AMET UNIVERSITY

DEPARTMENT OF NAUTICAL SCIENCE

(2023-2026)

OUTCOME BASED EDUCATION SYSTEM

Syllabus Revised as per the latest IMO model course 7.03 officer in charge of a Navigational watch 2014.with reference to the basic principles to be observed in keeping a navigational watch as per STCW regulation VIII/2 and STCW code

AMET DEEMED TO BE UNIVERSITY

VISION AND MISSION OF THE UNIVERSITY

Vision

To sustain identity as a World Class Leader in Maritime Education and empower learners with wholesome knowledge through progressive innovation in training, research and development which will render students a unique learning experience and a transformation impact on the Global Society.

Mission

AMET Will Strive Continuously To:

- Impart value-based higher education and technical knowledge with uncompromising strides of an outstanding quality.
- Be a Centre of Excellence in skill development in emerging technologies in accordance with industrial trends.
- Create World class research capabilities on par with the finest in the world and broaden student's horizons beyond classroom education.
- Nurture talent and entrepreneurship and enable all round personality development in students.
- Empower students from across socio economic strata.
- Make a positive difference to society through technical education.

VISION AND MISSION OF NAUTICAL SCIENCE DEPARTMENT

Vision

To keep the curriculum updated with the latest international and national requirements as well as meet the requirements of standards for training certification and watch keeping (STCW) convention as amended.

Mission

- To be a source of best practices that will deliver uncompromising technical competency and professional excellence.
- To embrace emerging technologies in a seamless manner and integrate it progressively to our curriculum.
- To develop and sustain our research capabilities par excellence in order to create ideas that can propagate the required knowledge understanding and proficiency to meet the expectation of future shipping.
- To reach out and train beyond conventional domain that will instill confidence and nurture entrepreneurship.
- To empower the students to accept and adapt to the constant demands of progressively changing socio cultural economic and environmental aspects that will influence their growth and development.
- To enable the students with the academic and ethical rigor that will make them to be a source of positive energy creativity and an icon of ethical practices.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs) AND PROGRAM OUTCOMES (POs)

PROGRAM EDUCATIONAL OBJECTIVES(PEO'S)

The Program Educational Objective of the Bachelor of Nautical Science is to facilitate the students to:

PEO	Description
PEO 1	Become successful navigating officer as a 'Seafarer' who is able to be competent, innovative and productive in addressing the needs of the Shipping Industry such as: Maritime Education and Research, Maritime Law, Port Agency and Harbor Pilot.
PEO 2	Grow professionally with the knowledge and proficiency skills throughout the career.
PEO 3	Acquire high standard of ethical conduct, safety culture, positive attitude, societal responsibilities

PROGRAM OUTCOMES (POS)

PO	Description
PO1	Apply knowledge of Maritime courses and analyse a problem, identify, formulate and solve nautical problems using basic fundamental principles of mathematics and science.
PO2	Communicate effectively with shipping community for presentation, documentation of reports adopting the new design standards.
PO3	Assess the local and global impact of maritime situations on individuals, organization and society and the consequent responsibilities relevant to their professional nautical practice.
PO4	Comprehend safety, security and management principles and apply these to one's own work, as a member and leader in a team, to efficiently carry out shipboard operation
PO5	Apply the professional and ethical responsibilities and norms of shipping practice.
PO6	Relate the impact of the maritime situations in various environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PO7	Use and learn the limitations involved in recent techniques, skills and modern nautical equipment necessary for shipping industry and to be engaged in lifelong learning to meet these contemporary issues.

PROGRAM SPECIFIC OUTCOMES NAUTICAL SCIENCE

PSOs	Description
PSO1	Attain proficiency in all aspects of ship board operations and excel in problem solving by operating as a team to find solutions of various issues in that may arise onboard the ship.
PSO2	Operate effectively in a professional environment by providing knowledge and skill in ship handling, voyage planning, navigation, cargo operation, collision avoidance, maintenance, safe working practices on a stable ship by applying available modern tools and techniques.
PSO3	Achieve excellence in outstanding leadership in the nautical field and develop a passion for lifelong learning and research in advance fields.

MAPPING OF PEO'S WITH PO'S AND PSO'S

MAPPING	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
PEO 1: Become successful navigating officer as a 'Seafarer' who is able to be competent, innovative and productive in addressing the needs of the Shipping Industry such as: Maritime Education and Research, Maritime Law, Port Agency and Harbour Pilot.	√	√	√	√	√	√	√	√	√	√
PEO 2: Grow professionally with the knowledge and proficiency skills throughout the career.	√	√	√	√		√	√	√	√	√
PEO 3: Demonstrate high standard of ethical conduct, safety culture, positive attitude, societal responsibilities.		√	√	√	√			√	√	√

CURRICULUM for B.SC NAUTICAL SCIENCE

(ACADEMIC YEAR 2023-2026)

SEMESTER: I

S. No	COURSE CODE	COURSE CATEGORY	COURSE TITLE	Contact Hours	L	T	P	C
THEORY								
1	236EN1A12TA	HS	Communicative English –I	2	2	0	0	2
2	236MA1A11TA	BS	Nautical Mathematics – I	3	2	1	0	3
3	236PH1A11TA	BS	Nautical Physics & Electronics- I	3	2	1	0	3
4	231NS1A14TA	PC	Ship Construction -1	2	2	0	0	2
5	231NS1A14TB	PC	Ship Operation Technology – I	2	2	0	0	2
6	231NS1A14TC	PC	Cargo Handling and Stowage – I	3	2	1	0	3
PRACTICAL								
7	231NS1A14PD	PC	Rule of the Road- I	2	0	0	2	1
8	234CS1A13PA	ES	Foundation of Information Technology – Laboratory	4	0	0	4	2
9	231NS1A14PE	PC	Ship Operation Technology Laboratory – I	2	0	0	2	1
10	236PH1A11PA	BS	Nautical Physics & Electronics Lab – I	2	0	0	2	1
11	236EN1A12TC	EEC	Personality development program-I	2	0	0	2	1
Total				**27**	**12**	**3**	**12**	**21**

Note: L- Lecture T- Tutorial P – Practical C- Credit

Course Category:
HSS-Humanities and social sciences
MC-Management Courses
PC-Professional Courses
PE-Professional Elective
BS-Basic Science
ES-Engineering Science
OE-Open Elective
M-Mandatory

CURRICULUM for B.SC NAUTICAL SCIENCE

(ACADEMIC YEAR 2023-2026)

SEMESTER: II

S. No	COURSE CODE	COURSE CATEGORY	COURSE TITLE	Contact Hours	L	T	P	C
THEORY								
1	236EN1A22TB	HS	Communicative English – II	2	2	0	0	2
2	236MA1A21TB	BS	Nautical Mathematics – II	3	2	1	0	3
3	236PH1A21TG	BS	Nautical Physics & Electronics – II	3	2	1	0	3
4	231NS1A24TA	PC	Navigation – I	3	2	1	0	3
5	231NS1A24TB	PC	Bridge Equipment & Bridge Resource Management-I	2	2	0	0	2
6	231NS1A24TC	PC	Ship Construction – II	2	2	0	0	2
PRACTICAL								
7	231NS1A24PD	PC	Rule of the Road- II	2	0	0	2	1
8	231NS1A24PE	PC	Ship Operation Technology Laboratory – II	2	0	0	2	1
9	236PH1A21PG	BS	Nautical Physics & Electronics Lab – II	2	0	0	2	1
Total				**21**	**12**	**3**	**6**	**18**

CURRICULUM for B.SC NAUTICAL SCIENCE

(ACADEMIC YEAR 2023-2026)

SEMESTER: III

S. No	COURSE CODE	COURSE CATEGORY	COURSE TITLE	Contact Hours	L	T	P	C
THEORY								
1	231NS1A34TA	PC	Navigation – II	3	2	1	0	3
2	231NS1A34TB	PC	Bridge Equipment & Bridge Resource Management-II	2	2	0	0	2
3	231NS1A34TC	PC	Ship Stability – I	3	2	1	0	3
4	231NS1A34TD	PC	Ship Operation Technology – II	2	2	0	0	2
5	231NS1A34TE	PC	Cargo Handling and Stowage – II	3	2	1	0	3
6	231NS1A34TF	PC	Maritime law-I	2	2	0	0	2
7		ES	Marine Engr. Automation Control System-I	2	2	0	0	2
PRACTICAL								
8	231NS1A34PG	PC	Rules of the Road-III	2	0	0	2	1
9	231NS1A34PH	PC	Ship Operation Technology Laboratory-III	2	0	0	2	1
10		ES	Marine Workshop Practice – I	2	0	0	2	1
11		EEC	Interpersonal Communication	2	0	0	2	1
Total				**25**	**14**	**3**	**8**	**21**

CURRICULUM for B.SC NAUTICAL SCIENCE

(ACADEMIC YEAR 2023-2026)

SEMESTER: IV

S. No	COURSE CODE	COURSE CATEGORY	COURSE TITLE	Contact Hours	L	T	P	C
THEORY								
1	231NS1A44TA	PC	Navigation – III	3	2	1	0	3
2	231NS1A44TB	PC	Bridge Equipment & Bridge Resource Management-III	2	2	0	0	2
3	231NS1A44TC	PC	Ship Stability – II	3	2	1	0	3
4	231NS1A44TD	PC	Ship Operation Technology – III	2	2	0	0	2
5	231NS1A44TE	PC	Cargo Handling And Stowage – III	3	2	1	0	3
6	231NS1A44TF	PC	Meteorology – I	3	2	1	0	3
7	231NS1A44TG	PC	Marine Law II	2	2	0	0	2
8	231NS1A44TH	PE	Professional Elective Course-I	2	2	0	0	2
PRACTICAL								
9		ES	Marine Workshop Practice – II	2	0	0	2	1
10		EEC	Professional Communication	2	0	0	2	1
11	231NS1A44PI	PC	Chart work and Voyage Planning –I	3	0	0	3	2
Total				**27**	**16**	**4**	**7**	**24**
Professional Elective Course-I								
1		PE	Shipboard communication and Procedures –I					
2		PE	Polar Navigation					

CURRICULUM for B.SC NAUTICAL SCIENCE

(ACADEMIC YEAR 2023-2026)

SEMESTER: V

S. No	COURSE CODE	COURSE CATEGORY	COURSE TITLE	Contact Hours	L	T	P	C
THEORY								
1	231NS1A54TA	PC	Navigation – IV	3	2	1	0	3
2	231NS1A54TB	PC	Bridge Equipment & Bridge Resource Management-IV	2	2	0	0	2
3	231NS1A54TC	PC	Ship Stability – III	3	2	1	0	3
4	231NS1A54TD	PC	Maritime Commerce	2	2	0	0	2
5	231NS1A54TE	PC	Meteorology – II	3	2	1	0	3
6	231NS1A54TF	PC	Maritime law-III	2	2	0	0	2
7		PE	Professional Elective Course-II	2	2	0	0	2
8		ES	Open Elective Course-I	3	2	1	0	3
PRACTICAL								
9	231NS1A54PG	PC	Chart work and Voyage Planning –II	3	0	0	3	2
10		ES	Marine Workshop Practice – III	2	0	0	2	1
11		EEC	Personality Development Program – I	2	0	0	2	1
Total				**25**	**16**	**4**	**5**	**23**
PROFESSIONAL ELECTIVE COURSE-II								
1		PE	Shipboard Communication and procedures II					
2		PE	Pump Operation & Maintenance					
OPEN ELECTIVE COURSE-I								
1		ES	MOOC/NPTEL Program					
2		ES	Satellite Communication					

