0.5	
	2.2 Defines a. Range of Tide b. Duration of Tide c. Chart Datum d. Mean High Water Springs	0.5	

	2.3 Calculates the intermediate Times / Height of water for Standard Ports	1.5	
	2.4 Calculates the intermediate Times / Heights of water for Secondary Ports	2	
	2.5 Predicts the tidal current direction and rate from the information available on the chart	1.5	
3	Buoyage system	4	1
	3.1 Explains the Principles and Rules of the International Association of Lighthouse Authorities Buoyage Systems 'A' and 'B'	0.5	
	3.2 States the dangers of placing implicit reliance upon floating Navigational Aids	0.5	
	3.3 Describes the different types of buoys in the IALA system	1	
	3.4 Description, Explanation and Use of Lateral and Cardinal buoys	1	
	3.5 Description, Explanation and Use of <ul style="list-style-type: none"> a. Isolated Danger Buoys b. Safe Water Marking Buoys c. Special Marking Buoys d. Emergency Wreck Marking Buoys e. Virtual buoys 	1	
4	Passage Planning	11	6
	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.); Reference to M.S notice 854 and IMO Res. A. 893 (21). The above to include – <ul style="list-style-type: none"> 4.1 Appraisal – (Sources of Appraisal and Data to collect from the Sources) Ascertain the charts and publication required for the voyage and whether they are corrected and up-to-date, extract all relevant information from the publications such as Ocean Passages of the World, Sailing Directions, Routing Charts, List of Lights and Fog Signals, List of Radio Signals, Guide to Port Entry and Routeing Charts 4.2 Planning – (Planning on the Chart and Planning on the Voyage Plan Sheet) Plot courses on the charts, both small and large scale, way points, no-go areas, contingency anchorages, alerts, abort points and other relevant marks. Prepare a Voyage plan sheet 4.3 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. 4.4 Monitoring – Monitor frequently the traffic, position, weather, visibility and maintain a situational awareness at all times. Check the proper functioning of navigational instruments and fill up logs periodically during 	11	6
5	Collision Prevention Regulations	12	3
	5.1 Rules 1-41 <ul style="list-style-type: none"> a. Revision of points covered in T4206 b. Defines Masthead Light, Stern light, Side Lights and 	12	3

	<p>Towing Light</p> <p>c. States the Range of the Navigation Lights</p> <p>d. Describes / Recognizes Lights and Shapes carried by vessels when underway</p> <p>e. Describes / Recognizes Lights and Shapes carried by vessels when making way through water</p> <p>f. Describes / Recognizes Lights and Shapes carried by vessels when at Anchor</p> <p>g. Describes / Recognizes Lights and Shapes carried by vessels Not Under Command, Restricted in her ability to Maneuver and when constrained by her draught</p> <p>h. Describe / Recognize Lights and Shapes carried by vessels when engaged in special activities</p> <p>i. Describes / Recognizes Lights and Shapes carried by Fishing vessels</p> <p>j. Defines short and Prolonged blast</p> <p>k. Describes the equipment carried for sound signals</p> <p>l. Describes the sound signals to be used by vessels when in sight of one another including Manoeuvring signals</p> <p>m. Describes the sound signals sounded by vessels when navigating in or near an area of restricted visibility</p>		
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TEXT BOOKS

1. Selected pages from Admiralty Tide Tables volume1, 2 & 3-1992 –Hydrographer of Navy
2. **IMO Rules of the Road – Bhandarkar Publications**
3. Chart Work for Mariner-Capt S.K.Puri

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. International Lights, Shapes and Sound Signals – D. A. Moore
13. International Regulations for Preventing Collisions at sea- Nautical Press

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SEMESTER V

UG21T5502	Naval Architecture Paper – I	45+20=65 Hrs	Credits-4
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Section A – Ship Stability			
SN	Specific Learning Objectives	Lectures	Tutorials
1	Simpson’s Rule:	9	5
	1.1 Define Second moment of area (Moment of Inertia).	1	
	1.2 Sketch and describe second moment of a rectangle about axis passing through centroid and about one of its sides.	2	
	1.3 Sketch and describe Theorem of Parallel axes.	1	
	1.4 State marine applications of Simpson’s Rules.	1	
	1.5 Compute second moments of area about transverse axis passing through centre of flotation and about centerline using Simpson’s Rules.	2	
2	Centre of Pressure:	6	3
	2.1 Define Centre of pressure and its importance.	1	
	2.2 Compute Centre of pressure for regular shapes.	2	
	2.3 Compute Centre of pressure for combination of regular shapes.	3	
3	Bilging:	7	2
	3.1 Sketch, define and describe bilging of a box shaped vessel.	2	
	3.2 Explain effects of bilging of a compartment with / without permeability.	1	
	3.3 Calculation on bilging and flooding of a midship compartment for a box-shaped vessel.	3	
	3.4 Explain actions to be taken in the event of partial loss of intact buoyancy by closing openings and using cross flooding arrangements.	1	

Section B – Ship Construction			
4	Stresses & Strains:	7	2
	4.1 Explain stresses experienced by ships in still water and in seaway.	0.5	
	4.2 Explain ‘hogging’ and ‘sagging’ and difference between them.	0.5	
	4.3 Explain how hogging and sagging stresses result in tensile or compressive forces in the deck and bottom structure.	1	
	4.4 Describe water pressure loads on the ship’s hull.	0.5	
	4.5 Describe liquid pressure loading on the tank structures.	0.5	
	4.6 Describe qualitatively the stresses set up by liquid sloshing in a partly filled tank.	0.5	
	4.7 Describe racking stress and its causes.	0.5	
	4.8 Explain what is meant by ‘pounding’ or ‘slamming’ and state which part of the ship is affected and strengthened.	1	
	4.9 Explain what is meant by ‘panting’ and state which part of the ship is affected and strengthened	1	
	4.10 Describe stresses caused by localized loading.	1	

5	Principles of Ship Design	6	3
	5.1 Explain the principles of ship design as Safety, sustainability, efficiency, nature of service, dimensions, manpower requirement, deadweight, seakeeping & manoeuvrability, strength, corrosion factor, economic factor, etc.	3	
	5.2 Describe four stages of design as Concept, Preliminary, Contract and Detail design. 5.3 Describe Plans and Specifications developed during ship design.	1 2	
6	Shipyard Plans and Practices	5	4
	6.1 Explain sequence of events in ship construction.	1	
	6.2 Describe various ship building practices- Prefabrication, Preparation of Lines Plan, Sheer Plan, half-breadth Plan, Body Plan, Lofting and Fairing, methods of marking, Transfer of Plan to plate, use of computers, numerical control.	1	
	6.3 Explain progress of a plate from stockyard to ship.	1	
	6.4 Explain various shipyard processes - Plate straightening, blasting and painting, edge preparation, Cutting, drilling, bending, shaping, Sub-assembly, assembly, Testing.	1	
6.5 Explain Launching of a ship and Sea Trials.	1		
7	Specialised Ships	5	1
	7.1 Describe strength and construction of ships using Midship sections of Passenger ship, Ro-Ro ship, Refrigerated cargo ship, Liquefied gas carrier (LPG & LNG), Chemical tankers.	5	

TEXT BOOKS

1. Ship Stability for Masters & / Mates - C.B.Barrass and D.R.Derrett
2. Ship construction –D.J. Eyres

RECOMMENDED BOOKS FOR REFERENCE:

- 1.Ship Stability for Mates & Masters - Martin A. Rhodes
- 2.Ship Construction for Engineers - Reid
- 3.Ship construction - Pursey

	<p>Immersion suits, TPAs: 1.25 Describe Immersion suit, and TPA, use, care and maintenance.</p> <p>Line Throwing Appliances: 1.26 Describe line throwing appliance, use, care and maintenance.</p> <p>Survival at sea: 1.27 Explain the techniques used for survival at sea and recovery of person. 1.28 Explain LSA plan and training Manual. 1.29 State the rescue operation (Med-Evac) by helicopter.</p>	1 1 2	
2	Introduction to fire fighting	3	1
	<p>2.1 Explain objective of fire safety and functional requirement as per SOLAS.</p> <p>2.2 Describe the theory and chemistry of fire.</p> <p>2.3 Explain fire triangle/tetrahedron, modes of combustion.</p> <p>2.4 List the different Classes of fire.</p> <p>2.5 Explain the control of class A, B and C fires.</p> <p>2.6 Explain Fire Safety Plan and Training Manual.</p>	0.25 0.25 0.25 0.25 1 1	
3	Fire Prevention	3	1
	<p>As per SOLAS Convention.</p> <p>3.1 Describe Class A, B and C Class divisions.</p> <p>3.2 Describe different types of Fire dampers and ventilators.</p> <p>3.3 State the use of IG system for fire prevention in tankers.</p> <p>3.4 Explain the construction of means of Escape, stairway, fire doors.</p>	1 0.5 0.5 1	
4	Fire Detection and Safety Systems:	4	1
	<p>4.1 Purpose and functional requirement as per SOLAS.</p> <p>4.2 Describe the Types of Detectors, Selection of Fire Detectors and Alarm systems and their operational limits.</p> <p>4.3 Describe the fixed fire detection and alarm system.</p> <p>4.4 Explain the periodic testing of sensors and detection system.</p> <p>4.5 Explain Fire control stations.</p>	0.5 1 1 1 0.5	
5	Fire Fighting Appliances:	15	7
	<p>5.1 Describe the Construction, operation and merits of different types of portable and non-portable fire extinguishers and fixed fire extinguishing installations for ships.</p> <p>5.2 Explain Fire Pumps, Emergency Fire pumps, Fire mains, isolation valves, Relief valves, Fire hydrants and different types of fire hoses and nozzles used and their maintenance.</p> <p>5.3 Explain International shore connection.</p> <p>5.4 Describe various types of portable fire extinguishers, and their suitability for different types of fires, refilling, maintenance and testing.</p> <p>5.5 Describe the steam smothering system, Carbon dioxide smothering system, Inert gas system, Flue gas system, Foam smothering system for liquid fires, High expansion foam system.</p> <p>5.6 Explain Fireman's outfit, Self-Contained Breathing Apparatus (SCBA), Safety lamps, fire axe, and their maintenance.</p> <p>5.7 Explain use of EEBD for escape and its maintenance.</p>	3 2 1 2 4 2 1	