CURRICULUM for B.SC NAUTICAL SCIENCE

(ACADEMIC YEAR 2023-2026)

SEMESTER: VI

S. No	COURSE CODE	COURSE CATEGORY	COURSE TITLE	Contact Hours	L	T	P	C
THEORY								
1	231NS1A64TA	PC	Maritime Management	2	2	0	0	2
2	231NS1A64TB	PC	Ship Operation Technology – IV	2	2	0	0	2
3	231NS1A64TC	PC	Cargo Handling and Stowage – IV	3	2	1	0	3
4	231NS1A64TD	PC	Ship Stability-IV	3	2	1	0	3
5		PE	Environmental Studies	2	2	0	0	2
6		ES	Marine Engr. Auto. Control Systems – II	2	2	0	0	2
7		ES	Open Elective Course-I	3	2	1	0	3
PRACTICAL								
8	231NS1A64PE	PC	Chart work and Voyage Planning –III	3	0	0	3	2
9		EEC	Personality Development Program – II	2	0	0	2	1
10	231NS1A64PF	PC	Ship Operation Technology Laboratory – IV	2	0	0	2	1
Total				**24**	**14**	**3**	**7**	**21**
Open Elective Course-I:								
1		ES	MOOC/NPTEL Program					

COMMON FRAME WORK FOR CURRICULUM DEVELOPMENT

AMET CURRICULUM – CREDIT SHARE

SEMESTER	CONTACT HRS	CREDITS	LECTURE	PRACTICAL
I	**27**	**21**	**12**	**12**
II	**21**	**18**	**12**	**06**
III	**25**	**21**	**14**	**08**
IV	**27**	**24**	**16**	**07**
V	**25**	**23**	**16**	**05**
VI	**24**	**21**	**14**	**07**
TOTAL	**149**	**128**	**84**	**45**

Humanities	Basic Science	Engineering Science	Professional Core	Professional Elective	Open Elective	Project /Internship	EEC	Total
4	**14**	**15**	**85**	**6**			**4**	**128**

LEGEND:

L	Lecture
T	Tutorial
P	Practical/laboratory
C	Credit
M	Marks

CATEGORY:

HS	Humanities Course
BS	Basic Science
ES	Engineering Science
PC	Professional Core
PE	Professional Elective
EEC	Employment Enhancement Course

PROGRAM	B.Sc Nautical Science				
Course Code **236EN1A12TA**	Course Name : **Communicative English - I**	Course Code **UFLE101**	Course Name : **Communicative English - I**	Course Code **UFLE101**	Course Name : **Communicative English - I**
Year and Semester	I Year (I Semester)	Contact hours per week (2 Hrs)			
Prerequisite course					

Course category				
Humanities and Social Sciences	Management courses	Professional Core	Professional Elective
Basic Science	Engineering Science	Open Elective	Mandatory

Course Objective		
	1	To enhance the listening skills through audio and video clippings.
	2	To enable students improve their lexical, grammatical competence.
	3	To achieve fluency and accuracy in oral communication.
	4	To assist students to write reports.
	5	To develop vocabulary for language proficiency.
Course Outcome	CO1	Speak effectively according to the context.
	CO2	Recognize formal elements of specific genres of organizational communication.
	CO3	Practise the unique qualities of professional rhetoric and writing style.
	CO4	Develop professional work habits through collaborative and cooperative learning in the class room.
	CO5	Participate actively in writing activities that relates to scientific and technical communication in the workplace.
	CO6	Write different kinds of letters for personal and official communication.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	2	2	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO6	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-
Average	-	**3.00**	-	-	-	**2.00**	**2.00**	-	-	-	-	-	-	-	-

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT I

Reading – Comprehension: Shipping Industry by Muralikrishnan - **Writing**: Discourse markers and Developing hints - **Listening**: Short texts - **Speaking:** Introducing oneself - **Vocabulary**: Countable and uncountable nouns - **Grammar**: Parts of speech - **SMCP:** General (Procedure, Spelling, Message markers, Responses, Distress etc.,)

UNIT II

Reading: Skimming: Marine Pilot Reshma: A Chennai Ponnu is India's First Marine River Pilot by Roshne Balasubramanian, - **Writing**: Paragraph writing – **Listening:** Telephonic conversation - **Speaking:** Sharing information of a personal kind - **Vocabulary**- Maritime vocabulary - **Grammar**: Tenses - **SMCP**: External communication phrases

Unit III

Reading: Scanning: The Sea is History by Dereck Walcott - **Writing**: Official letter, Curriculum Vitae and covering Letter - **Listening**: Narratives from different sources - **Speaking:** Expressing opinions. **Vocabulary:** Collocations, One-word substitution - **Grammar:** Articles, Question tags - **SMCP:** Search and Rescue Communications

UNIT IV

Reading: Decoding: Captain Phillips Movie Review from Times of India Newspaper - **Listening:** Listening to conversations - **Speaking:** Speaking about one's friend - **Vocabulary**: Phrasal verbs, Idioms - **Grammar**: Active and Passive voice - **SMCP:** General Ship knowledge and Parts of a ship

UNIT V

Reading: Analysing: Case Study: The Indian Ocean Observing System by Juliet Hermes and Roxy Mathew - **Writing**: Creative writing and poster making **Listening:** Listening to TED talks - **Speaking:** Short group conversation - **Vocabulary**: Homonyms, Homophones and Homographs - **Grammar**: Conditional sentences,

conjunctions - **SMCP:** Types of vessels

Text Book:

M. Subha et al. (Ed). A General English Course Book for the Maritime Learners. (2023). Island Publishers: India. (in Print)

Reference Books:

1. IMO Standard Maritime Communication Phrases (SMCP) 2000
2. Adair, John. Effective Communication. London: Pan Macmillan Ltd., 2003.
3. Carnegie, Dale. The Quick and Easy Way to Effective Speaking. New York: Pocket Books, 1977.
4. Crystal, David. The Cambridge encyclopedia of the English language. Cambridge University Press,1995.
5. Murphy, Raymond, Essential Grammar in Use, New Delhi, Cambridge University Press, 2009.

Reference web site:

https://www.ted.com/talks
https://www.vocabulary.com/dictionary

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Program	B.Sc Nautical Science					
Course Code **236MA1A11TA**	Course Name **Nautical Mathematics-I**		L	T	P	C
			2	1	0	3
Year and Semester	I Year (I Semester)		Contact hours per week 4 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
	Basic Science	Engineering Science	Open Elective		Mandatory	
	✓					

Course Objective	1	To apply algebra principles to Nautical Studies.
	2	To illustrate basics of finite difference operator and interpolations.
	3	To create an understanding of Statistical concepts in solving problems.
	4	To illustrate geometric properties.
	5	To introduce the basic concepts of trigonometric ratios and trigonometric identities
Course Outcome	CO1	Demonstrate algebraic facility with algebraic topics including linear, quadratic, exponential, logarithmic, and trigonometric functions.
	CO2	Apply various interpolation methods and numerical differentiation and integration to real value problems.
	CO3	Explain the importance of measures of central tendency.
	CO4	Compute volume and surface area of combined solids.
	CO5	Apply trigonometry to solve problems including those involving angles of elevation and depression
	CO6	Apply the algebra, statistics, numerical methods, Geometry and Trigonometry techniques in engineering problems

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	-	2	-	-	-	-	-	-	-	-
CO2	3	-	1	-	-	-	2	-	-	-	-	-	-	-	-
CO3	3	-	1	-	-	-	2	-	-	-	-	-	-	-	-
CO4	3	-	1	-	-	-	2	-	-	-	-	-	-	-	-
CO5	3	-	1	-	-	-	2	-	-	-	-	-	-	-	-
CO6	3	-	1	-	-	-	2	-	-	-	-	-	-	-	-
Average	**3**		**1**				**2**	-	-	-	-	-	-	-	-

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT I: ALGEBRA AND THEORY OF EQUATIONS

Binomial theorem: Integer coefficient and rational coefficient- Solution of equation: quadratic, cubic and bi-quadratic (Bi-section Method)-Solutions of Reciprocal Equations-Diminishing the roots of an equation - Removal of terms from the equations.

UNIT II: RATIO'S, PROPORTION AND NUMERICAL METHODS

Ratio's and Proportion-Direct-Inverse and joint Variation-Interpolation: Newton forward and backward-Application of Numerical Differentiation and integration using Trapezoidal, Simpson's 1/3 rule.

UNIT III:STATISTICS

Function and scope of Statistics-Pictorial representation of data-Measures of Central Tendency: Mean, Median, Mode, Mean deviation, Quartile deviation and Standard deviation- correlation and regression analysis.

UNIT IV: MENSURATION AND SOLID GEOMETRY

Area and volume of regular and irregular solid figure- Determination of Median- Centroids- incentre and Circumference of triangle-Simple problems in Circle, Parabola, Ellipse and hyperbola.

UNIT V: TRIGONOMETRY

Relation between trigonometric ratios-Compound angles-Inverse trigonometric functions- Solution of trigonometric equations- Relation between angles and sides of a triangle- Expansions of $\sin n\theta, \cos n\theta$ $\sin^n \theta$ *and* $\cos^n \theta$.

Text Book:

1. Higher Engineering Mathematics by B. S .Grewal, 42th edition , Khanna publishers,2012

Reference Books:

Dr. P.R. Vittal , “Allied Mathematics”, Margham Publications, Chennai, Reprint Edition, 2011

2. Graham Lawler MA, “Understanding Maths”, Viva Study Mates Publishers, Fourth Edition, 2011

3. Capt. G.E. Earl, Capt. D.M. Robinson, “Munro’s Mathematics for Deck Officers”, Glasgow: Brown, Son & Ferguson, Fifth Edition, 1983.

4. Capt. H. Subramanian , “Spherical Trigonometry”, Vijaya Publications, First Edition, 1994

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Program	B.Sc., (Nautical Science)				
Course Code **236PH1A11TA**	Course Name **Nautical Physics & Electronics - I**		L	T	P	C
			3	0	0	3
Year and Semester	I Year (I Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
	Basic Science	Engineering Science	Open Elective	Mandatory		
	✓					

Course Objective	1	To understand the basic principles of physics that will be useful for their marine carrier.
	2	To understand the basic concepts of mechanics for marine applications.
	3	To describe the origin and propagation of sound waves.
	4	To demonstrate the propagation of light and working of optical instruments.
	5	To describe the magnetic property of materials and heat.
	6	To understand the basics of semiconductor, diodes, transistors, amplifiers and oscillators.
	7	To relate physical concepts necessary to understand and apply in the field of Maritime education.
Course Outcome	CO1	Explain the concept of physics laws and their marine applications.
	CO2	Students will have knowledge acoustics and their characteristics
	CO3	Demonstrate the principles of optics and their applications
	CO4	Discuss the effect of magnetism and heat
	CO5	Describe basics of electronics and electronic devices applications
	CO6	Summarize the applications of acoustic and optics in navigational observations

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	2	-	-	-	-	-	-	-	-	-	-
CO2	1	2	-	1	-	3	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	3	-	-	-	-	-	-	-	-	-	-
CO4	1	3	-	3	-	2	1	-	-	-	-	-	-	-	-
CO5	2	2	-	2	1	2	-	-	-	-	-	-	-	-	-
CO6	1	3	-	2	2	1	2	-	-	-	-	-	-	-	-
Average	1.3	2.1	-	2	2	2	1.5	-	-	-	-	-	-	-	-

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit I: Mechanics

Circular motion- Rotational motion - Kepler's laws- Newton's law of gravitation – Variation of 'g' with height and depth – Orbital velocity – Escape velocity - Stationary satellite – ***Launching of a satellite** - Weather broadcasting – Concept of Gyroscope - Metacentre, Metacentric height, Metacentric height of a ship- Plimsoll lines - Marine hydrometer.