6	Fire Control, Firefighting & Shipboard Organisation:	5	3
	6.1 Explain the Fire organization on ships.	0.5	
	6.2 State Fire alarm and duties as per muster list.	0.5	
	6.3 Explain the conduct of Fire Drills and the statutory requirements for fire drills.	0.5	
	6.4 Fire safety precautions on cargo ships and tankers during working.	0.5	
	6.5 Explain the automatic sprinkler system fitted onboard.	0.5	
	6.6 Describe firefighting actions for fires in Accommodation, Machinery spaces, Boiler rooms, Cargo holds, Galley, etc.	1	
	6.7 Describe procedure of firefighting in port and dry-dock.	0.5	
	6.8 Describe the Procedure for re-entry after putting off fire.	0.5	
	6.9 Explain the Rescue operations from affected compartment and First aid.	0.5	

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
9. LSA Code.
10. FSS Code

INDIAN MARITIME UNIVERSITY

SEMESTER V

UG21T5504	Specialized Cargo Handling & Stowage	45+20=65 Hrs	Credits-4
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SN	Specific Learning Objectives Unit	Lectures	Tutorials
1	Containers and Containerisation	6	2
	<p>1.1 Introduction to Containerisation- Parts and Features of a container Types, sizes and markings of containers, CSC Plate</p> <p>1.2 Segregation and care of containers carrying dangerous goods.</p> <p>1.3 Stowage and securing gear of containers viz. container shoes, stacking cones, interlayer stackers, twist locks, bottle screws and turnbuckles.</p> <p>1.4 Stowage Arrangement of a container ship, and how the position of container is designated, Bay plans and stack weight, Loadicator and Loading Plans.</p> <p>1.5 Factors affecting a container stow: Stability, trim, list, stresses, stack height, weight, dangerous goods, special requirements.</p> <p>1.6 Anti-heeling tanks, Torsional stresses, contents of Container Securing code. Special requirements of Dangerous Cargo, reefer containers and out-of-gauge containers; DG Manifest, Reefer Manifest, Temperature Logs.</p> <p>1.7 Damages to container.</p>	<p>0.5</p> <p>1</p> <p>1</p> <p>0.5</p> <p>1</p> <p>1</p> <p>1</p>	
2	Reefer Ships and Refrigerated Cargo	4	1
	<p>2.1 Explain how hold and lockers are prepared for loading refrigerated cargo. Explain the need of pre-cooling of spaces and dunnage to be used Explain the dunnage requirements for refrigerated cargo. It is essential that any dunnage to be used is placed in the space before pre-cooling, since the use of warm dunnage could cause considerable damage. Explain the cargo should be inspected ashore by the ship's officers before loading to see that it is in good condition and has been properly pre-cooled where it is required.</p> <p>2.2 Explain the random inspection of the cargo should be made during loading. Explain that damaged product or carcasses which have thawed should be rejected or loaded separately as they could cause spoiling of the remainder of the cargo which was in good condition.</p> <p>2.3. Explain that on cargoships with a limited amount of refrigerated space, it is usual practice to arrange that the refrigerated cargo is to be loaded last and discharged first at its destination. Give the example of commodities which are carried in chilled condition, Examples of frozen cargo.</p> <p>2.4 General outline of refrigeration systems (Direct, Indirect and air-cooled systems)</p> <p>2.5 Care, monitoring and records of cargo during passage, Purpose of temperature recording.</p>	<p>1</p> <p>1</p> <p>1</p> <p>0.5</p> <p>0.5</p>	

3	Oil Cargoes, Oil Tanker Operations and Related Pollution- Prevention Regulations:	15	8
	3.1 Tanker Arrangement-Describe for crude carriers and product tankers, the general arrangement of: Cargo tanks, pumprooms, segregated ballast tanks, slop tanks, cofferdams-peak tanks, Ventilators leading to accommodation and machinery spaces.	1	
	3.2 Definitions: (Crude oil, Refined products, Spiked crude, Sour crude, Vapour pressure, Reid vapour pressure, Upper and lower flammable limits, Pour point, Flash Point, Threshold Limit Value, Permissible Exposure Limits, Volatile Liquid)	1.5	
	3.3 Hazards of Oil Cargoes, Flammability diagram.	1	
	3.4 Cargo piping system (Free flow, Ring main, Direct) along with Advantages & Disadvantages. Explain Pollution prevention arrangements (Segregated ballast, Clean ballast, Slop tank and handling of slops, Load-on-top, ODMCS)	2	
	3.5 Requirement of IG system. Describe Inert gas system including boiler uptake valve, scrubber, blowers, oxygen analyser, deck seal, non-return valve, PV valve, PV breaker and mast riser. Hazards of Inert Gas. Explain Inerting, purging and gas freeing operations.	1.5	
	3.6 Crude Oil Washing, its hazards and benefits, COW checklist, MARPOL regulations for COW. Preparation for cargo tank entry.	1	
	3.7 Items of pre-arrival checklist. Loading and discharging operations on a tanker. Care of cargo during transit.	1	
	3.8 Use of Oxygen analyser, Explosimeter, Tankscope, Multigas detector and Dragger tubes.	1	
	3.9 Introduction to Cargo pumps (Centrifugal, Reciprocating, Eductor)	1	
	3.10 Contents of International Safety Guide for Oil Tankers and Terminals ISGOTT.	1	
	3.11 Cargo calculations for quantity and ullage of oil cargo based on volume and height of space, density of cargo and temperature change- For a box shape ship.	3	
4	Heavy Lift Ships and Project Cargoes	3	1
	4.1 Heavy Lift Ship Operations, Elements for consideration of Heavy Lift Operations.	1	
	4.2 Effect of the heavy lifts on the seaworthiness and the stability of the ship;	1	
	4.3 Precautions to be taken whilst loading/discharging heavy lifts , Transportation and Planning Considerations for Heavy Lift Cargoes.	1	

5	Chemical Tankers (SOLAS Chapter VII, MARPOL Annex II, IBC Code):	6	3
	5.1 Explain Type 1, Type 2 and Type 3 chemical tankers. Explain various categories (X, Y, Z, OS) of cargoes.	0.5	
	5.2 Hazards associated with chemical cargoes (Reactivity, Flammability, Toxicity, Health & Pollution Hazards) and control measures, PPE. State the gas measuring equipment carried on chemical tankers.	1.5	
	5.3 Purpose and use of IBC code. Information available in cargo data sheet.	0.5	
	5.4 Purpose and objective of P & A manual, Certificate of Fitness. Cargo Record Book.	1	
	5.5 Typical tank arrangements with piping. Tank cleaning and control of pollution in chemical tankers. Hazards involved with tank cleaning operation. Use of slop tanks.	1.5	
	5.6 Explain “closed circuit” loading operation using a vapour- return line with the help of simple diagram. Purpose of using the Framo pumps unloading operation.	1	
	5.7 Various types of tank coatings, introduction to CHRIS Code.	1	
6	Gas Tankers :(Ch. VII of SOLAS, SIGTTO and IGC Code) LNG, LPG, LEG and Chemical Gases in Bulk:	6	3
	6.1 Type A, Type B and Type C tanks; each cargo tank is fitted with high level alarm and auto- shut off.	1.5	
	6.2 Purpose and objectives of the IGC Code. Certificate of fitness.	0.5	
	6.3 Hazards of gas cargoes and control measures adopted	1	
	6.4 Definitions - 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.	1.5	
	6.5 Various types of ships (Fully pressurized, Semi pressurized, Fully refrigerated)	0.5	
	6.6 Various types of tanks (integral, membrane, semi-membrane, independent and internally insulated tank)	1	
7	Ro- Ro Ships	3	1
	7.1 Preparation of the car decks for the loading of trailers and vehicles, Floating decks.	1	
	7.2 Procedures for opening, closing, securing of bow, stern and side doors and ramps (external/ internal). Care and maintenance of the systems. Maintaining water-tight integrity of the cargo decks.	1	
	7.3 Ventilation System, Fire Precautions , Vehicle stowage and securing,Ro-Ro ship stability & inherent dangers.	1	
8	Offshore Supply Vessels:	2	1
	8.1 Types and features of Offshore supply vessels	1	
	8.2 Use and purpose of OSVs. Introduction to DP Vessels	1	

TEXT BOOKS

1. Cargo Work for Ship officer – Capt Errol Fernandes
2. Cargo Works – D.J. House

RECOMMENDED BOOKS FOR REFERENCE:

1. Cargo Work – Kemp and Young
2. Cargo Works – Taylor
3. Cargo Notes- Dhananjay Swadi
4. ISGOTT, IGC Code, IBC Code,CSC ,MARPOL

INDIAN MARITIME UNIVERSITY

SEMESTER V

UG21T5505	Marine Environmental Protection	45+15=60 Hrs	Credits-4
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SN	Specific Learning Objectives Unit	Lectures	Tutorials
1	MARPOL Convention General -	3	1
	1.1 Explain brief history of MARPOL convention.	0.5	
	1.2 Define, harmful substance, discharge, ship, and incident.	0.5	
	1.3 State that violations of the Convention are prohibited.	0.5	
	1.4 Describe the inspections which may be made by Port State authorities and outline actions which they may take.	0.5	
	1.5 Describe the provisions for the detection of violations and enforcement of the Convention.	0.5	
	1.6 State that reports on incidents involving harmful substances must be made without delay.	0.5	
2	Marpol Annex I: (Regulations for the Prevention of Pollution by Oil)-	7	3
	2.1 Define/explain- oil, oily mixture, oil fuel, oil tanker, combination carrier, nearest land, special area, and instantaneous rate of discharge of oil content, wing tank, centre tank, slop tank, clean ballast, and segregated ballast, Particularly Sensitive Sea Areas (PSSA), Vessel response plan(VRP), bilge water holding tank, oily water separator.	1	
	2.2 Describe the surveys and inspections required under the provisions of MARPOL.	1	
	2.3 State that the condition of the ship and its equipment should be maintained to conform to the provisions of the Convention.		
	2.4 State that the certificate issued after survey is the International Oil Pollution Prevention (IOPP) Certificate.		
	2.5 List the conditions under which oily mixtures may be discharged into the sea from an oil tanker.	1	
	2.6 List the conditions under which oily mixtures from machinery-space bilges may be discharged into the sea		
	2.7 State that the provisions do not apply to the discharge of clean or segregated ballast.		
	2.8 Describe the conditions under which the provisions do not apply to the discharge of oily mixtures from machinery spaces where the oil content without dilution does not exceed 15 parts per million.		
	2.9 State that residues which cannot be discharged into the sea in compliance with the regulations must be retained on board or discharged to reception facilities.		
	2.10 List the special areas for the purposes of Annex I.	1	
	2.11 State that any discharge into the sea of oil or oily mixtures from an oil tanker or other ships of 400 tons gross tonnage and above is prohibited while in a special area.		