Unit II: Acoustics and Ultrasonics

Wave motion- Progressive waves-longitudinal and transverse waves- velocity of a transverse wave in a stretched string- laws of transverse vibrations- Sonometer-frequency of AC source Sound - Musical sound and noise – characteristics of musical sound – Intensity and Loudness - Decibel - Doppler's effect – different cases - Interference of two travelling waves – Use in Decca and Loran, Echo, Principle of Radar, Echo sounder - Ultrasonics – Ultrasonics production by piezoelectric crystal oscillator – ***Applications of ultrasonics** SONAR – Signalling.

Unit III: Optics

Propagation of light - Laws of reflection and refraction, Reflection of light at plane and curved surfaces – Periscope - Refraction, Refraction of light through a prism and lenses – Magnification - Aberrations-spherical aberration- chromatic aberration - methods to minimize -Optical instruments-compound microscope, reflecting and refracting astronomical telescopes– Binoculars – ***Sextant** – Interference and Diffraction – Fresnel and Fraunhofer's diffraction at single slit– Resolving power of optical instruments – Microscope and telescope.

Unit IV: Magnetism and Heat

Magnetism: Geomagnetism – Magnetic elements of Earth – ***Measurements of declination, dip** and horizontal intensity - Magnetism of the ship and its components – *Mariner's compass. Effect of motion of the ship and latitude on the compass - Dia, para and ferro magnetic materials comparison - Antiferromagnetism – Hysteresis– ferromagnets, ferrimagnets and their

applications.

Heat: Heat and Temperature – Principle of spontaneous combustion - Hygrometry- Rain, Snow and Hail - Boyles Law - Charles Law - Expansion of solid and liquid-Anomalous expansion of water-Transmission of heat - Conduction-convection-radiation- Laws of thermodynamics- Carnot engine.

Unit V: Electronics Devices and applications

Semiconductors – intrinsic and extrinsic – Doping – P type and N type semiconductors – PN junction diode – forward and reverse biasing – V-I characteristics – Rectifier, bridge Rectifier – uses as a voltage regulator - Introduction of electronic circuit - ***Thermistors** - thermistor as transducer - Transistors – PNP and NPN transistors – working of transistors as an amplifier in Common Emitter; Amplifier –- positive Feedback in amplifier- Oscillators– Sinusoidal oscillator– Radio frequency oscillator (Hartley oscillator) – Wein Bridge oscillator.

***Innovation**

Group discussion- video presentation – model making- power point presentation by students

Text Book:

1. D.S. Mathur, P.S.Hemne, 2000, Mechanics, S. Chand & Company Ltd, New Edition, New Delhi, 1-848.
2. Hugh D. Young and Roger A. Freedman, 2011, Sears and Zemansky's University Physics: Electricity and Magnetism, Vol- II, Pearson Education Limited, 12th edition, Chennai, Delhi, 1-452.
3. Michael Nelkon, 1978, Fundamentals of physics, St Albans: Hart-Davis Educational, 3rd edition, 1-784.
4. Brijlal & Subramanyam, 1999, A Text Book of Sound, S. Chand & company Ltd, 2nd edition, New Delhi, 1-300.
5. N Subramanyam, Brijlal, MN Avadhanulu, 2006, A Text Book of Optics, S. Chand & company Ltd, 23rd Revised edition, New Delhi, 1-729.
6. D.P. Kothari, I. J. Nagrath, 2017, Basic Electronics, McGraw Hill Education (India) Private Limited, 2nd edition, New Delhi, 1-552.
7. V. K. Mehta, Rohot Mehta, 2014, Principles of Electronics, S. Chand & company Ltd, 7th Revised edition, New Delhi, 1-792.
8. David A. Bell, 2009, Fundamentals of Electronic Devices and Circuits, Oxford University Press (India), 5th Edition, New Delhi, 1-212.
9. Jacob Millman, Christos Halkias, Chetan Parikh, 2010, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw-Hill Education, Second Edition, New Delhi, 1-846.

Reference Books:

1. Halliday, Resnick and Walker, 2009, Fundamentals of Physics, Wiley India, extended 8th edition, New Delhi, 1-1279.
2. Frederick J. Keller, W. Edward Gettys, Malcolm J. Skove, 1993, Physics, classical and modern, McGraw-Hill Education (India), 2nd edition, New Delhi, 1-1187.
3. Brijlal & Subramanian, 2001, Principles of Physics, S. Chand & company Ltd, revised edition,New Delhi, 1-1105.
4. H.S. Hans, S.P. Puri, 2009, Mechanics, Tata McGraw Hill Publishing Company Ltd, 2nd edition, New Delhi, 1-551.
5. David A. Bell, 2009, Fundamentals of Electronic Devices and Circuits, Oxford University Press (India), 5th Edition, New Delhi, 1-212.
6. Malvino, Solid state physics

Document Prepared in " Board of Studies" held on Date: 09.06.2023	Document Approved in " Academic Council"

<table>
<tr><td rowspan="2">Course Code
231NS1A14TA</td><td colspan="3" rowspan="2">Course Name
B.Sc., (Nautical Science)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Year and Semester</td><td colspan="3">I Year (I Semester</td><td colspan="4" rowspan="2">Contact hours per week
2 Hrs.</td></tr>
<tr><td>Prerequisite course</td><td colspan="3">Ship Construction</td></tr>
<tr><td rowspan="4">Course category</td><td colspan="2">Humanities and Social Sciences</td><td>Management courses</td><td colspan="2">Professional Core</td><td colspan="2">Professional Elective</td></tr>
<tr><td colspan="2"></td><td></td><td colspan="2">✓</td><td colspan="2"></td></tr>
<tr><td colspan="2">Basic Science</td><td>Engineering Science</td><td colspan="2">Open Elective</td><td colspan="2">Mandatory</td></tr>
<tr><td colspan="2"></td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td rowspan="3">Course Objective</td><td>1</td><td colspan="6">To introduce the students to various parts of the Ship Construction.</td></tr>
<tr><td>2</td><td colspan="6">To classify the types of Ship and ship profiles.</td></tr>
<tr><td>3</td><td colspan="6">To Appraise the purpose of deck openings in ships.</td></tr>
<tr><td rowspan="6">Course Outcome</td><td>CO1</td><td colspan="6">Identify Frames, Beams and Beam knees</td></tr>
<tr><td>CO2</td><td colspan="6">Identify various types of ships and their constructions.</td></tr>
<tr><td>CO3</td><td colspan="6">Explain about watertight bulkheads</td></tr>
<tr><td>CO4</td><td colspan="6">Recognize and label the parts of the tank structures</td></tr>
<tr><td>CO5</td><td colspan="6">Enumerate anchor and mooring arrangement and procedures.</td></tr>
<tr><td>CO6</td><td colspan="6">Associate and understand the relevance anchor and mooring arrangements.</td></tr>
</table>

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	1	2	-	1	1	2	1	-	-	-	-	-	1	1	1
CO6	1	2	-	1	1	2	1	-	-	-	-	-	1	1	1
Average	2	2.50	-	2	2	2.50	2	-	-	-	-	-	2	2	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1 Frames, Beams and Beam knees

Longitudinal & transverse framing, Beams and Beam knees – Sketch & their importance in Ship Construction.
Combined system of framing on transverse sections of the ship.
Illustrates the general arrangement of the following ship types: general cargo oil, chemical and gas tankers ,bulk carrierscombination carriers, container, ro-ro ,passenger .
The primary structural members and indicate the proper names for the various parts to include holds, engine-room, peak tanks, double-bottom tanks, hatchway, tween deck and position of bulkheads, cofferdams, pump-room, cargo tanks, slop tank and permanent ballast tanks: camber , rise of floor , tumblehome , flare , sheer ,rake parallel middle body Entrance , run

UNIT 2 Water Tight Bulkheads

Functions, construction and stiffening of water tight bulkheads including collision bulkheads, Corrugated bulkhead.sketches a hatch corner in plain view, showing the structural arrangements
sketches a plane bulkhead, showing connections to deck, sides and double bottom , the arrangement of stiffeners, a corrugated bulkhead , explains why transverse bulkheads have vertical corrugations and for-and-aft ,bulkheads have horizontal ones .

UNIT 3 Sketch and Describe the following

i) Bilge keels- Sketch and Describe Bilge Keel.
ii) Double bottom Tank- Sketch and Describe Double bottom Tank.
iii) Peak tanks - Sketch and Describe of Forepeak and Aft peak tanks.
iv) Side, Wing tanks and Bilges – Sketch and Describe of Wing tanks and

Bilges.
Defines: forward perpendicular (FP) ,after perpendicular (AP) , length between perpendiculars (LBP) , length on the waterline (LWL) , length overall (LOA) , base line , moulded depth, beam and draught , extreme depth, beam and draught .
– Describes and illustrates standard steel sections: ,flat plate ,offset bulb plate , equal angle , unequal angle ,
channel , tee .

UNIT 4 Deck Opening

Construction, stiffening & closing arrangement of openings on deck &
Superstructures, Water tightness of Hatches, Opening in Oil, Chemical & Gas tankers.
illustrates hold drainage systems and related structure
sketches the deck edge, showing attachment of sheer strake and stringer plate , sketches a radiused sheer strake and attached structure .
Describes the stress concentration in the deck round hatch openings ,explains compensation for loss of strength at hatch openings , sketches a transverse section through a hatch coaming , showing the arrangement of coamings and deep webs .

UNIT 5 Anchor, Chain and Mooring Arrangements

Mooring bitts showing their attachment to the decks Cable stopper, describes and sketches an arrangement of modern weather-deck mechanical steel hatches ,describes the cleating arrangements for the hatch covers, describes roller, multi-angle, pedestal and Panama fairleads , sketches mooring bitts, showing their attachment to the deck, sketches typical forecastle mooring and anchoring arrangements, showing the leads of moorings ,describes the anchor handling arrangements from hawse pipe to spurling pipe, describes the construction of chain lockers and how the bitter-ends are
secured in the lockers ,explains how to secure anchors and make spurling pipes watertight in preparation for a sea passage , describes the construction and use of a cable stopper .