	<p>2.12 Describe the conditions under which an oil tanker may discharge oily mixtures through ODMCS.</p> <p>2.13 Describe the conditions under which a ship, other than an oil tanker, may discharge oily mixtures in a special area.</p> <p>2.14 Describe conditions in which processed bilge water from machinery spaces may be discharged in a special area.</p>		
	<p>2.15 State that ballast water should not normally be carried in cargo tanks of tankers provided with segregated ballast tanks.</p> <p>2.16 Explain the exceptions in which ballast may be carried in cargo tanks.</p> <p>2.17 State that, in new ships of 400 tons gross tonnage and above and in new oil tankers of 150 tons gross tonnage and above, no ballast water should normally be carried in any oil fuel tank.</p>	1	
	<p>2.18 Pumping, piping and discharge arrangement in oil tankers. MARPOL line.</p> <p>2.19 Describe Crude oil washing operation.</p>	1	
	<p>2.20 Oil Record Book (Part I – Machinery space operations and Part II – Cargo/ ballast operations)</p> <ul style="list-style-type: none"> ● Describe the requirements for the provision of Oil Record Books. ● List the various entries that need to be made in the Oil Record Book with respect to above for following operations: ● Explain that each completed operation shall be signed by the officer or officers in charge of the operations and master of the ship. ● State that the Oil Record Book should be kept on board readily available for inspection and should be preserved for a period of three years after the last entry has been made. 	1	
	<p>2.21 SOPEP</p> <ul style="list-style-type: none"> ● State that the Shipboard Oil Pollution Emergency Plan (“SOPEP”) is to be seen as an information from the owners to the master of a ship. ● State it is an advice to the master how to react in case of an oil spill to prevent or at least mitigate negative effects on the environment. ● State that the Plan contains operational aspects for various oil spill scenarios and lists communication information to be used in case of such incidents. ● State that it is compulsory for all ships of more than 400 gross tons (oil tankers of more than 150 GT) to carry a SOPEP on board. ● List the contents of SOPEP. ● Describe that the Plan consists generally of 4 sections with the mandatory contents and its appendices with additional information as contact addresses and data plus a set of certain drawings for easy reference for the master. 	1	
3	Marpol Annex II: (Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk)	5	3
	<p>3.1 Cargo categories -</p> <ul style="list-style-type: none"> ● State that the requirements of Annex II apply to all ships carrying noxious liquid substances in bulk. ● Explain the categories of noxious liquid chemicals ● State that the conditions for the discharge of any effluent containing substances falling in those categories. ● State that more stringent requirements apply in special areas 	1	

	<ul style="list-style-type: none"> State that pumping and piping arrangements are to be such that, after unloading, the tanks designated for the carriage of liquids of category Z do not retain more than certain stipulated quantities of residue. 		
	<p>3.2 Procedures and Arrangements Manual –</p> <ul style="list-style-type: none"> State that the Manual identifies the arrangements and equipment needed to comply with Annex II and specifies the operational procedures with respect to cargo handling, tank cleaning, slops handling, residue discharging, ballasting and deballasting, prewash and ventilation procedures. 	1	
	<p>3.3 Cargo Record Book – To be completed, on a tank-by-tank basis, whenever any operations with respect to a noxious liquid substance take place.</p>	1	
	<p>3.4 Shipboard Marine Pollution Emergency Plan (SMPEP) -</p> <ul style="list-style-type: none"> Explain that this plan is to be seen as an information from the owners to the master of a particular ship advising the master how to react in case of a spill of noxious liquid substances to prevent or at least mitigate negative effects on the environment. Describe that the Plan contains operational aspects for various spill scenarios and lists communication information to be used in case of such incidents. Explain that such plan has to fulfil the requirements for the SOPEP and additionally for the Shipboard Marine Pollution Emergency Plan for noxious liquid substances. Explain that if a combined plan “Shipboard Marine Pollution Emergency Plan” (SMPEP) is carried, it has to be in accordance with the guidelines. 	2	
	<p>3.5 Explain Reception facilities and cargo unloading Terminal arrangements.</p>	1	
4	Marpol Annex III: (Regulations for the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form)	2	1
	<p>4.1 State that for the purpose of this Annex, empty receptacles, freight containers portable tanks and road and rail tank wagons which have been used previously for the carriage of harmful substances are treated as harmful substances themselves unless precautions have been taken to ensure that they contain no residue that is hazardous to the marine environment.</p> <p>4.2 State that packaging, containers and tanks should be adequate to minimize hazard to the marine environment</p> <p>4.3 Describe the requirements for marking and labelling packages, freight containers, tanks and wagons</p> <p>4.5 Describe the notification procedures for loading/unloading harmful substances as per MARPOL Annex III</p> <p>4.6 Describe the documentation relating to the carriage of harmful substances by sea</p> <p>4.7 State that certain harmful substances may be prohibited for carriage or limited as to the quantity which may be carried aboard any one ship</p> <p>4.8 State that jettisoning of harmful substances is prohibited except for the purpose of securing the safety of the ship or saving life at sea</p>	2	

5	Marpol Annex IV: (Regulations for the Prevention of Pollution by Sewage from Ships)	2	1
	5.1 State that Annex IV contains a set of regulations regarding the discharge of sewage into the sea, ships' equipment and systems for the control of sewage discharge, the provision of facilities at ports and terminals for the reception of sewage, and requirements for survey and certification	0.25	
	5.2 Describe the provisions regarding the discharge of sewage into the sea	0.5	
	5.3 State that an International Sewage Pollution Prevention Certificate is issued by national shipping administrations to ships under their jurisdiction showing compliance	0.25	
	5.4 State that the annex requires ships to be equipped with either a sewage treatment plant or a sewage comminuting and disinfecting system or a sewage holding tank, Standard discharge connection.	0.5	
	5.5 State that the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; or is discharging sewage which is not comminuted or disinfected at a distance of more than 12 nautical miles from the nearest land.		
6	Marpol Annex V: (Regulations for the Prevention of Pollution by Garbage from Ships)	4	1
	6.1 Define, for the purposes of Annex V: Garbage, nearest land, special area.	0.5	
	6.2 State that the disposal into the sea of all plastics is prohibited	0.5	
	6.3 State the regulations concerning the disposal of other garbage	0.5	
	6.4 List the special areas for the purposes of Annex V	0.5	
	6.5 Garbage Management Plan	2	
	<ul style="list-style-type: none"> • State that the ships have to carry a garbage management plan which the crew are required to follow • Describe the content of the Garbage Management Plan, Garbage Record Book • Explain Placards • Garbage Record Book - Describe the various operations when the Garbage Record Book has to be completed and various entries that need to be made. • Explain the disposal criteria for cargo residues/cargo hold washing water residues. 		
7	Marpol Annex VI: (Regulations for the Prevention of Air Pollution from ship)	6	2
	7.1 Define, for the purposes of Annex VI: continuous feeding, emission control area (ECA), new installations, Nitrogen Oxide (NOx) technical code, ozone-depleting substances, sludge oil, shipboard incineration, particular matter (PM), volatile organic compounds (VOCs)	1	
	7.2 Describe the provision for the issuance of International Air Pollution Prevention certificate, duration of validity of the certificate.	1	
	7.3 Describe the regulation regarding NOx in regulation 13 of Annex VI	0.5	
	7.4 Describe the requirement for SOx emission control area (SECA)	0.5	
	7.5 Describe the requirement for fuel oil quality in regulation 18 of Annex VI	0.5	
	7.6 List the special areas for the purposes of Annex VI	0.5	
	7.7 Volatile Organic Compound (VOC) Management Plan-	0.5	
	<ul style="list-style-type: none"> • Explain Volatile Organic Compounds (VOC) • Explain that VOC emissions from ships can be due to incomplete combustion processes and include crankcase, exhaust and evaporation emissions 		

	7.8 SEEMP Issue or endorsement of a certificate, Ships Energy Efficiency Management Plan (SEEMP)	0.5	
	7.9 Describe EEDI. (Energy Efficiency Design Index)	0.5	
	7.10 Information to be included in the bunker delivery note.	0.5	
8	Ballast Water Management:	4	1
	8.1 Define: ballast water, ballast water management, sediments	1	
	8.2 State that in order to show compliance with the requirements of the Convention each vessel shall have on board a valid Certificate, a Ballast Water Management Plan and a Ballast Water Record Book	0.5	
	8.3 Describe the various methods of ballast exchange	1	
	8.4 Describe the standards that need to be observed in ballast water exchange	1	
	8.5 Explain the safety procedure to be followed during BWM for ship and crew.	0.5	
9	Anti-Fouling Paint Pollution:	3	1
	8.3 Introduction, Brief History, Antifouling, Effects and Zones, Antifouling purpose and types, Environmental Impact.	1.5	
	8.4 State that convention prohibits the use of harmful organotins in anti-fouling paints used on ships and will establish a mechanism to prevent the potential future use of other harmful substances in anti-fouling system.	1.5	
10	Anti-Pollution Equipments (Introduction):	3	
	10.1 Describe the operating procedures of anti-pollution equipment : sewage plant, incinerator, comminutor and ballast water treatment plant	3	
11	National Response Centre with respect to pollution prevention: General idea	1	
12	Ship Recycling: Brief history, IMO Guidelines on ship recycling, concept of Green Passport for ships	2	
13	National Pollutant Discharge Elimination System (NPDES) of US Clean Water Act	3	1
	13.1 Give an overview of NPDES	1	
	13.2 Explain that the VRP Vessel Response Plan is a plan required for vessels trading to/from/in USA and this US Coast Guard's new regulations to improve pollution	1	
	13.3 Explain that the Oil Pollution Act of 1990 (OPA-90) and the international treaty, MARPOL 73/78, require owners/operators of certain vessels to prepare Vessel Response Plans (VRP) and/or Shipboard Oil Pollution Emergency Plans (SOPEP) and in addition, for certain vessels carrying noxious liquid substances a Shipboard Marine Pollution Emergency Plan (SMPEP).	2	