Text Book:

1. Ship construction - D J Eyres

Reference Books:

Ship Construction notes - Kemp & Young
2. Ship Construction – Pursey
3. Ship Construction for Marine Students - Reeds
4. Ship Construction – Taylor

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council**

Program	B.Sc., (Nautical Science)					
Course Code **231NS1A14TB**	Course Name **Ship Operation Technology - I**		L	T	P	C
			2	0	0	2
Year and Semester	I Year (I Semester		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To Understand the shipping industry
	2	To Appreciate the need for maritime education
	3	To be aware of the regulatory regime that operates and controls the shipping industry.
Course Outcome	CO1	Describe the Ship parts and nautical terms
	CO2	Illustrate the Shipboard Organization and Shipping elements
	CO3	Explain about international regulatory regime
	CO4	List out the industry requirements for personal life saving appliances
	CO5	Discuss about the fire fighting system in global shipping
	CO6	Indicate the role of International shipping regulatory regime

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

INTRODUCTION TO SHIPPING

UNIT 1: Ship Parts and Shipping/Nautical terms

- Names of various parts of ship and Shipping terms: - Few examples are - abaft, abeam, aboard, ahead, amidships, athwartships, accommodation ladder, afloat, aft, aground, ahead, aloft, alongside, astern, Avast, fore and aft line, bulkhead etc.

UNIT 2: Shipboard Organization and Shipping elements

- Types of departments in merchant navy vessels and their responsibilities in brief: -Deck, Engine, Catering. Duties and Responsibilities of Officers and Ratings onboard, Ships routine, Time of Watches, Dog Watch and its purpose, Shipping company Structure:-Organization chart of a shipping company - Operation Dept., Technical Dept., Three basic modes of operation of commercial ships:- Linear, Tramp, Industrial, Cargo types, Ports: Importance of ports, Functions and features of a port, Facilities and services provided by a port, Operational definitions: Harbor, Dock, Lock, Breakwater, Wharf, Dolphin, Stevedore, Tug, Safe Port, Berth.

UNIT 3: International Trade and Shipping

Importance of Shipping, Why the demand for shipping, what is a shipping system, Actors in shipping business: - Ship owners, ship builders, scrap dealers, terminal operators, intermodal transport operators, ship agents, charterers, shipbrokers,

- International Maritime Passages: - Panama Canal, Suez Canal, Strait of Malacca, Strait of Hormuz, Strait of Magellan, Cape of Good Hope, Important oceans, Important ports of the world.

UNIT 4: Personal life-saving appliances

- Classification of ships for life saving Appliances, General requirements for life saving appliances, Lifebuoy specification and its use, L/buoy Self-igniting lights, L/buoy Self Activating smoke signals, Buoyant Lifelines

Specifications as per LSA Code, Lifejackets requirements – Adult and child, Inflatable lifejacket, L/J lights specification, Immersion suits requirements, Anti exposure suits requirements, thermal protective aids specification,

Pyrotechnics

- Pyrotechnics and its uses: - Rocket parachute flares, Hand flares, Buoyant smoke signals, Line throwing apparatus and its uses, General Emergency alarm and PA system,

Unit 5: Basic knowledge on Fire Fighting on board

- Basic principles of fire protection, detection and fire extinction in ship as per FSS code, Causes of fire onboard. Fire Triangle, Fire Tetrahedron, Starvation, cooling, smothering, classification of Fires, Fire plan, fire wallet, Type of Detectors – Heat, flame and smoke detectors, Flammable limits, Flammability diagram, Action to be taken on observing the fire.
- Fire Retardant bulkheads, Fire doors, Fire Dampers, International shore connection: - SOLAS Requirements, Standard dimension, Materials and Accessories, Personalprotection: -Fire-fighter's outfit – SOLAS requirement – Personal equipment - breathing apparatus – Lifeline, Emergency Escape Breathing Device (EEBD): - Purpose, Parts, Particulars, Markings, Means of Escape, Fire Blankets

Text Book:

1. Seamanship Notes by Kemp and Young
2. Seamanship Techniques by D.J House
3. Seamanship by Capt Bhandarkar

Reference Books:

1. Code of Safe Working Practices for Merchant Seaman
2. Seamanship and Nautical Knowledge – Nicholls

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code 231NS1A14TC	Course Name **CARGO HANDLING AND STOWAGE- I**		L	T	P	C
			3	0	0	3
Year and Semester	I Year (I Semester		Contact hours per week 3 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To Introduce to students to conventional method of carriage of cargo
	2	To Appraise care of cargo
	3	To Understand the gear used for handling cargo
Course Outcome	CO1	Identify different types of ships and cargo
	CO2	Discuss about basic aspect of cargo operations
	CO3	Define and label different types of cargo gear
	CO4	Explain about care and maintenance of cargo gear
	CO5	Describe about different types of cargo operations.
	CO6	Interpret the terminology related to cargo operations

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	1	1	2	1	-	-	-	-	-	1	1	1
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	1.83	2.83	-	1.83	1.83	2.83	1.83	-	-	-	-	-	1.83	1.83	1.83

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT -1 - Types of Ships and cargoes (BASICS)

Introduction to various common types of ships, the type of cargoes they carry and the method of cargo operations unique to each.

- General cargo ship, basic ship's cargo gear – derricks and cranes, types of general cargo e.g. bales, boxes, bags, crates, cases, pallets,
- Bulk carrier, examples of bulk cargoes and method of loading by conveyor and discharging by grab
- Container ship with cell guides, diagram of container and container operation by gantry
- Tankers for liquid cargoes using pumps and piping. Example of oil, products, chemicals and gas cargoes.

Introduction to specialized ships and cargoes

- Heavy lift ships and heavy lift cargoes, refrigerated ships and reefer cargoes, dangerous goods, multipurpose ships, ro-ro ships and their cargoes, offshore supply vessels and their functions

UNIT-2 - Introduction to Basic Aspects of Cargo Operations/ HOLD CLEANING CARGO OPERATIONS- BASICS

l

- Importance of cargo care to economical operation of ship. Care of cargo on board ship
- The hazard of fire and its prevention, control and extinction in cargo operations. Interaction between cargoes and the resultant contamination and tainting. Separation of cargoes by natural bulkheads or artificial divisions.
- Stowage and handling to prevent breaking, chafing, crushing.
- Temperature variations leading to sweat damage, ship and cargo sweat, monitoring of dew-point temperature and ventilation to prevent sweat.
- Sea water damage, importance of structural integrity and hatch cover water tightness.
- Shifting of cargo, toppling, and methods of securing to prevent the same viz. blocking, chocking and lashing.
- Dunnage and its use to increase friction, prevent damage from sweat and in separating cargoes. Shifting boards.
- Ballasting and deballasting operations.
- Duties of the Officer on Cargo Watch

Ventilation and control of sweat

Log Book Entries Need for ventilation of cargo spaces.

- Ship sweat and cargo sweat, and differentiate between them.
- Factors affecting sweat. Dew point, Temperature, wet and dry bulb thermometers, Dew point measurement.

- Control of sweat by ventilation
- Operation of ventilation system
- Cargoes requiring special ventilation due to emission of gases, absorption of oxygen, dust, release of moisture
- Hygroscopic cargo check list.

HOLD CLEANING / PREPARATION

Need for inspection of holds,

- Items to be inspected,
- Importance of cleaning holds,
- Checking weather tightness of hatch covers
- Use of dunnage & spar ceiling,
- Disposal requirements of dunnage
- Importance of checking bilge suction
- Use of deodorizing wash
- Blanking of ballast line

UNIT-3 - Items of cargo gear, their use, care and maintenance- module 1 Ropes, wires & chains:

- lNatural and synthetic ropes-manila, polypropylene, terylene, nylon. Breaking stress of ropes, wires and chains

Blocks:

- Parts of a blocks, Types of blocks, 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.

Shackles:

- Types of shackles. Marking on shackles.

Cargo hooks:

- Swivels, Locking arrangement on Swivel Hooks, precautions to prevent "unthreading" (Split Pin/ Keyway/Locking nut etc) Marking on cargo hooks.

Calculations / numerical

- Finding Breaking stress of various types of ropes
- Finding required size of rope to lift a given weight

UNIT-4 Items of cargo gear, their use, care and maintenance- module 2

Cargo Gear Register:-

- Chain Register(Cargo Gear Register).; Breaking strength; Proof Load; Factor of Safety; Safe working load (SWL)Calculation of SWL using Factor of Safety given.
- Care of ropes and wire used for cargo gear. Maintenance of wire ropes. When to condemn a wire rope.

CALCULATIONS / NUMERICALS

- 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.
- Proof load calculations
- Sling legs stresses at various angles- optimum angle

UNIT-5 - Cargo-handling safety Detailed cargo operations (module-1)

- Inspection of cargo gear prior work. l Precautions during cargo operations while using cargo gear.
- Effective communication during loading and discharging.
- Dock safety regulations pertaining to above (dust, personal protection, awareness of moving parts of machinery).
- Precautions to be taken whilst operating hatch covers.

Capacities of cargo spaces and quantification

- Bale and Grain Capacity; Stowage factor, Broken stowage- quantification by "volume available"
- Heavy cargoes:- Deadweight and displacement- Quantification by shore weights / draft surveys. Load density. Permissible load density
- Liquid cargoes:- Cargo density; Ullage and soundings – quantification by ullage/soundings
- Load lines- introduction.

CALCULATIONS/ NUMERICALS:

- Simple numerical limited to item (a) i.e. Bale and grain capacity- to find quantity that can be loaded for Break-bulk cargo given SF and Broken stowage/ and / grain cargo given grain capacity and SF.
- Finding cargo loadable given area of hold and Load density

Segregation and separation of cargoes:

- Segregation of different cargoes with reference to dangerous goods, dry, wet, delicate, dirty, valuable cargo.
- Separation between parcels of cargo and methods of separation.
- Separation between parcels of cargo for different ports.

Securing cargoes:

- Contents of Lashing Code and Cargo Securing Manual.
- Need for solid stow and securing.
- Methods of blocking, lashing, shoring and trimming cargo.
- Method of securing heavy loads, vehicles and containers.

Before Entering Enclosed or Contaminated Spaces

Dangerous spaces like cargo, fuel or ballast tanks, pump rooms, duct keel spaces.
Ensure oxygen content is 21% by volume by using measuring instruments.
Need for thorough ventilation of the space.
Prepare Safety Checklist.
Use of various instruments to check the gases in a compartment.

Text Book:

1. Safe cargo handling procedures Vol 1 and Vol 2 by P.J.Samson

Reference Books:

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

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code 231NS1A14PD	Course Name **RULES OF THE ROAD-I**		L	T	P	C
			0	0	2	1
Year and Semester	I Year (I Semester		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	1. To introduce the students to importance of Collision Regulations
	2	2. To make students understand the different types of craft and their mutual obligation / duties in a collision situation
	3	To readily recognise the type of craft by correlating to the lights and shapes displayed
Course Outcome	CO1	To appreciate and discern that a ship has serious limitations in her manoeuvering.
	CO2	To relate that the COLREGS have laid the rules of the road to avoid confusion between two free-thinking OOWs.
	CO3	To appreciate that there are various navigating craft with limitations and how the ROR lays down the lights and shapes for all vessels for recognizing the type of craft and its peculiar
	CO4	To readily identify within half minute of sighting the type of craft and action to avoid collision.
	CO5	To readily appreciate, identify the various aspects of a sighted vessel (Target ship)
	CO6	To have a basic understanding of the sectors, overlapping sectors and the reason for special positioning of lights and shapes.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	3	3	-	3	-	-	-	-	-	3	3	3
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	3	-	-	3	3	-	3	-	-	-	-	-	3	3	3
CO5	3	-	-	3	3	-	3	-	-	-	-	-	3	3	3
CO6	1	2	-	1	1	2	1	-	-	-	-	-	1	1	1
Average	2.33	2.67	-	2.33	2.33	2.67	2.33	-	-	-	-	-	2.33	2.33	2.33

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1:- ROR: International Regulations for Preventing Collisions at Sea (Basics)

2.4 Some history of the regulations.
2.5 Importance of ROR IRPCS(Colregs) and general layout of Sections and parts in Colregs.
2.6 Introductory Rules to Colregs– Rule 1 and 3 dealing with defintions. Purpose of definitions.
2.7 Viedeos and pictures- exhibition of various types of Fishing vessels, Seaplanes
2.8 Introductory idea of Masthead Lights, sidelights, Stern light, spacing and changing aspects - Sectors thereof just sufficient to appreciate Part A and Part B.

UNIT 2:- ROR: PART C Regulations concerning Lights and Shapes:- Rules 20-24, complete

2.9 Rule 20 mandatory requirement of lights to be exhibited from sunset to sunrise as well as at other times as deemed by prevailing circumstances.
2.10 Rule 21 definitions regarding MHL, SL, Sternlight and all round lights
2.11 Rule 22 visibility of lights - indicating that lights should be visible at minimum ranges (in nautical miles) determined according to the type of vessel. Explanation on luminosity as in Annexe and that the range of practical visibility depends on atmospheric conditions and prevailing meteorological visibility.
2.12 Rule 23 lights and shapes to be carried by power-driven vessels underway.
2.13 Demonstration on ‘horizontal perspective” - apparent view of a ship seen from various angles of view (aspect).
2.14 Demonstration on how the apparent view of a ship as seen in horizontal perspective changes as she changes her course.
2.15 Rule 24 lights and shapes for vessels towing and pushing including a combination of tows.
2.16 Practical demonstration of identifying above types of vessels based on Lights and shapes as seen from various angles, ROR cards and Quizzes, Self assessment applications

UNIT 3:- ROR: PART C Regulations concerning Lights and Shapes:- Rules 25 -31, complete

2.17 Rule 25 light and shapes requirements for sailing vessels underway and vessels under oars.- exemptions thereof.
2.18 Rule 26 light and shapes requirements for fishing vessels.
2.19 Rule 27
- 2.19.1 light and shapes requirements for vessels not under command or
- 2.19.2 restricted in their ability to manoeuvre.
- 2.19.3 various types of RAM vessels,
- 2.19.4 differentiating between an ordinary RAM vessel and a dredger.
- 2.19.5 Mine sweeper.

2.20 Practical demonstartion of identifying above types of vessels based on Lights and shapes as seen from various angles, ROR cards and Quizzes, Self assessment applications
2.21 Rule 28 lights and shapes requirements for vessels constrained by their draught.
2.22 Rule 29 light and shapes requirements for pilot vessels.
2.23 Rule 30 lights and shapes requirements for vessels anchored and aground.
2.24 Rule 31 lights requirements for seaplanes
2.25 Practical demonstartion of identifying above types of vessels based on Lights and shapes as seen from various angles, ROR cards and Quizzes, Self assessment applications

UNIT 4:- Part D – Sound and Light Signals (Rules 32-37) and Part E

2.26 Rule 32 definitions of whistle, short blast, and prolonged blast, specifications
2.27 Rule 33 Requirements and specifcation regarding sound appliances to be carried by deifferent ships.
2.28 Rule 34 manoeuvring and warning signals, using whistle or lights. The need for giving these signals whilst taking avoiding action, including a few case studies.
2.29 Demostration through Internet applications on these sound signals. As regards manoeuvring and warning signals- the need for giving these signals whilst taking avoiding action, including a few case studies where negligence to sound these signals gave rise to near-misses and or collisions

2.30 Rule 35 sound signals to be used in restricted visibility.
2.31 Rule 36 signals to be used to attract attention.
2.32 Rule 37 distress signals, various types and their practical applications.
2.33 PART E : Rule 38 giving exmption granted to older vessels from complying with a few of the PART C and D requirement.
2.34 Pratical exercises on identfying various types os ships, identifying from the horizontal perspective the action taken by the other vessel
2.35 Caution on wrong inference as to the size and length of ships as observed from the perspective view- both at day and at night.

UNIT 5: Rules of Part B – Section I – Rules 4,5,6,7

- Rule 5 :- Explain a ‘proper lookout’ and interpret the intent of full appraisal of the situation and risk of collision. Describe the procedures of keeping a lookout, Duties of Lookout. How to perform lookout duties, maintain an efficient lookout and report objects in degrees and points on the bows. Explain the meaning of “ all available means “ , prevailing circumstances “ sight and hearing”
- Rule 6 :- SAFE SPEED
  - Explains what is meant by a safe speed.
  - Describe with reference to court cases how ‘proper and effective action’ and ‘within a distance appropriate to the prevailing circumstances and conditions’ may be interpreted
  - State the factors to be taken into account in determining a safe speed.
  - Explain in detail, supported by videos and PPTs each of the factors mentioned in this Rule and other possible factors that a particular situation may call for.
- Rule 7 : Risk of collision
  - Explain that a target approaching at a ‘constant bearing’ is “risk of collision”. Explain the words “

deemed to exist" by citing examples / case studies / hypothetical situations

- The limitation of constant bearing when it is applied to (a) large targets, Tows, Pair-trawlers (b) In a Head-on situation (c) similar
- Explain how the use of radar affects the determination of safe speed, Explains what is meant by risk of collision
- Describe the proper use of radar equipment in determining whether the risk of collision exists. Explain the dangers of making assumptions on the basis of scanty information, citing example from clear weather as well as the use of radar. Illustrate, using examples from court cases
- The significance of long-range scanning with particular reference to (a) prevailing sea-clutter state (b) approaching fog-banks (c) passing showers (d) similar factors
- How failure to plot may lead to a lack of appreciation of a developing situation. Illustrate, using examples from court decisions

Text Book:

1.IMO Rules of the Road- Bhandarkar

2. UKHO Admiralty Buoyage –NP735
3. ROR Cards
4. Radar Plotting Sheets

Reference Books:

1. Collision Regulations – A.J.Cockroft
2. A Mariner's Guide to Colregs-Capt.Y.Chaabra
3. Rule of the Road- Manual – Capt.S.K.Puri
4. Intl Lights, Shapes and Sound Signals D.A.Moore
5. Mariners handbook- NP100
6. IMO / NI publications on Bridge Watchkeeping Procedure

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code 234CS1A13PA	Course Name **Foundation of Information Technology-Laboratory**		L	T	P	C
			0	0	4	2
Year and Semester	I Year (I Semester)		Contact hours per week 4 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
	Basic Science	Engineering Science	Open Elective		Mandatory	
		✓				

Course Objective	1	To explain formatting and alignment using word (MS-Office)
	2	To understand absolute and relative cell references.
	3	To learn avoiding redundant data.
	4	To provide a knowledge on creating web page.
Course Outcome	CO1	Understand formatting and alignment using word (MS-Office).
	CO2	Illustrate absolute and relative cell references
	CO3	Familiarize with the knowledge on creating web page
	CO4	Identify and avoid redundant data
	CO5	Acquaint with the knowledge on creating web page.
	CO6	Summarize the usage of information technology in shipboard operations.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	-	3	3	-	-	-	-	-	-	-	-	3
CO2	-	2	-	-	3	3	-	-	-	-	-	-	-	-	3
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	2	-	-	3	3	-	-	-	-	-	-	-	-	3
Average	-	3	-	-	2	2	-	-	-	-	-	-	-	-	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1:Word Processing Tool

Using Smart art, mail merge, track changes, review comments, insertion of drawing tools, shapes and mathematical symbols.

UNIT 2:Spreadsheet Tool

Introduction to Spreadsheets, Concept of Worksheets and Workbooks, Creating and Saving a worksheet. Working with a spreadsheet: entering numbers, text, date/time, series using AutoFill, Editing and formatting a worksheet including changing color, size, font, alignment of text, Inserting or Deleting cells, rows and columns, Formula-Entering a formula in a cell, using operators(+,-,*,/) in formulae, Relative referencing, Absolute referencing and mixed referencing, Printing a worksheet. Use All Statistical functions: SUM (), AVERAGE (), MAX(), MIN(), IF() etc; Inserting tables in worksheet, Embedding Charts of various types: Line, Pie, Scatter, Bar and Area in a worksheet.

UNIT 3:Database Management tool

Introduction – Identify the components of a Database – Constrain data entry using field properties – Create a database – Create a table using the design view – Modify table data, sort and filter records –Establish table relationships – Create query joins – Create a query – Add criteria to a query – Create a form – Modify the design of a form – view and edit data using an access form – Create a Report – Add a control to a report- Format the controls in a report.

UNIT 4:Presentation Tool

Introduction to Presentation Graphics, Understanding the concept of Slide Shows, Basic elements of a slide, Different types of Slide Layouts, Creating and saving a Presentation, Different views of a slide: Normal view, Slide Sorter view and Slide Show, Editing and Formatting a slide: Adding Titles, Subtitles, Text, Background, Watermark; Headers and Footers, Numbering Slides; Printing Slides Handouts, Inserting pictures from files, Animating pictures and Text with Sound Effects, Timing Text box, Pictures and Slides, Rehearse Timings, Ungrouping and Grouping Objects (like text, picture).

Unit 5:Hyper Text Markup Language

Introduction to Web Page Designing using HTML, Creating and saving an HTML document, accessing a web page using a web browser (Internet Explorer, Mozilla Firefox, Opera, Apple Safari, Netscape Navigator, Google Chrome); Elements in HTML: Container and Empty elements, Designing web pages using the following elements: HTML, HEAD, TITLE, BODY and attributes.