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 V

UG21T5506	Bridge Equipment & Watch keeping Paper -II	45+15=60 Hrs	Credits-4
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Section A – Bridge Equipment (41 Hrs.)			
SN	Specific Learning Objectives	Lectures	Tutorials
1	Radar	9	3
	<p>1.1 Fundamental Principles of Radar</p> <ul style="list-style-type: none"> ● Explain radiation hazards and precautions, safety precautions necessary in the vicinity of open equipment, radiation hazard near antennae and open waveguides. ● Describe the characteristics of radar sets: Bearing range accuracy, HBW. VBW, pulse length, pulse recurrence rate ● Sketch Block diagram and explain use of various controls ● Explain safe distances from radar spares and magnetic compasses ● Describe maximum & minimum range of radar, range and bearing discrimination ● Explain external factors affecting radar detection, radar horizon, sub refraction, super refraction & ducting, effect of precipitation and sea on radar detection ● Explain factors that might cause faulty interpretation: Indirect echoes, side echoes, multiple echoes, second 'trace echoes. ● Explain range & bearing accuracy, error in range & bearing <p>1.2 Setting Up and Maintaining Displays of Radar and ARPA</p> <ul style="list-style-type: none"> ● Describe 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 & bearing. <p>1.3 IMO Marine Radar Standards</p> <ul style="list-style-type: none"> ● Explain Marine Radar Performance Specifications, Performance standards for radar equipment, Limitations of the radar X-band and S-band. <p>1.4 Radar Plotting</p> <ul style="list-style-type: none"> ● Plot relative motion triangle and identify various vectors and angles, course, speed and aspect of other ships in relative and true presentation. Closest point of approach (CPA) and time to point of approach (TCPA), bow pass, in relative and true presentation. <p>1.5 Automatic Radar Plotting Aid (ARPA):</p> <ul style="list-style-type: none"> ● Demonstrate setting vector lengths based on own vessel speed and range scale in use. ● Explain 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. ● Explain advantages of compass stabilization of a relative display, use of Trial manoeuvre and predictive motion vectors. 	<p>0.5</p> <p>0.5</p> <p>1.0</p> <p>0.25</p> <p>0.75</p> <p>1.0</p> <p>0.5</p> <p>0.5</p> <p>1.0</p> <p>0.5</p> <p>1.5</p> <p>0.25</p> <p>0.5</p> <p>0.25</p>	

2	Use of Radar in Navigation	3	1
	2.1 Obtain position fix by radar bearings and ranges, 2.2 Appreciate possible errors and reliability of fix, 2.3 Explain use of Aids to radar navigation: Use of passive (trails, history) and active aids, RACONs and SARTs. 2.4 Explain AIS overlay on radar / ARPA 2.5 Explain Radar overlay on ECDIS. 2.6 Describe use of parallel indexing technique in radar navigation:	0.5 0.5 0.5 0.5 0.5 0.5	
3	Gyro Compass:	4	2
	3.1 Describe a free gyroscope and its gimbal mountings 3.2 State that in the absence of disturbing forces the spin axis of a free gyroscope maintains its direction in space 4.3 Explain what is meant by gyroscopic inertia and precession 4.4 Describe the precession resulting from a torque about axes perpendicular to the spin axis 4.5 Explain that friction at gimbal pivots produces torques which give rise to precession 4.6 State that the rate of precession is proportional to the applied torque 4.7 State that 'tilt' as movement of the spin axis in the vertical plane 4.8 State that 'drift' as the apparent movement of the gyroscope in azimuth resulting from the earth's rotation 4.9 Explain how a free gyroscope can be made north-seeking by the use of gravity control and describes the resulting oscillations of the axis Describe the use of damping in azimuth and damping in tilt to cause settling of the axis and thus produce a gyrocompass.	0.25 0.25 0.25 0.25 0.25 0.25 0.5 0.5 0.5 0.5	
4	Ship Security Alert System (SSAS):	1	1
	4.1 Describe operation, precaution while using and its limitations	1	
5	Magnetic Compass	3	1
	5.1 Describe 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. 5.2 Explain Heeling error effect and method of correction. Cause sitting of compasses with reference to the proximity of magnetic material and electric appliances. 5.3 Care and maintenance of liquid compass.	1 1 1	
6	Various Other Navigation – Aids	11	3
	6.1 GPS - <ul style="list-style-type: none"> ● 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 advantages & limitations, alarm setting & errors, system configuration, frequencies used, C/A & P/A codes, basic line measurement, Dilution of Precision (DOP), various DOPs used, selective availability and its effect on the accuracy of a fix, accuracy of GPS and how the accuracy can be downgraded, why a fix obtained from the GPS receiver cannot be plotted directly onto a navigational chart, datum shifts. 6.2 Augmented Satellite systems(DGPS): (0.5Hr)	3 0.5	

	<ul style="list-style-type: none"> Explain working principle & limitations of Differential GPS (DGPS) system. <p>6.3 Regional Satellite Navigation systems</p> <ul style="list-style-type: none"> Introduction to RSNS- Explain China's BeiDou (COMPASS) Navigation satellite system, India's Indian Regional Navigational satellite system (IRNSS-Navik), Japan's Quasi-Zenith satellite system (QZSS) and France's Doppler Orbitography and Radio Positioning Integrated by satellite (DORIS), GLONASS, Galileo. <p>6.4 Automatic Identification System (AIS)</p> <ul style="list-style-type: none"> Describe types & purpose of AIS information exchange, data exchange, Information displayed on AIS screen, limitations & precautions of AIS during use of AIS for collision avoidance. <p>6.5 LRIT (Long Range Identification and Tracking)</p> <ul style="list-style-type: none"> Explain purpose of LRIT, Data transmitted by LRIT, authorized receivers/ users of LRIT. Compare LRIT and AIS. <p>6.6 VDR (Voyage Data Recorder)</p> <ul style="list-style-type: none"> Describe concept and purpose of VDR, details & duration of data recorded on VDR, modules of VDR float free Playback Options S-VDR. <p>6.7 Bridge Navigation Watch Alarm System (BNWAS) Explain operation, precautions & limitations.</p> <p>5.12 Introduction to Intelligent Awareness System used for Navigation</p> <p>5.13 The concept of "Digital Twins"</p>	1.5	
		1	
		1	
		1	
		1	
		2	
		1	
	Section B – <u>Watchkeeping</u> (19 Hrs.)		
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) including the content, application & intent of COLREGS72:	8	2
	1.1 Explain principles observed in keeping safe navigational watch.	1	
	1.2 Explain relieving of duties, procedure of taking over watches.	1	
	1.3 Explain effective use and testing of all navigational equipment during watch.	1	
	1.4 List the parameters to be recorded and kept during the watch of the movements and activities relating to the navigation of the ship, Steering the correct course.	1	
	1.5 Determine standard compass error is at least once a watch and, when possible, after any major alteration of course.	0.5	
	1.6 Compare standard and gyro compasses and repeaters frequently, and synchronize with the master compass.	0.5	
	1.7 Describe manual testing of automatic pilot, functioning of navigation and signal lights, radio equipment.	0.5	
	1.8 Describe importance of a lookout, blind pilotage techniques in restricted visibility, navigation with a pilot embarked, VTS procedures, watchkeeping procedures at anchor, usefulness of Ship Reporting Systems, and circumstances in which to call the master.	2.5	
	1.9 Action to be taken on receiving Storm Warning- Read barometer pressure, wind speed & direction, state of sea, gathering information from weather reports.	1	

2	Bridge Procedures Guide and its Contents:	3	1
	2.1 Describe understanding of the principles of safe watchkeeping as detailed in the ICS Bridge Procedures Guide.	3	
3	Watch Keeping at Sea under Different Conditions in Different Area	2	1
	3.1 Explain watch keeping in clear weather, in hours of darkness, in coastal and congested waters and in rough weather.	1	
	3.2 Describe Ice navigation & Ice patrolling as per SOLAS (SAFETY OF NAVIGATION)	1	
4	Tests as per Safety of Life at Sea(SOLAS), as amended	1	
	4.1 Describe preparation for proceeding to sea, making port and entering harbours.	1	

TEXT BOOKS

1. Bridge Equipment, Charts & Publication Nutshell Series Book 5- Capt. H. Subramaniam
2. Modern electronic Navigation Aids-Bhatia & Sinha
3. Nautical watch Keeping- Capt. H. Subramaniam
4. Ship-borne radar ARPA- Capt. H. Subramaniam

RECOMMENDED BOOKS FOR REFERENCE:

1. Bridge Procedure Guide - ICS
2. Bridge Team work - Nautical Institute
3. Watch Keeping Notes – E. Fernandes
4. Electronic Navigation Systems by L. Tetley & D. Calcutt
5. Ship Magnetic Compass- Capt T.K. Joseph & Capt. S S S Rewari

INDIAN MARITIME UNIVERSITY

SEMESTER V

UG21P5507	Ship Operation Technology Lab (Practical)	60 Hrs	Credits-2
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SN	Specific Learning Objectives	Hours
1	Watch Keeping & Marine Communication	15
	1.1 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.	3
	1.2 Morse symbols for the alphabet and numerals, to send and receive Morse code messages by flash lamp up to six words per minute.	3
	1.3 Knowledge of operation of radio equipment to be carried and used in a life boat & life raft (EPIRB, SART etc.),	3
	1.4 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,	3
	1.5 Ability to transmit and receive the distress signal “SOS”, urgency signal and Safety signal.	3
2	SMCP	7
	2.1 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.	7
3	Pilot Embarking and Disembarking	3
	3.1 Explain action and precautions on Navigating Bridge during Pilot Embarkation and Disembarkation.	3
4	Safe Working Practices	10
	4.1 Safe working practices as per Code of safe working practices for Merchant Seaman.	
5	Enclosed Space Entry	5
	5.1 Filling up the checklist prior entering Enclosed Space and use of Gas measuring equipment- Explosimeter, O2Analyser, Multi gas detector, Carbon monoxide detector, rescue of a person from enclosed space.	2
	5.2 Demonstrate entering enclosed spaces with atmospheres suspected to be unsafe for entry- donning SCBA, permit systems and adequate safe working practices. (Group activity).	3
6	Corrosion Prevention & Surface Preparation	10
	6.1 Demonstrate understanding of importance of 'Surface Preparation methods' required prior painting a surface.	2
	6.2 Demonstrate the proper use of following Electric and Pneumatic machines for surface preparation - Needle Guns, Chipping Machines, Angle Grinders.	2
	6.3 Demonstrate the understanding of maintenance routines of above Equipment.	1
	6.4 Demonstrate how 'Wet' and 'Dry' film thickness can be measured after painting a surface.	1
	6.5 Explain the difference in results after painting a surface using a brush, a roller and using a spray machine.	2

	6.6 Demonstrate the use of a 'Paint Spray Machine' to paint a given surface after taking all due precautions.	2
7	Risk Assessment Practical	5
	7.1 Carry out risk assessment for working on mast, funnel painting, ballast tank entry.	3
	7.2 Demonstrate use of gas measuring instruments.	2
8	Moorings	5
	8.1 Demonstrate taking rope stopper and wire stopper	1
	8.2 Demonstrate rigging of slip wire	1
	8.3 Demonstrates reeving the wire on the drum of mooring winch correctly.	1
	8.4 Demonstrate putting number of lines on a single bollard	1
	8.5 Demonstrate connecting mooring wire to tail by Mandal / Tonsberg shackle	1

UG21P5508	Navigation Lab I (Practical)	60 Hrs	Credits-2
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SN	Specific Learning Objectives	Hours
1	General	20
	1.1 Carry out Boxing of Compass.	2
	1.2 Demonstrate use of azimuth mirror in a binnacle/ repeater for taking compass bearings of terrestrial and celestial objects.	3
	1.3 Read the aneroid barometer and calculate atmospheric pressure at sea level, by applying the corrections.	2
	1.4 Calculate the dew point using a hygrometer.	1
	1.5 Demonstration for the use and reading of Barograph	1
	1.6 Uses the Ship's Code and Decode Book to decode a reduced report from a shore station	4
	1.7 Use of International Code of Signals	4
	1.8 Use of Medical First Aid Guide	3
2	COLREGS	20
	2.1 Identification of various collision situations in clear visibility and action to avoid collision, using magnetic board, wooden models or any other aid.	17
	(The answers should include - 'Recognition', 'Responsibility', 'Action', 'Appropriate sound signal and day light signals' and 'Any ordinary practice of seaman' and 'Observance of good seamanship'.)	3
	2.1 Identification of lights and shapes and IALA buoys.	
3	OOW Simulator	20
	3.1 Carries out Look Out Duties – Reporting in Points	2
	3.2 Carries out Helmsman Duties	4
	a. Responses to Orders	
	b. Steers a Straight Line Course	
	c. Alters to new course with Minimum Overshoot	
	2.2 Identifies different Speed Logs and Explain the various controls on them	1
	2.3 Operates an Echo Sounder	1
	2.4 Explains the various controls on Auto Pilot	1
	2.5 Alters vessels course on Auto Pilot	1
	2.6 Changes over between Hand Steering and Auto Pilot and vice versa	1
	2.7 Explains the functions of Off Course Alarm and sets a given value	1
	2.8 Navigates through the Menu of GPS	1
	2.9 Synchronizes Master Gyro with Repeaters	1
	2.10 Operates a Marine Radar in Relative Motion	1
	2.11 Starts a Radar	1
	2.12 Changes over between Head Up, North Up and Course Up	1
	2.13 Correlates Radar Image with Chart	1
	2.14 Uses the EBL and VRM	1
	2.15 Plots vessels position on the Chart	

INDIAN MARITIME UNIVERSITY

SEMESTER V

UG21T5509	Maritime Risk Management	15+5=20 hrs	Credit-1
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Introduction of Risk Assessment	4	1
	1.1 Define Risk assessment, Health and Safety at work place.	1	
	1.2 Describe the obligation of Employer and Employee.	1	
	1.3 Explain the Principles of Risk Assessment	1	
	1.4 Explain Risk Assessment in practice, such as Tool Box Meeting, Take 5, etc.	1	
2	Hazard Identification and Reporting	7	2
	3.1 Give an overview of Ship design and structure for identification of Hazards on board ship.	1	
	3.2 Explain the Hazards which can be removed /Hazards which cannot be removed.	2	
	3.3 Explain Categories of Hazard.	1	
	3.4 Explain Common areas of Hazard.	1	
	3.5 Introduction to Hazard Checklist	1	
	3.6 Explain what should be assessed / who has to carry out the assessment / process of Identifying Hazards.	1	
5	Practice and Exercise on making Risk Assessment	4	2
	5.1 Guidance On Main Elements of Risk Assessment	1	
	5.2 Classify Work Activities- Identify Hazards-Identify Risk Controls- Estimate Risk-Determine the tolerability of the risks-Prepare Risk Control Action Plan to improve risk controls as necessary-Review adequacy of Action Plan-confirm whether the risks are now tolerable-Ensure risk assessment and controls are effective and up-to-date-	2	
	5.3 Risk Assessment exercise.	1	

RECOMMENDED BOOKS FOR REFERENCE:

1. Code of Safe Working Practices.
2. ISM Code.
3. M & MS Notices for Case Studies.

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SEMESTER VI

Semester-VI Courses

SR. NO.	Course Code	Course Name	Lect/Prac Hrs	Tutorial Hrs	Total Hrs	Credits
1	UG21T5601	Voyage Planning & ECDIS	60	20	80	5
2	UG21T5602	Naval Architecture Paper – II	60	20	80	5
3	UG21T5603	Ship Maintenance and Emergencies	60	20	80	5
4	UG21T5604	Ship Manoeuvring & Collision Prevention Regulations	60	20	80	5
5	UG21T5605	IMO & International Conventions	45	15	60	4
6	UG21T5606	Human Resource Development & Shipping Management	60	20	80	5
7	UG21P5607	Navigation Lab II (Practical)	60	-	60	2
8	UG21E5608					
9	UG21E5609					
10	UG21E5610					
11	UG21E5611					
		Total			520	31

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SEMESTER VI

UG21T5601	Voyage Planning & ECDIS BA Chart 5047/5048/2675	60+20=80 Hrs	Credit-5
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SN	Specific Learning Objectives	Lecture	Tutorial
1	Knowledge of Voyage planning and its execution	12	5
	<p>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. (<i>Practical Voyage Planning Exercises</i>)</p> <p><u>Appraisal</u> – 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.</p> <p><u>Planning</u> – 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 Plandocument.</p> <p><u>Execution</u>–Duringthevoyage,fixpositionsasindicatedonthevoyage plan, maintain sufficient bridge manning levels, obtain Navigational and weather warnings, maintain lookout and navigate to keep clear ofother vessels and navigational hazards.</p> <p><u>Monitoring</u> – 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.)</p>		
2	Ship reporting systems:	4	1
	2.1The use of reporting in accordance with general principles for ship reporting systems.	1.5	
	2.2VTS reporting procedures.	0.5	
	2.3INSPIRES/ INDSAR as per M.S. Notice of DGS.	2	

3	Bridge Resource Management:	4	1
	3.1 Knowledge of bridge resource management principles including: allocation, assignment, and Prioritization of resources;	2	
	3.2 Knowledge of bridge resource management principles including: effective communication; assertiveness and leadership;	2	
	3.3 Knowledge of bridge resource management principles including: obtaining and maintaining situational awareness;	2	
	3.4 Bridge resource management's situational awareness wrt followings: Ocean Passages, In coastal waters, Restricted visibility, Pilot embarked; Action on receiving storm warning	2	
4	Weather Routeing:	4	1
	4.1 Weather routing services available to shipping; Shore based weather routeing	1	
	4.2 Information of current, wind and ice to select an optimum route, use of wave charts to select the best route.	2	
	4.3 Basic considerations in Voyage Planning, selection and use of data; Least time track and ship's performance curves.	2	
5	Voyage Planning Exercises:	4	2
	5.1 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.	4	
6	ECDIS	16	6
	6.1 Introduction of ECDIS, Generation and components of ECDIS.	2	
	6.2 Advantages and Disadvantages of ECDIS over paper chart; Limitations of ECDIS.	1	
	6.3 Definitions: ENC, SENC, ECDIS, Standard Display, Base Display, Vector Chart, Raster Chart, ECS, RCDS, Safety Contours, Safety Depth, Shallow and Deep contours, SCAMIN, Overscale, Underscale, Dual Fuel System.	3	
	6.4 Features of ECDIS; Difference between Raster Chart and Vector Chart.	3	
	6.5 IMO Performance standard for ECDIS, Resolution MSC 232(82).	3	
	6.6 Traditional Symbols (NP 5011) & Simplified Symbols (NP 5012), Chart Scale, Information Layers.	2	
	6.7 Chart Quality and Accuracy (CATZOC).	2	
7	GMDSS:	8	2
	7.1 Introduction History	1	
	7.2 Statutory framework (As per SOLAS, ITU)	4	
	Functional requirements, Sea Areas Definitions, Carriage requirements in general, Equipment specs in A1, A2, A3 and A4, Carriage requirement details, means of ensuring availability, Primary and Secondary alerting means, Bridge Alarm Panel		
	7.3 Radio Regulation Theory	12	
	Authority of Master, Secrecy of Correspondence		
	7.4 World Wide Navigational Warning System & India's role as co-coordinator for Navarea 8	2	
8	Documents:	8	2
	8.1 A systematic knowledge and use of the contents of the Sailing Directions;	2	
	8.2 A systematic knowledge and use of the contents of List of light and fog signals, List of radio signals;	2	
	8.3 A systematic knowledge and use of the contents of the, Ocean passage of the world;	1	
	8.4 A systematic knowledge and use of the contents of the Notices to mariners, M & MS Notices;	2	
	8.5 A systematic knowledge and use of the contents of the Guide to port entry.	1	

TEXT BOOKS

- 1 Chart Work: Basic Concepts & Miscellaneous Calculations- Chaudhari S.S

RECOMMENDED BOOKS FOR REFERENCE:

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

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SEMESTER VI

UG21T5602	Naval Architecture Paper –II	60+20=80 Hrs	Credit-5
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Section A – Ship Stability (40 Hrs)			
SN	Specific Learning Objectives	Lecture	Tutorial
1	Dry – Docking	10	2
	1.1 Explain critical period, critical instant, and loss of metacentric height during dry-docking.	3	
	1.2 Explain importance of trim during dry-docking.	1	
	1.3 Calculations based on above	6	
2	Shear Force & Bending Moments:	10	2
	2.1 Explain shearing force & bending moments of a box shaped vessel	2	
	2.2 Calculate & graphically represent SF/BM of a box shaped vessel in even keel condition under various condition of loads.	7	
	2.3 State the hazards on exceeding SF / BM	1	
3	Effect of Increased Beam and Freeboard	2	1
	3.1 Describe the effect of increasing the beam on ship's stability with the help of GZ curve	1	
	3.2 Describe the effect of increasing the freeboard on ship's stability with the help of GZ curve.	1	
4	Stress calculating Instrument (Loadicator):	5	3
	4.1 States that each ship above a specified length is required to carry a loading manual, in which are set out acceptable loading patterns to keep shear forces and bending moments within acceptable limits	0.5	
	4.2 Explain documents for Loading Instrument, Class Certificate, Class approved Loading Manual, Class approved test conditions.	1	
	4.3 Describe the input parameters and output results.	0.5	
	4.4 Describe the testing procedure and importance of maintaining record.	0.5	
	4.5 Explain likelihood of overstressing hull structure when loading certain bulk cargoes	2	
	4.6 Demonstrate calculations of intact stability using stress calculating equipment (Loadicator)		
5	Inclining Experiment	3	2
	5.1 State the objective of inclining experiment	1	
	5.2 Describe the procedure of inclining experiment	1	
	5.3 State precautions to be observed	0.5	
	5.4 Compute light ship KG.	0.5	