Text Book:

1. Katherine Murray, "First Look Office 2010", by Microsoft Corporation, 2010.
2. Rajkamal, "Internet and web technologies" –Tata McGraw-Hill, New Delhi, 2002

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Program	B.Sc., (Nautical Science)					
Course Code 231NS1A14PE	Course Name **Ship Operation Technology Laboratory – I**		L	T	P	C
			0	0	2	1
Year and Semester	I Year (I Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To impart the knowledge of rope work.
	2	To create awareness about the importance of life saving appliances.
	3	To Enable the students to become proficient with Morse code
Course Outcome	CO1	Identify Emergency equipment-SCBA, Immersion suits, Thermal Protective Aid
	CO2	Relate Heavy Lifts-Handling of heavy cargoes, securing
	CO3	Identify Chipping tools-Manual and Pneumatic
	CO4	Relate Mooring stations-Heaving line, head line, stern line, breast lines and springs
	CO5	Interpret Mooring the ship to a buoy using anchor chains
	CO6	Explain the method to prepare a metal surface for painting.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	3	3	-	3	-	-	-	-	-	3	3	3
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	3	-	-	3	3	-	3	-	-	-	-	-	3	3	3
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.33	3	-	2.33	2.33	3	2.33	-	-	-	-	-	2.33	2.33	2.33

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

S no	Task	Type	Description
1	Rope work	Types	Types of Rope/Constn/Lay/Care and Maintance of Ropes
2	Rope work	Types	Types of knots/Bends/Hitches/Whipping
3	Rope work	New coil	Opening new coil of rope / coiling /flaking/ cheesing
4	Rope work	Wire splicing	Wire splicing (Liverpool splice)
5	Mooring	Types	Types of mooring /belaying ropes to cleats/stag horns
6	Mooring	Procedures	Casting heaving line/ messenger line/ Tonnesberg link /mandal shackle
7	Anchor	Terminology	Anchoring terms/ anchor arrangements / swp while anchoring.
8	Anchor	Anchor types	Types of anchor /safe working practices while anchoring
9	Maintenance	Chipping & painting	Manual chipping and surface preparation / swp. check list
10	Maintenance	Typesof tools	Use of pneumatic and electric power tools for chipping
11	Maintenance	Flag etiquettes	International code of flags &signals.(international, national, house, courtesy, numerical and substitutes.)
12	Lsa /ffa	Donning	Donning of life jacket/ immersion suit/ thermal protective aid
13	Lsa /ffa	Types	Types of fire hose coiling
14	Cargo work	Lashing gear	Use of turnbuckle /bottle screw/ senhouse slip
15	Cargo work	Draft mark	Practical exercise in reading draught marks / swp to be followed.
16	Cargo work	Snatch block	Changing the direction of pull by using snatch block

Text Book:

1. Seamanship Notes by Kemp and Young
2.Theory and practice of seamanship by Danton G
3.Seamanship practice by Capt Dinger

REFERENCE BOOKS:

1.Life Boat and Life Raft – Capt Puri SK
2.Survival at sea – C.H.Wright
3.Brown's signaling

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Program	B.Sc., (Nautical Science)					
Course Code 236PH1A11PA	Course Name **Nautical Physics & Electronics Lab – I**		L	T	P	C
			0	0	2	1
Year and Semester	I Year (I Semester)		Contact hours per week 2 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
	Basic Science	Engineering Science	Open Elective		Mandatory	
	✓					

Course Objective	1	To introduce students to electronic equipment used in electronics.
	2	To apprise the purpose of calibrating scientific equipment's.
	3	To distinguish between resistance and specific resistance.
	4	To understand the instrumental errors and analyse.
	5	To explain about interference pattern and formation of air wedge
Course Outcome	CO1	Demonstrate the use of Marine hydrometer and Hare's apparatus
	CO2	Identify error analysis
	CO3	Observe air wedge and thickness of wire
	CO4	Understand the principle of surface tension
	CO5	Review the calibration of low range voltmeter – Potentiometer.
	CO6	Record the outcome of experiment and report the findings

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	3	1	2	3	-	-	-	-	-	-	-	-
CO2	2	3	-	2	3	1	2	-	-	-	-	-	-	-	-
CO3	3	1	-	1	3	2	3	-	-	-	-	-	-	-	-
CO4	2	2	-	2	2	1	2	-	-	-	-	-	-	-	-
CO5	3	1	-	2	1	2	1	-	-	-	-	-	-	-	-
CO6								-	-	-	-	-			
Average	2.3	2.2	2.2	1.7	2.3			-	-	-	-	-	2.0	2.3	2.2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Course contents

1. Marine hydrometer and Hare`s apparatus
2. Error Analysis
3. Air wedge – Thickness of wire
4. Surface tension of water -Capillary rise method
5. Calibration of low range voltmeter-Potentiometer
6. Spectrometer – Refractive index of the material of a prism
7. Resistance and Specific resistance of the material of a coil- Post Office box
8. PN-junction diode – I-V characteristics
9. Logic gates using ICs
10. Resistance by Ohm`s law

Text Book:

1. D.S. Mathur, P.S.Hemne, 2000, Mechanics, S. Chand & Company Ltd, New Edition, New Delhi, 1-848.
2. Brijlal & Subramanyam, 1999, A Text Book of Sound, S. Chand & company Ltd, 2nd edition, New Delhi, 1-300.
3. N Subramanyam, Brijlal, MN Avadhanulu, 2006, A Text Book of Optics, S. Chand & company Ltd, 23rd Revised edition, New Delhi, 1-729.
4. D.P. Kothari, I. J. Nagrath, 2017, Basic Electronics, McGraw Hill Education (India) Private Limited, 2nd edition, New Delhi, 1-552.
5. R. Murugesan, Electricity & Magnetism, 2017, S. Chand & company Ltd, 10th edition, New Delhi, 1-478.
6. V. K. Mehta, Rohot Mehta, 2014, Principles of Electronics, S. Chand & company Ltd, 7th Revised edition, New Delhi, 1-792.

Reference Books:

1. SL Gupta & V Kumar, 2013, A Hand Book of Electronics, Pragati Prakashan, 39th edition, Meerut, 1-1448.
2. M. Narayanamurthi and N. Lakshminarayan, 1997, Electricity and Magnetism, The National Publishing Company, 3rd edition.
3. Hugh D. Young and Roger A. Freedman, 2011, Sears and Zemansky's University Physics: Electricity and Magnetism, Vol- II, Pearson Education Limited, 12th edition, Chennai, Delhi, 1-452.
4. Halliday, Resnick and Walker, 2009, Fundamentals of Physics, Wiley India, extended 8th edition, New Delhi, 1-1279

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Program	B.Sc., (Nautical Science)					
Course Code 236EN1A12TC	Course Name **PDP-I (Personality Development Program)**		L	T	P	C
			0	0	2	1
Year and Semester	I Year (I Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To develop interpersonal skills.
	2	2. To enhance professionals with idealistic, practical and moral values.
	3	3. To participate effectively in work place related activities.
Course Outcome	CO1	Improves communication skills.
	CO2	Identify areas that they need to work on to become their best self.
	CO3	Plan their long-term career objectives.
	CO4	Enhance the quality of their personal and professional relationships.
	CO5	Provide professional help for overcoming personality related challenges

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	2	2	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO6	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-
Average	-	**3.00**	-	-	-	**2.00**	**2.00**	-	-	-	-	-	-	-	-

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit – I Introduction to Personality Development

The concept of personality - dimensions of personality – human perceptions – understanding people types of people - good habits - bad habits - nurturing good qualities for excellence

Unit – II Self-Management Skills

Self-awareness - self-confidence - emotional balance - stress handling - coping with failure - stress handling Patience – tolerance - trustworthiness.

Unit – III Mindset

Types of mindset- Growth Mind set, fixed mindset- poverty mindset-abundance mindset - group mindset- public mindset- press mindset- good/bad mindset- Learning mindset - developing growth mindset.

Unit – IV Motivation

Concept of motivation – types of motivation and its significance - Internal and external motivation - Importance of self-motivation.

Unit V – Other Dimensions of personality

Health and personality- love and personality - mind and memory - improving memory – business etiquette - care for environment.

Reference Books

1. R. Stephen Covey, The Seven Habits of Highly Effective People, New Delhi: Simon and Schuster,2013
2. Robin Sharma, The Everyday Hero Manifesto, 2021
3. Carol Dweck, Mindset, http//mindsetonline.com/what is it/about
4. Brian Tracy, Eat That Frog : 21 ways to stop procrastination and get more done in less time. London, Collins 2002
5. Brian Tracy, Goals: How to get everything you want, faster than you ever thought,
6 Criag, Callender,Ralph Edney. Introducing Time: A Graphic Guide London: Icon Books, 2010
7. James Clear Atomic habits
8. Jay Shetty, Think Like a Monk
9. NPTEL Link: http://Nptel.ac.in/courses/109104107/
10. https://onlinecourses.nptel.ac.in/noc22_hs77/preview
11. https://www.truity.com/test/big-five-personality-test

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Program	B.Sc., (Nautical Science)				
Course Code 236EN1A22TB	Course Name **Communicative English - II**		L	T	P	C
			2	0	0	2
Year and Semester	I Year (II Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To enable the students to write flawless sentences
	2	To enhance the students presentation skills
	3	To develop the reading skills of Science students
	4	To help learners develop their listening skills
	5	To enrich their professional vocabulary
Course Outcome	CO1	Write paragraphs and essays in different topics.
	CO2	Speak fluently without inhibition in a formal environment.
	CO3	Read articles of a general kind in magazines and newspapers.
	CO4	Comprehend conversations and short talks delivered in English.
	CO5	Help learners develop maritime vocabulary by developing their reading skills.
	CO6	Describe events and process without any grammatical error.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	2	2	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO6	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-
Average	-	**3.00**	-	-	-	**2.00**	**2.00**	-	-	-	-	-	-	-	-

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT I

Reading: Intensive reading: Merchant Navy: the World is their Oyster - **Listening:** Short formal and informal conversations. **Speaking:** Exchanging personal information - **Vocabulary**: Word formation - **Grammar**: Prepositions - **SMCP**: VTS - Phrases for acquiring and providing data for a traffic image

UNIT II

Reading: for local and global comprehension: Gibraltar Collision: Race to Remove Fuel from Stricken Ship - **Writing**: Summary Writing - **Listening:** Product description - **Speaking**: Formal and informal greetings – **Vocabulary**: Maritime vocabulary - **Grammar**: Articles - **SMCP:** Phrases for providing VTS Services

Unit III:

Reading: Analysing: The Drunken Boat by Arthur Rimbaud - **Writing**: Principles of Good writing - **Listening:** Narratives from different parts - **Speaking:** Sharing about everyday activities - **Vocabulary:** Prefixes and Suffixes - **Grammar:** Subject -Verb Agreement - **SMCP:** Safety on Board

UNIT IV

Reading: Reasoning: Hunter Killer – Movie Review - **Writing**: Report Writing - **Listening:** Listening to process description - **Speaking:** One's role model - **Vocabulary**: Synonyms and Antonyms - **Grammar**: Punctuation - **SMCP:** Crew

Unit V

Reading: Understanding: Marine Plastic Debris and Solid Waste Management in Peru October 2020 - **Writing**: Essay writing - **Listening:** Listening to story analysis - **Speaking:** Participating in conversations - **Vocabulary**: Abbreviations and acronyms, Numerical expressions - **Grammar**: Degrees of Comparison - **SMCP:** Rules of Road

Text Book:

M. Subha et al. (Ed). A General English Course Book for the Maritime Learners. (2023). Island Publishers: India. (in Print)

Reference Books:

1. IMO Standard Maritime Communication Phrases (SMCP) 2000
2. Adair, John. Effective Communication. London: Pan Macmillan Ltd., 2003.
3. Carnegie, Dale. The Quick and Easy Way to Effective Speaking. New York: Pocket Books, 1977.
4. Crystal, David. The Cambridge encyclopedia of the English language. Cambridge University Press,1995.

Murphy, Raymond, Essential Grammar in Use, New Delhi, Cambridge University Press, 2009.