Section B – Ship Construction (40 Hrs)			
6	Factor of Subdivision and Criterion Numeral	7	3
	6.1 Define floodable length, permissible length, factor of subdivision, criterion of service numeral.	1	
	6.2 Explain that permissible length affecting hull division on passenger ships.	1	
	6.3 Explain the application of the factor of subdivision to a passenger ship's ability to withstand the flooding of adjacent main compartments	2	
	6.4 Describes the requirements regarding unsymmetrical flooding	1	
	6.5 Describe the use of cross-flooding fittings	1	
	6.6 Describes stability criteria for Passenger ship in damaged condition	1	
7	Ship's Corrosion & Control	8	2
	7.1 Describes corrosion and factors affecting corrosion	2	
	7.2 Explain causes of corrosion in steel and also between dissimilar metals.	1	
	7.3 Explain various types of corrosion experienced by ships.	3	
	7.4 Describe methods of corrosion control in steel work and also between dissimilar metals including Cathodic Protection, Impressed Current System.	2	
8	Class Surveys	14	5
	8.1 Explain the role and functions of Classification Societies	1	
	8.2 State Various classification societies and IACS Members,	1	
	8.3 Describe surveys for assignments & retention of class.	2	
	8.4 Explain Harmonized System of Survey and Certification and its benefits	1	
	8.5 Describe Enhanced Programme of Inspections during Surveys of Bulk Carriers and Oil Tankers	2	
	8.6 Define – overall survey, close-up survey, substantial corrosion, corrosion prevention system	2	
	8.7 Sketch and describe critical structure areas	2	
	8.8 Describes the preparation for enhanced survey.	2	
9	9.1 Introduction to Autonomous and Semi-Autonomous ships	1	

TEXT BOOKS

1. Ship Construction by Capt. Errol Fernandes
2. Ship construction –D.J. Eyres
3. Ship Stability for Masters & / Mates - C.B. Barrass and D.R. Derrett
4. Ship Stability Operational Level- Capt. H. Subramaniam

RECOMMENDED BOOKS FOR REFERENCE:

1. Ship Construction for Engineers - Reid
2. Ship construction –Pursey
3. Taylor- Ship construction
4. Reed's Ship Construction for Marine Students E.A.Stokes

INDIAN MARITIME UNIVERSITY

SEMESTER VI

UG21T5603	Ship Maintenance and Emergencies	60+20=80 Hrs	Credits-5
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SN	Specific Learning Objectives	Lecture	Tutorial
1	General Ship Maintenance	8	2
	1.1 List the equipment / tools used for surface preparation.	0.5	
	1.2 Classify the various Swedish Standards of steel preparation such as St-2, St-3, Sa-2, Sa- 2.5, Sa- 3	0.25	
	1.3 Understand the corrosion reaction i.e. principle of Galvanic cell	0.25	
	1.4 Understand the purpose of Sacrificial Anode & Impressed Current System.	0.5	
	1.5 Introduction of Laser application for removing rust on steel surfaces.	0.25	
	1.6 Describe the required standard of preparation of steelwork depending upon the type of paint to be applied.	0.5	
	1.7 State that paints consist mainly of a Binder, a pigment and a solvent, and explains the purpose of each.	1.0	
	1.8 Understand the concept of MSDS for particular paint system.	0.25	
	1.9 Describe the action of Anodic Primers and Resistance type primers	1.0	
	1.10 List the common types of paints and their area of application along with their advantages and disadvantages for Alkyd paints, CRP paints, Vinyl paints, Bituminous paints, Epoxy paints, Polyurethane paints	1.5	
	1.11 Describe the action of Antifouling Paint and use of Self Polishing Antifouling Paint	0.25	
	1.12 Explain typical paint schemes for dry dock, underwater areas, boot topping, weather decks, superstructures & tank interiors	0.5	
	1.13 Describe the various Painting Defects, their Causes and Prevention	0.5	
	1.14 State the methods of measuring wet paint thickness and dry paint thickness	0.5	
	1.15 Describe procedures for cleaning and polishing of brass and copper.	0.25	
2	Inspection & Maintenance of Ship and Equipment	7	3
	2.1 Explain the procedure how to inspect the items in the Tanks/Holds, including Tank Tops, Deck Heads, bulk heads, pipe lines, valves, sounding pipes, longitudinal, web frames / girders, bilge Striker plate, bell mouths, drain holes, ladders where applicable.	2	
	2.2 Explain that spaces are prepared for survey and inspection by cleaning, descaling, demucking, desludging, etc.	1.5	
	2.3 Describe the maintenance of mooring winches/windlass and Inspection of chain lockers, anchor cables and anchors.	1.5	
	2.4 Describe maintenance of crane, lifeboat davits as per PMS.	1	
	2.5 List the different types of Lubricants.	0.5	
	2.6 Explain the purpose & method of Lubrication.	0.25	
	2.7 State the dangers of excess lubrication	0.25	
3	Planned Maintenance System	9	3
	3.1 State that Routine Maintenance is to be carried out as per PMS.	1	
		2	

	3.2 List out the advantages of planned maintenance over breakdown maintenance.	2	
	3.3 Examples of maintenance as per PMS: - Hatches / Cranes / Gangway.	1	
	3.4 State that hatch cover wheels, gears, racks and pinions and other moving parts, side cleats should be kept lubricated.	1	
	3.5 Explain that hydraulic systems for cargo holds should be checked for leakage, especially in tween decks where it may cause cargo damage. Explain that the weather tightness of hatch covers is checked by hose testing, Ultrasonic testing.	1	
	3.6 Describe Maintenance of Gantry cranes/Deck crane/ - wires, sheaves & blocks.	1	
	3.7 Describe maintenance of Gangway & Accommodation ladders.		
4	Contingency Plans for Response to Emergencies	15	5
	4.1 State the purpose of emergency drills.	0.5	
	4.2 List the contents of muster list. State the purpose of division of crew into different teams.	0.5	
	4.3 Understand the role of ship's crew during various emergencies as per Muster list.	1	
	4.4 Identify different element of Muster list in regard to emergencies relating to Oil Spill, Rescue from Enclosed space & Piracy	2	
	4.5 Describe various emergencies and actions to be taken as per contingency plans in following emergencies - Grounding & Beaching, Collision, Fire on board (Accommodation/ Engine Room/ Cargo), Steering failure including use of emergency steering, Parting of moorings at Berth, Cargo shifting, Piracy Attack on the vessel, Rescue from Enclosed spaces, Spills of dangerous goods, M/E failure in Coastal Waters.	5	
	4.6 Precautions for the protection and safety of passengers in emergency situations; warning the passengers, evacuating all passengers, taking a roll call, instructing passengers for donning lifejackets. Distribution of blankets to passengers.	2	
	4.7 Explain contents of Fire control plans and importance of fire drills.	1	
	4.8 Describe the immediate response on hearing an Emergency Alarm.	0.5	
	4.9 Describe the arrangement for towing and being taken in tow. Explain towing equipment and tools on board ship, describe methods of towing disabled ship and communication between two ships.	1	
	4.10 Describe the procedure for abandoning ship.	1	
	4.11 List the precautions required to be observed prior entering battery room and paint room.	0.25	
	4.12 Explain the importance of clear and concise communication.	0.25	
5	Dry Docking Operations	7	3
	5.1 List out the preparation to be carried out on board prior to dry docking of the vessel	1	
		0.5	
	5.2 List the various ships plans used during dry dock.	1.5	
	5.3 Explain the precautions to be taken before entering the dry dock	1.5	
	5.4 List out the items to examine in the dry dock such as shell plating, cargo holds, tanks, sea chest / overboard/sea suction valves, echo sounder and Doppler fittings, stern frame, rudder, propeller, anodes, anchors and chain cables, etc.		
		1	
	5.5 Describe the examinations to be made of the above listed items	1	
	5.6 Describe the cleaning, preparation and painting of the hull in the dry dock.	0.5	
	5.7 State the checks to be made prior to flooding of dry dock.		

6	Maintenance of Crew Accommodation	4	1
	6.1 State that Ship Sanitation Certificate/Exemption Certificate requirements.	1	
	6.2 Explain the need of Good housekeeping/hygiene on board.	1	
	6.3 Describe the methods of controlling insect infestation.	1	
	6.4 State the safety precautions to be observed during and after Fumigation.	1	
7	Preparation for Various Surveys of Ships	5	2
	7.1 Understand the basic knowledge of various surveys conducted on board.	0.5	
	7.2 Preparation for SEQ Survey - LSA/FFA items - weekly, monthly, quarterly, six monthly and yearly tests and maintenance to be carried out on - S.C.B.A. Sets (Fireman outfit), Emergency Fire pumps, Fire Hoses & Hydrants, Fire Flaps, Fire Detection Equip.(Sensors), Portable fire Extinguishers, Fixed Foam system & Remote Control Monitors, Emergency Generator, Fixed CO2 Systems, Life buoys, Life Boats, Life rafts, Navigation	2	
	7.3 Preparation for Load Line Survey – Load line Items such as - Ventilators including Fire Dampers, weather tight & Water tight Doors, hatch covers, Air pipes, freeing ports, bulwarks, scuppers, Load lines & Draft Marks.	1	
	7.4 Preparation for SRT Survey – GMDSS Equipment.	1	
	7.5 Preparation for IOPP Survey & Safety Construction Survey.	0.5	
8	Respond to Distress Signal at Sea	5	1
	8.2 Describe the actions to be taken on receipt of a distress message / sighting a distress signal and consequent response.	0.5	
	8.3 Describe the procedures for carrying out SAR – various search patterns & signals to be made by ships & aircraft.	1.25	
	8.4 Describe the precautions to be taken while manoeuvring the ship prior to the launching of lifeboat or rescue boats.	0.5	
	8.5 Describe the methods of picking up the survivors from sea using lifeboats and life rafts.	0.5	
	8.6 Describe procedures and precautions during Helicopter Operations.	0.5	
	8.7 Understand the contents and application of IAMSAR Volume III.	0.5	
	8.8 Understand the use of man overboard function in GPS for homing into the man in the water.	0.25	
	8.9 Explain the actions to be taken in case of a man overboard including the initial manoeuvring and immediate actions.	0.5	
	8.10 Describe various types of turns used for rescuing Man Overboard (Williamson Turn, Scharnov Turn, Single Turn/Anderson Turn).	0.5	

TEXT BOOKS

1. Ship Board Operations by H.I. Lavery

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

INDIAN MARITIME UNIVERSITY

SEMESTER VI

UG21T5604	Ship Manoeuvring & Collision Prevention Regulations	60+20=80 Hrs	Credits-5
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SN	Specific Learning Objectives	Lecture	Tutorial
1	Types of Anchors and Anchor Work:	4	2
	1.1 Describe parts of anchor used on ships.	0.5	
	1.2 Explain the terms <ul style="list-style-type: none"> ● 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 	1	
	1.3 Explain securing anchor for sea, covering spurling pipe.	0.5	
	1.4 State the markings on anchor cable, use of bow stopper,	0.5	
	1.5 Explain standing moor, running moor.	0.5	
	1.6 Explain Windlass, cable, link, swivel, joining shackle, shackle as a term of length, bitter end,.	1	
2	Anchoring:	4	2
	2.1 Explain the Procedures for anchoring in deep water and in shallow water.	1	
	2.2 Explain the Load on anchor due to wind, current, waves, Yawing, factors involved in determining the length of cable to be used.	1	
	2.3 Explain anchor holding power, Dragging anchor, clearing fouled anchor, hanging off anchor,slipping cable.	1	
	2.4 State the use of correct terminology for communication between bridge and anchor station crew.	0.5	
	2.5 Use of anchor buoys and Causes for loss of anchor.	0.5	
3	Ship Manoeuvring:	12	4
	3.1 Explain the effects of various deadweights, draughts, trim, speed and under-keel clearance on turning circles and stopping distances.	3	
	3.2 Explain Manoeuvring Data of Ship: Advance, transfer, drift angle, tactical diameter, trackreach, head reach, side reach, turning circles of a ship in loaded and ballast condition, and at different speeds.	2	

	3.3 Define directional stability.	0.5	
	3.4 Application of constant radial turn techniques, determining wheel over position, determining radius.	1	
	3.5 Explain the Effect of wind and current on ship handling: Effect of wind and current on a given ship while moving and when making large turns.	1	
	3.6 Explain the 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.	1.5	
	3.7 Explain Shallow-water effects, squat and bank effects.	1	
	3.8 State the reduction in under keel clearance due to rolling and pitching.	0.5	
	3.9 Explain Interaction between passing ships and between own ship and nearby banks (canal effect).	1	
	3.10 Explain the Effectiveness of Bow thrusters and stern thrusters.	0.5	
4	Mooring	8	2
	4.1 Explain Safe practices during mooring operation. snap back zone.	0.5	
	4.2 Describe the Mooring plan of a ship, optimum mooring pattern and rope leads.	1.0	
	4.3 State the load on mooring lines due to wind, current, waves, surging at berth.	0.5	
	4.4 State OCIMF recommendations on mooring equipment.	0.5	
	4.5 Explain Joining of two mooring ropes, slip wire, Synthetic fibre tails.	0.5	
	4.6 State the dangers of mixed mooring systems.	0.5	
	4.7 Explain the making fast of tugs, using fenders during berthing/unberthing.	1	
	4.8 Explain Heaving load, render load, stalling load, Correct layers of lines on split drums, correct reeling of lines on drum of mooring winch. Self-tensioning winches.	1	
	4.9 Explain the Mooring Winch Brake testing	1	
	4.10 Explain the Danger of belaying rope on a single bollard.	0.5	
	4.11 Explain SPM and CBM Mooring.	1	
5	COLREGS	16	6
	5.1 Application of International Regulations for Preventing Collisions at Sea (IRPCS) 1972, as amended including- <ul style="list-style-type: none"> ● Overview of the Annexures to Colregs. ● Describe the positioning, spacing and screening of lights. 	12	
	5.2 Case study on collision.	4	
6	Navigation in restricted visibility	4	1
	6.1 Explain Navigational Equipment and Techniques used for safe navigation in restricted	2	

	visibility (blind navigation / blind pilotage techniques).	2	
	6.2 Describe the Procedures for embarkation and disembarkation of pilot.		
7	Ice Navigation	4	1
	7.1 List the contents of Polar Code.	1	
	7.2 Explain the Basic ship handling in ice	1	
	7.3 Explain sighting and reporting of ice, working through ice, navigation in ice.	1	
	7.4 Explain the effects of ice accretion on stability of the vessel.	1	
8	Contingencies	4	1
	8.1 Explain the actions to be taken as per Contingency Plans in the following emergencies- <ul style="list-style-type: none"> ● Grounding, ● Beaching, ● Collision, ● Steering failure, ● Parting of moorings at berth, ● Spills of dangerous goods 	4	
9	Piracy	4	1
	9.1 Explain the Best Management Practices for protection against Piracy	4	

TEXT BOOKS

1. IMO Rules of the Road-Bhandarkar Publications
2. Theory and Practice of Seamanship - Danton G

RECOMMENDED BOOKS FOR REFERENCE:

1. Life Boat and Life Raft - Capt. Puri S.K.
2. Survival at sea - C.H. Wright
3. Seamanship Notes - Kemp & Young
4. Seamanship & Nautical Knowledge- Nicholls
5. OCIMF / SIGTO/INTERTANCO
6. Seamanship Technique– D.J House
7. BMP 5
8. Polar code
9. Mariner’s Guide to preventing collision- Capt. Yashwant Chhabra

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SEMESTER VI

UG21T5605	IMO & International Conventions	45+15=60 Hrs	Credits-4
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SN	Specific Learning Objectives	Lectures	Tutorials
1	International Organisations & IMO:	6	2
	1.1 State that maritime law is based partly on generally accepted customary rules developed over many years and partly on statute law enacted by States.	0.5	
	1.2 State that matters of safety, protection of the marine environment and conditions of employment are covered by statute law.	0.5	
	1.3 State that the main sources of maritime law are international conventions.	0.5	
	1.4 State that the adoption of international conventions and agreements is intended to provide uniform practice internationally.	0.5	
	1.5 State that a convention is a treaty between the States which have agreed to be bound by it to apply the principles contained in the convention within their sphere of jurisdiction.	0.5	
	1.6 State that, to implement a convention or other international agreement, a State must enact national legislation giving effect to and enforcing its provisions.	0.25	
	1.7 State that recommendations which are not internationally binding may be implemented by a State for ships flying its flag		
	1.8 Explain that the main originators of international conventions concerned with maritime law are:	0.25	
	a) International Maritime Organization (IMO)	1	
	b) International Labour Organization (ILO)		
	c) Comite Maritime International (CMI)		
	d) United Nations		
	1.9 Describe:		
	a) flag State jurisdiction	0.5	
	b) coastal State jurisdiction		
	c) port State jurisdiction		
	1.10 Describe main elements of SOLAS, MARPOL and STCW.		
	– Explain the significance of the ‘no more favourable treatment’ clause in the SOLAS, MARPOL, STCW and ILO Minimum Standards in Merchant Ships Conventions	1.5	
	– Distinguish between private and public international law		
	– Explain that public maritime law is enforced through:		
	– surveys, inspection and certification		
	– penal sanctions (fines, imprisonment)		
	– administrative procedures (inspection of certificates and records, detention)		
	– State that the operation of a ship is governed by the national laws and regulations of the flag State, including those laws and regulations giving effect to international conventions		
	– State that differences of detail usually exist in the national laws of different states implementing the same convention		

	<p>– State that, when serving in a ship flying a foreign flag, it is essential that the master and chief mate familiarize themselves with the laws and regulations of the flag State</p> <p>– State that, when in port, a ship must also comply with the appropriate laws and regulations of the port State</p> <p>– Describe the importance of keeping up to date with developments in new and amended legislation.</p> <p>- Organizations with maritime functions; UNO, WHO, ITF, UNCITRAL, UNCTAD, WTO (Outline of work relevant to maritime sector)</p> <p>- IMO Instruments: Conventions, Protocols, Codes, Recommendations, and Guidelines. (purpose and examples of each)</p> <p>-IMO Conventions: List of IMO conventions. Development, adoption, conditions for coming into force, implementation, enforcement and amendments of conventions.</p>		
2	Indian Merchant Shipping Act, 1958:	9	3
	<p>2.1 Definitions.</p> <p>2.2 Registration of Indian ships; Section 20 to 74</p> <p>2.3 Seamen and Apprentices. Section 88 to 218</p> <p>2.4 Investigation and inquiries. Section 357 to 389</p>	9	
3	International Law of the Sea:	9	3
	<p>3.1 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.</p> <p>3.2 Responsibilities of coastal states,</p> <p>3.3 Settlement of Disputes; Law of the Sea Tribunal.</p> <p>3.4 UNCLOS definition of marine pollution and duties of states towards environmental protection.</p> <p>3.5 UNCLOS definition of piracy. IMO’s definition of “armed robbery” Duties of states to suppress piracy.</p>	<p>2</p> <p>2</p> <p>1.5</p> <p>1.5</p> <p>2</p>	
4	Maritime Labour Convention and Maritime Safety:	11	4
	<p>4.1 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW)</p> <ul style="list-style-type: none"> • Explain the general obligations under the Convention • Define, for the purpose of the Convention: • Certificate of Competency • Certificate of Proficiency • seagoing ship • Describe the issue of certificates and their endorsement by the issuing Administration. • Describe the control which may be exercised by a duly authorized control officer • Explain that the regulations contain: • Mandatory minimum requirements for the certificate of Competency and certificate of Proficiency. <p>4.2 International Convention for the Safety of Life at Sea, 1974 as amended (Brief contents of all chapters) (SOLAS)</p> <p>4.3 International Convention on Load Lines, 1966 (LL 1966), as amended</p>	<p>2</p> <p>1.5</p> <p>1.5</p>	