Reference web site:

https://www.shortstoryguide.com/short-stories-sea/

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Program	B.Sc., (Nautical Science)					
Course Code 236MA1A21TB	Course Name **Nautical Mathematics - II**		L	T	P	C
			2	1	0	3
Year and Semester	I Year (II Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
	Basic Science	Engineering Science	Open Elective		Mandatory	
	✓					

Course Objective	1	To expand the functions by differentiation
	2	To provide the required ideas to solve the problems on second order differential equations.
	3	To describe the basic ideas of integration and its properties.
	4	To acquaint the student with the concepts of vector calculus needed for problems in
	5	To explain the fundamental concepts of spherical triangle
Course Outcome	CO1	Calculate the limit of a function at a point numerically and algebraically using appropriate techniques including L'Hospital's rule.
	CO2	Illustrate the use of differential higher order equations.
	CO3	Apply the rules of integration to certain types of functions.
	CO4	Apply the multiple integrals using vector calculus.
	CO5	Measure the spherical angle and its properties.
	CO6	Apply the concepts of Calculus for engineering applications.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	2	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	2	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	2	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	2	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	2	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	2	-	-	-	-	-	-	-	-
Average	**3**	**2**					**2**	-	-	-	-	-	-	-	-

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT-1: DIFFERENTIAL CALCULUS

Successive differentiation-nthderivative for standard-Application of Leibnitz's theorem- Indeterminate forms-L'Hospital rule- Taylor's and Maclaurin's series-Partial derivatives of first and higher orders.

UNIT-2: DIFFERENTIAL EQUATIONS

Linear Differential Equations of the first, second with constant coefficients-Application of Differential equations: Newton's Second Law of Motion, Newton's Law of Cooling- ship motion in roll oscillations.

UNIT-3: INTEGRAL CALCULUS

Integration of standard functions-Definite integral - properties-Application of integration-Arc length of a curve and Surface area-Volumes of revolution - Physical applications of integration.

UNIT-4: VECTOR CALCULUS

Gradient- Divergence - Curl - Directional derivative – Irrotational and Solenoidal-Vector integration - Application of Green's theorems and stokes theorems.

UNIT-5: SPHERICAL GEOMETRY

Napier’s Rules -Circular Parts of Right angle -Spherical Triangle-Quadrantal Spherical Triangle -Sine formula-Cosine Formula-Haversine formula - Solutions of Spherical triangles and its application to Navigational problems.

Text Book:

1. B. S . Grewal, Higher Engineering Mathematics, 42nd edition , Khanna publishers, 2012.
2. J..H. Clough Smith, , An Introduction to Spherical Trigonometry, Brown Son and Ferguson Ltd, 2002
3. M.L. Khanna , Spherical Trigonometry, AI Prakash Nath Publications, 1995.

Reference Books:

1. P.R. Vittal , Allied Mathematics, Margham Publications, Chennai, Reprint Edition, 2011
2. MA. Graham Lawler, Understanding Maths, Viva Study Mates Publishers, Fourth Edition, 2011
3. Capt. G.E. Earl, Capt. D.M. Robinson, Munro's Mathematics for Deck Officers, Glasgow Brown, Son & Ferguson, Fifth Edition, 1983.

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Program	B.Sc., (Nautical Science)					
Course Code 236PH1A21TG	Course Name **Nautical Physics & Electronics - II**		L	T	P	C
			2	0	0	3
Year and Semester	I Year (II Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
	Basic Science	Engineering Science	Open Elective		Mandatory	
	✓					

Course Objective	1	To Enhance the fundamental knowledge in Physics and its applications relevant to various streams of Maritime Engineering and Technology
	2	To determine the electrical parameters such as resistance and capacitance.
	3	To understand the laws of electromagnetic induction and their uses.
	4	To apply the principle of cells and generators and understand the various effects due to
	5	To explain the applications of electromagnetic waves and different elements of communication.
Course Outcome	CO1	Describe the fundamentals of electricity
	CO2	Explain electromagnetic induction and measuring instruments.
	CO3	Describe electrochemical and electromagnetic current
	CO4	Demonstrate the magnetic and heating effect of electric current
	CO5	Students will have the basic knowledge of radioactivity and radio wave communications
	CO6	Summarize the application of electromagnetic induction and radio wave communications relevant to marine field

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	1	-	2	-	-	-	-	-	-	-	-
CO2	1	3	-	2	-	1	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	3	-	-	-	-	-	-	-	-	-	-
CO4	1	3	-	1	-	2	2	-	-	-	-	-	-	-	-
CO5	1	2	-	2	3	1	-	-	-	-	-	-	-	-	-
CO6	1	3	-	2	2	1	2	-	-	-	-	-	-	-	-
Average	1.5	2.5	-	1.75	2.25	2.25	2	-	-	-	-	-	-	-	-

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit I: Fundamentals of electricity

Electric current–potential difference – Resistance – Ohm's law - Electric power and energy, Electrical appliances on board ship – AC and DC voltages , dangerous levels – Earthing - Electrical safety measurement - ***Resistances in series and parallel**–factors influencing resistance of a conductor – electrical resistivity – Kirchoff's laws – Wheatstone's bridge- specific resistance of a conductor - Capacitance – Principle of capacitor - Series and parallel combination of capacitors.

Unit II: Principles of electromagnetic induction and measuring instruments

Electromagnetic induction – laws of electromagnetic induction – Generator rule – Self and mutual inductions – Coefficient of coupling – combination of inductors – series and parallel combination. Induction motor - Principle- construction and working of a moving coil galvanometer–***conversion of galvanometer into ohm meter, ammeter and voltmeter**.

Unit III: Electrochemical and Electromagnetic current

Primary cells – Daniel, Lechlanche and dry cell - acid battery (Lead acid accumulator) – construction and working – cells in series and parallel - Chemical effect-Corrosion and electrolysis, Cathodic protection.

Generators: ***DC generator**- AC generator- AC sinusoidal voltage and current– principle, construction and working. Magnetic effect: Circular lifting magnet - Transformer - Construction and working – losses and methods to reduce the losses.

Unit IV: Heating and magnetic effect of electric current

Heating effects: Heating effect of electric current – Joule's law of electric heating – Experiment to verify Joule's law — Applications of heating effect – electrical fuse – arc lamps.

Magnetic effects: Magnetic effect of electric current – magnetic flux – Biot and Savart's law – magnetic field at a point due to a straight long current carrying conductor – Cork screw rule – Right hand thumb rule – magnetic field along the axis of a current carrying coil – magnetic field on the axis of a solenoid

Unit V: Radioactivity and Principle of radio wave communication

Radioactivity: Emission from Radioactive nuclei, Detection of radiation, Radiation fission and fusion, Nuclear reactors, Nuclear hazards and precautions.

Radio wave propagation – ground and sky waves. Skip distance and skip zone. Cathode ray tube (CRT) – action of CRT – applications of CRT. ***Radar** – basic principle– range of a radar - Basic elements of a communication system – *Radio broadcasting – Transmission and reception – modulation – amplitude modulation– Frequency modulation (FM) -advantages of frequency modulation – Demodulation – Fibre optic communications - Satellite communication.

***Innovation:** Group discussion- video presentation – model making- power point presentation by students

Text Book:

1. Hugh D. Young and Roger A. Freedman, 2011, Sears and Zemansky's University Physics: Electricity and Magnetism, Vol- II, Pearson Education Limited, 12th edition, Chennai, Delhi, 1-452.
2. M. Narayanamurthi and N. Lakshminarayan, 1997, Electricity and Magnetism, The National Publishing Company, 3rd edition.
3. R. Murugesan, Electricity & Magnetism, 2017, S. Chand & company Ltd, 10th edition, New Delhi, 1-478.
4. SL Gupta & V Kumar, 2013, A Hand Book of Electronics, Pragati Prakashan, 39th edition, Meerut, 1-1448.
5. V. K. Mehta, Rohot Mehta, 2014, Principles of Electronics, S. Chand & company Ltd, 7th Revised edition, New Delhi, 1-792.
6. George Kennedy, 2008, Electronic Communication Systems, Tata McGraw-Hill Education (India), 4th edition, New Delhi, 1-745.
7. M. Morris Mano, Michael D. Ciletti, 2007, Digital Design, Pearson Prentice Hall, Fourth Edition, New Delhi, 1-611.

Reference Books:

1. Halliday, Resnick and Walker, 2009, Fundamentals of Physics, Wiley India, extended 8th edition, New Delhi, 1-1279.
2. Frederick J. Keller, W. Edward Gettys, Malcolm J. Skove, 1993, Physics, classical and modern, McGraw-Hill Education (India), 2nd edition, New Delhi, 1-1187.
3. Brijlal & Subramanian, 2001, Principles of Physics, S. Chand & company Ltd, revised edition,New Delhi, 1-1105.
4. David A. Bell, 2009, Fundamentals of Electronic Devices and Circuits, Oxford University Press (India), 5th Edition, New Delhi, 1-212.
5. Digital Fundamentals- Floyd , 2006, 9th edition, Pearson Prentice HallT.

Reference web site:

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code 231NS1A24TA	Course Name **Navigation –I**		L	T	P	C
			3	0	0	3
Year and Semester	I Year (II Semester)		Contact hours per week 3 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To familiarize Students with Maritime Geography.
	2	To understand the Shape & Dimension of the Earth.
	3	To impart basic concept of Terrestrial Navigation and Principles of Sailing
Course Outcome	CO1	Comprehend and develop knowledge about Maritime Geography
	CO2	Relate the shape & Dimension of the Earth
	CO3	Acquire the concept of Terrestrial Navigation
	CO4	Develop knowledge about Parallel, Plane and Mercator Sailings
	CO5	Familiarize with the use of Traverse Tables in Day's Work
	CO6	Describe the use position lines and position circles.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Terrestrial Navigation

UNIT1 –Distance & Direction

Brief explanation on following topics
Shape of Earth; Earth's axis, earth's poles, Sphere & Spheroid.
Position on Earth - Equator, Meridians, Latitude and Parallels of latitude, Prime Meridian and Longitude, Difference of Latitude (D'lat) and Difference of Longitude (D'long); Position by Latitude and Longitude.
Distance - Nautical mile, Geographical mile; Statute mile, Kilometre and Comparison of all units of distance. Explanation of 'Cable' and 'Knot' as a unit of distance and speed; Effect of polar compression on nautical mile. Basic Calculations on Distance.
Direction – True North, Magnetic North and Compass North and terms Variation & Deviation. Ship's Head and Course – Differences and obtain value of True Course, Magnetic Course and Compass Course based on applicable Variation and Deviation. Calculations to find various courses from one another.

Bearings– Basic understanding on the directional concept used onboard a ship. Explain difference between True and Relative bearing of terrestrial objects from ship's observation and precautions on use of compass bearing to true bearing before plotting it.

UNIT 2 – Position and Terrestrial Position Lines

Positions used in Terrestrial Navigation. How a position of Ship is expressed at an instant. Dead Reckoning (DR) Position, Estimated Position (EP), Observed Position (Fix).
Brief explanation on "Effect of Wind, Current and Tidal Streams". Set & Drift concept to determine position.
Terrestrial Position lines– Definition of a position line / circle. Explanation on Compass / True bearing to plot a terrestrial position line. Explain various methods of obtaining a position line and finding the position by range and bearings of terrestrial objects.

UNIT 3–Maritime Geography

Explain in brief about World Atlas – Geography and in detail about names of various Oceans, Continents, Seas, Canals, Straits, Major Ports & Harbours and navigable ocean routes along with its location on the world map, including India's major & minor ports, seas around the sub-continent. Cadets should be able to indicate, draw / identify & locate these places on a world map.