	<ul style="list-style-type: none"> • State that no ship to which the Convention applies may proceed to sea on an international voyage unless it has been surveyed, marked and provided with an International Load Line Certificate (1966) or an International Load Line Exemption Certificate, if appropriate • Explain to which ships the Convention applies • Describe the duration of validity of an International Load Line Certificate (1966) • Explain the circumstances in which an International Load Line Certificate (1966) would be cancelled by the Administration • State the control to which ships holding an International Load Line Certificate (1966) are subject when in the ports of other Contracting Governments • state that the International Load Line Certificate (1966) will not be delivered to a ship until the surveyor has certified that the marks are correctly and permanently indicated on the ship's sides <p>4.4 International Safety Management (ISM) Code</p> <ul style="list-style-type: none"> • Objectives and Functions of the code. • Outline of the contents of all chapters. • State that a Safety Management System in compliance with the ISM Code must be in place on board all passenger ships, tankers and bulk carriers of 500gt and upwards. • State that a Safety Management System in compliance with the ISM Code must be in place onboard all vessels of 500gt and upwards from 1 July 2002 • State that the details of the ship's system may be found in the ship's Safety Management Manual <p>4.5 Certification, audits. Impact and practice of Risk management.</p> <p>4.6 ILO's Convention – MLC 2006 –</p> <ul style="list-style-type: none"> • Engagement, Discharge, Welfare of Seamen and Repatriation; Discipline; Abandonment of Seafarers. • -Ship Owner Responsibility for Injury and Death Claims; Ship Safety; <p>4.7 Port State Control (authority, inspections, detentions, common deficiencies, MOUs and their benefits)</p>	3	
5	Other Conventions and Codes:	10	3
	5.1 International Ship and Port Facility Security Code (ISPS Code) -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.	4	
	5.2 Purpose of LLMC, CLC 1992, FUND 1992, Supplementary Fund and Bunker Conventions.	2	
	5.3 Purpose of International Convention on salvage 1982.	1.5	
	5.4 Nairobi convention on removal of wrecks (purpose and responsibility for wreck removal.	1	
	5.5 Code of Casualty Investigation (IMO): Brief outline of contents	1.5	

TEXT BOOKS

1. Merchant Shipping Act-1958

RECOMMENDED BOOKS FOR REFERENCE:

1. SOLAS 1974 as amended
2. MARPOL as amended
3. ISM Code
4. ISPS Code
5. MLC 200
6. STCW as amended
7. UNCLOS
8. Maritime Legislation and Shipboard Management for deck officers by Capt. M.V. Naik& Capt. C.L. Dubey
9. Website for reference: www.imo.org

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SEMESTER VI

UG21T5606	Human Resource Development & Shipping Management	60+20=80	Credits-5
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SN	Specific Learning Objectives	Lectures	Tutorials
1	Basic Structure and organization of Shipping.	10	4
	1.1 State the types of Shipping Services - Liner and Tramp	1	
	1.2 State the types of ships and cargoes in Liner and Tramp shipping.	1	
	1.3 State the Freight brokers, Clearing and Forwarding Agents, Bunker and Stores suppliers, shipping Agencies.	1	
	1.4 Explain the Role of Shipping Companies.	1	
	1.5 List the types of Shipping Companies.	1	
	1.6 State the various departments in shipping company's office and their functions.	1	
	1.7 Describe Role of superintendents and Designated Person Ashore.	1	
	1.8 Sketch Company's Organizational Chart.	1	
	1.9 Describe Shipboard organizational structure.	0.5	
	1.10 Describe functions and responsibilities of shipboard staff.	1	
	1.11 List cadet's duties on board.	0.5	
2	Ship Chartering:	9	4
	2.1 Explain the meaning of charter types of charters and their relevance to trade	2	
	2.2 State the charter markets of the world	2	
	2.3 Explain the common charter parties.	2	
	2.4 Explain the terms- Laydays, Laycan, Laytime, Demmorage, Despatch, Freight, NOR, Safe port, Safe berth.	3	
3	Contract of Affreightment:	7	1
	3.1 List the Responsibilities, obligations, immunities and liabilities of carrier and shipper and the limitations of liabilities as per the a. Carriage of Goods by Sea Act, 1925. b. The Indian Multimodal Transport of Goods Act, 1993. c. Hague Visby rules; Hamburg rules, Rotterdam Rules.	4	
4	Human Resource Management: General	12	3
	4.1 State the Function, Requirement & Selection of Personnel.	0.5	
	4.2 Explain the Performance Appraisal and Reward System.	0.5	
	4.3 State the Working Conditions as per MLC.	0.5	
	4.4 State the Employer's Liabilities for Health and Safety.	0.5	
	4.5 State the relation with Trade Union & Workers Participation in Management.	0.5	
	4.6 Explain Cross cultural, multi-racial and multi-lingual environment.	1	
	Human values		
	4.7 State the Indian insight on managing self, human relationships, managing stress, decision making and resolving ethical dilemma; enhancing life satisfaction.	1	
	4.8 State personal traits that will assist in effective functioning onboard, physical fitness, health and personal hygiene, travel arrangements.	1	
	4.9 List human factors and their importance.	1	

	4.10 Explain the Importance of Interpersonal relationship. 4.11 State that Building positive attitude and behavior by developing a professional and organizational culture. 4.12 Explain mental gymnastics & creative problem solving techniques 4.13 Manage anger/violence prevention/aggression control & conflict 4.14 Manage stress, distress situations, accidents proneness, depression / fear / fatigue / revenge v/s forgiveness 4.15 Cope with anxiety of being away from home, use of drugs & alcohol and sexual health	1 1 1 1 1 0.5	
5	Personnel Management: Shipping	8	3
	MS Act 1958 5.1 Section 95 (registration of recruitment and placement agencies) 5.2 Part VII (Employment of seafarers on Indian flag vessel) Recruitment and placement rules 2005 5.3 Explain & define significance of the RPS, Rules, 2005 5.4 State the purpose of the rule, benefit to seafarers under the rule, responsibilities of employer, rights and responsibilities of the seafarer. 5.5 Access information regarding registered recruitment and placement agencies. Article of Agreement (Indian Ships) 5.6 State general content of agreement 5.7 State Responsibilities of employer & seafarer Collective Bargaining Agreement (foreign flagship) 5.8 State general content of agreement 5.9 State the needs of foreign shipping companies to comply with RPSL rules 5.10 State the responsibilities of foreign employer & seafarer 5.11 Explain the Nature of the job at sea, demands of the career – technical, practical, physical, emotional and psychological. 5.12 State onboard human relations role of human error in accidents.	1 2 0.5 1 0.5 0.5 0.5 0.5 0.25 0.25 0.5 0.5	
6	Communication and Negotiation:	4	1
	6.1 State the importance of communication; interpersonal communication. 6.2 State the barriers to effective interpersonal communication, communication in organizations. 6.3 State how to use communication skills for negotiating and managing conflicts. 6.4 Explain importance of effective communication, time management & planning.	1 1 1 1	
7	Leadership, Teamwork, Motivation and Positive Attitude	10	4
	7.1 State the Importance of teamwork, team spirit. 7.2 State the Necessity of positive attitudes, work ethics, allocation, assignment, and prioritization of resources. 7.3 Explain assertiveness and motivation and decision making. 7.4 Explain Motivational Theory i) McGregor's Theory X and Theory Y (ii). Maslow's Hierarchy of Needs Theory (iii). Herzberg's Motivation-Hygiene Theory.	1 1 1 1	

7.5 Explain Trait's approaches to leadership, Fiedler's contingency approach to leadership	1	
7.8 Explain the Managerial Grid	1	
7.9 State knowledge, skills, attitude	1	
7.10 Explain Age, Fatigue, Control of human errors, Situational awareness.	2	
7.11 State the Need for familiarisation with work environment and procedures.	1	

TEXT BOOKS:

1. Future of Human Resource Management – Raman Preet

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 DongWook 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
8. Institute of Chartered Ship Brokers.
9. Strategic Leadership Models & Theories – Som Sekhar Bhattacharya
10. Principles of Management by Openstax.
11. Human Resource Management by Gary Dessler and Biju Varkkey
12. Human Resource Development by David McGuire
13. Human Resource Development - Experiences, Interventions, Strategies by T V Rao.

INDIAN MARITIME UNIVERSITY

SEMESTER VI

UG21P5607	Navigation Lab II (Practical)	60 Hrs	Credits-2
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SN	Specific Learning Objectives	Hours
1	General	5
	1.1 Identify certain major stellar constellations and navigational stars using star finder.	2
	1.2 Demonstrate taking altitude of celestial bodies using sextant	2
	1.3 Calculate Gyro Error using the Sun	1
2	COLREGS	5
	2.1 Identify various collision situations in restricted visibility and take action to avoid collision.	3
	2.2 Execute Radar Plotting on the sheet to obtain desired CPA	2
3	OOW SIMULATOR	15
	3.1 Demonstrate the ability to manoeuvre the vessel using a constant Radius Turn	2
	3.2 Operate an ARPA –	8
	<ul style="list-style-type: none"> ○ Acquire Targets on ARPA ○ Interpret ARPA information such as Range and bearing, course and speed of other ships, time and distance of closest approach ○ Identify and Select True and relative vectors and sets the Vector lengths ○ Identify and Select Trails – Long / Short ○ Recognize on Radar - RACONs and SARTs ○ Draw parallel Indexes ○ Carry out Trial Manoeuvres and interprets the information 	
	3.3 Operate Radar in True Motion	1
	3.4 Deal with simulated collision situations between own- ship and target vessel in Clear Visibility.	2
	3.5 Deals with simulated collision situation between own ship and target vessel in Restricted Visibility	2
4	ECDIS Practical	20
	4.1 Demonstrates the uses of	20
	<ul style="list-style-type: none"> ● All specific functions including <ul style="list-style-type: none"> ○ North Up / Course Up Orientation ○ Change of Scale ○ Overlays ○ Layers ○ Traditional / Simplified Symbols ○ Safety / Shallow / Deep Contours ○ Safety Depths ○ CATZOC 	
	4.2 Prepare a passage plan on ECDIS from Port “A” to Port “B”	
	<ul style="list-style-type: none"> ● Sea area selection ● Route planning information 	

	<ul style="list-style-type: none"> ● Construction of a route -Draw Courses Graphically and Alphanumerically, Indicate Courses and Distances ● Set Track Limits, Set appropriate Alarms ● Curve track planning ● Create Maps, Prepare Schedule, Obtain Tidal Information, ● Carry out Route Check, Modify Route ● Planning notes ● Safety values ● Check for navigational safety of monitored area ● Vector time <p>4.3 Monitor the vessel's progress on the above plan</p> <p>4.4 Updating of ENC – Maintaining charts up to date including the use of AIO.</p>	
5	GMDSS Practical	5
	5.1 Transmits a distress message by VHF DSC.	1
	5.2 Transmits a distress message by MF DSC.	1
	5.3 Transmits a distress message by HF DSC.	1
	5.4 Transmits a distress message using Sat C.	2