UNIT4- Plane, Parallel and Mercator Sailing Methods

Explain Terms - Rhumb Line, Departure and Mean / Middle Latitude.
Parallel Sailing – Relationship between Equator, Parallel of Latitude, Departure &D'Long. Basic calculations to find distance between two positions based on Parallel Sailing formulae.
Plane Sailing - Relationship between D'Lat, Departure and Distance; Plane sailing triangle &formulae. Basic calculations to find distance between two positions based on Plane Sailing Formulae.
Mercator Sailing - Meridional parts, Difference in Meridional Parts (DMP) & relationship between Course, D'long and DMP. Explain differentiation between Plane and Mercator sailing. Brief introduction on the difference between Middle & Mean Latitude.
Triangle relationship to find course and distance between two positions and also to find the arrival position based on Mercator sailing formulae using Nautical Table.

UNIT 5 – Traverse Sailing - Day's Work Calculation based on Traverse Table

Explain use of Nautical Table (Traverse Table) to obtain the position of the ship at any given time for a given compass course and speed.
Computation of various distances traversed by ship based on courses steered & speed ordered. Effect of wind & current on the ship and calculation of arrived position catering to drift experienced.
Position computing for 24 hr duration as part of Day's work practiced by navigator using Traverse Table - Based on courses & speeds of the Ship catering to the run recorded by the log or estimated speed or engine speed allowing for the effect of wind and current, etc and Variation &Deviation of Compass / Magnetic Courses undertaken. Day's Work Calculations.

Text Book:

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

Reference Books:

1. Nichol's Concise Guide Volume-1 and 2
2. The Admiralty Manual of Navigation
3. Principles of Navigation: Vol. 1- Nautical Institute
4. Navigation Guide Vol. 1: Near Coastal Navigation- Alexander Simpson
5. Practical Navigation for Officers of the Watch- Frost, A
6. NAV Basics: The Earth, the sailings, Tides & Passage Planning Vol.1- Witherby International Ltd.

Oxford School Atlas.

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code 231NS1A24TB	Course Name **Bridge Equipment & Bridge Resource Mgt-I**		L	T	P	C
			2	0	0	2
Year and Semester	I Year (II Semester)		Contact hours per week 2 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To familiarization of Doppler Effect.
	2	To introduction to radar and safe watch keeping.
	3	To understand the importance of Bridge resource management
Course Outcome	CO1	Interpret the principle of Doppler Effect and its application in speed log
	CO2	Relate about transducers, their siting etc.,.
	CO3	Relate to RADAR, ARPA, ECDIS, etc.,.
	CO4	Illustrate navigational, anchor watch and the COLREGS
	CO5	Enumerate the Aids for Navigation.
	CO6	Compare the advantages and limitations of navigational aids.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	2	2	2	3	2	-	-	-	-	-	2	2	2
CO5			-					-	-	-	-	-			
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT-1Bridge Layout, Chronometer and Telegraph/ RPM indicator

1. **Lay out of Bridge:** Sketch the layout of the Bridge with its Navigational Equipment, Use of various Navigational Equipment's, Brief introduction on purpose /functions of various equipment's.
2. **Chronometer:** Description, checking chronometer error from Radio Signals/GPS, Stowage of chronometer, running down and restarting, batteries and replacement. Correct UTC, Advantages, maintenance, Accuracy, controls
3. **Marine Binocular:**- Purpose, Specifications ,Focusing Methods, Shock Protection, Eye Cups, Light Transmission Factor, Care to be Taken, Stowage
4. **Telegraph:**-Electric telegraph, description and its operation.
5. **Day Light Signalling Lamp:-** use, care and Emergency source of power
6. **Fog Signalling Equipment:-** Sound signally Equipments as in part-D of COLREG 72
7. **Wiper & Clear View Screen:-**Use, care and precaution of wiper & clean view screen (CVS).
8. **Rudder Angle Indicator**- significance, need to watch the same to ensure Feedback iscomplete etc.

Unit 2Fundamental principles of radar:
2.Fundamental Theory

2.1 Fundamental Principles of Radar: - General Description, Range Determination – Range Rings – Variable Range Marker, Bearing Determination – Electronic Bearing Marker, Block diagram – Power Source – Trigger Unit – Modulator – Magnetron - Scanner, TR Cell – Local Oscillator – Mixer – IF Amplifier – Video Amplifier - Receiver and display units,

2.2 More about Magnetron, Waveguide and the scanner, Use of various basic controls – Anti-clutter(Sea& Rain) - Range Rings – VRM – EBL – ERBL - Tuning – Gain – Brilliance – Range Selector – Standby – Pulse Length Selector – Heading Marker on/off – Performance Monitor – Racon -SART.

2.3 The characteristics of radar sets: Bearing range accuracy, HBW. VBW, pulse length, Pulse Repetition Frequency(PRF), wavelength(WL),

2.4 Some Limitations Of A Radar:- Range and bearing discrimination, Minimum and Maximum Range, Range Accuracy, Bearing Accuracy

2.5 Sitting of components and safe distances:- Location of scanner and its effect, location of display unit, location of transceiver unit, location of spares and safe distances with respect to magnetic compasses and other electrical appliances.

2.6 Characteristics of a Target which influence its range,

2.7 Weather Effects on Radar Performance

2.8 Shadow Areas, Shadow Sectors, Blind Sectors and their measurement of Limits

Unit 3 Radar as a Navigational Aid

3.1. Precautions in taking Radar Fixes and effect of coast reflectivity, tides, shadow areas,Shapes and sizes of targets on accuracy of obtained Range and bearing.

Factors that might cause faulty interpretation (Spurious Echoes): Indirect echoes, side lobe echoes, multiple echoes, second trace echoes, spoking and starring.

3.2. Relative Motion Display:- Head Up display – North Up Display, Comparison between Head Up and North Up Display, Course Up Display, Off-Centre RM Displays

3.3. True Motion Display, Sea stabilization, Ground Stabilisation, Advantages and Disadvantages of RM & TM

3.4. General Procedure to switch on a Radar, Procedure to switch off, Procedure to check the Efficiency

3.5. The use of parallel indexing technique in radar navigation: wheel over positions and safety margins.

UNIT 4 Steering Gear Control System and its Auxiliaries

1. **Telemotor :**Inter-switching of follow-up and Non follow-up & Emergency steering system. Basic idea on how rudder acts / propeller wash etc
2. **Steering control systems:** Knowledge of steering control systems, operational procedures, procedure for testing of steering system, auxiliary steering
3. **The automatic pilot:** Principle, functions, auto pilot alarm, Various settings of the auto-pilot for optimal Performance, Adaptive Autopilot, Change over from manual to auto and vice-versa. Circumstances where Autopilot should not be used. Off-course alarm and its limitations. IMO specifications.

Unit 5 Performing safe navigational watch as per Section A- VIII/2 and B-VIII/2 of STCW:

UNIT 5
Keeping a safe navigational watch as per Section A-VIII/2 and B-VIII/2 of STCW:
Keeping a safe Navigational Watch:-

- States that the officer of the watch is responsible for navigating safely ,with particular regard to avoiding collision and stranding
- describes the principles to be observed in keeping a navigational watch asset out in section A-VIII of the STCW Code regarding:
- navigation
- navigational equipment

- navigational duties and responsibilities
- 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
- describes there commendation on operational guidance for officers incharge of a navigational watch contained in chapter VIII, section A-VIII/2 of the STCW Code:
- maintenance of an efficient lookout
- the use of engines and sound signaling apparatus
- taking over the navigational watch
- periodic checks of navigational equipment
- compliance with SOLAS V/19regarding 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 watch keeping personnel
- describes the duties of the officer of the watch while at anchor
- lists the entries which should be made in the logbook

Action on receiving storm warning at Sea -Understand obligations of Meteorological services as per SOLAS,

Bridge Procedures Guide and its contents: Contents – emergency checklists as per BPG, Master/ Pilot information Exchange, Information provided to Pilot as soon as arrival on bridge, Pilot Card, Wheelhouse Poster

Drills related to above items, Log book entries

CONNING ORDERS (Helm orders) and Internal communications: Demonstrate clear,concise communication and acknowledgement at all times in a seaman like manner with due regards to Standard Marine Communication Phrases, explain various methods to call the Master to the bridge,
Drills on mock steering, helm orders at the steering stand and Rudder angle indicator checks

Text Book:

1. Shipborne Radar & Nautical Watch Keeping – Capt. H. Subramaniam
2. Bridge Procedure Guide - ICS

Reference Books:

1. A Mariner's guide to preventing collisions- Capt. Y.Chhabra
2. Bridge Equipment &Watch Keeping Notes – E. Fernandes.
3. STCW Convention / CODE with latest Amendments- Extracts on Bridge Watch Keeping-duties, functions and procedures.
4. Shipborne Radar and ARPA-- Capt. H. Subramaniam
5. Electronic Navigational Aid—Sonnenberg
6. Modern Electronic Aids—Bhatia and SinhaK
8. International; Code Of Signals—HMSO
9. Bridge Team work - Nautical Institute
10. Mariners Handbook – HMSO Publication

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code 231NS1A24TC	Course Name **Ship Construction – II**		L	T	P	C
			2	0	0	2
Year and Semester	I Year (II Semester)		Contact hours per week 2 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To understand the use of steel in ship building.
	2	To introduce the terminologies related to ship constructions
	3	To draw and label the various parts of the ship
Course Outcome	CO1	Relate various parts of ship's hull, strength bearing members, cargo holds, tanks, etc.,.
	CO2	Assess the effect of free surface on the ship's stability, sounding pipes, air pipes, etc.,.
	CO3	Illustrate the bilge and ballast pump and piping arrangements
	CO4	Comprehend Integrity of the ship's hull in relation to openings, doors, ramps, etc.,
	CO5	Interpret the construction of Rudders, propellers, stern frame, etc.,
	CO6	Infer the function of various components to construct a ship

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2			3					-	-	-	-	-			
CO3	3		1	3	3		3	-	-	-	-	-	3	3	3
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.2	3	0.67	2.2	2.2	3	2.2	-	-	-	-	-	2.2	2.2	2.2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1. Sounding Pipes, Air Pipes and Ventilators

Sketch and describe the
Construction of Sounding pipes, Air Pipes, Ventilators.

UNIT 2. Pump & Piping Arrangement:

General Pumping arrangements, Bilge & Ballast line system, Pumpingarrangement on tankers. Hold drainage systems and related structureBilge piping system, strum boxDeck freeing arrangements, freeing ports, scuppers and open rails , describes the bilge piping system of a cargo ship states that each section is fitted with a screw-down non-return suction valve , describes and sketches a bilge strum box ,describes a ballast system in a cargo ship ,describes the arrangement of a fire main and states what pumps may be used to pressurize it ,describes the fitting of air pipes to ballast tanks or fuel oil tanks ,describes the arrangement of fittings and lashings for the carriage of containers
on deck .

UNIT 3. Special Doors on Cargo Vessels:
Methods adopted to maintain integrity of divisions & openings in the hull including STERN DOOR, SIDE DOOR & BOW DOORS.

UNIT 4 Rudder Arrangement & Stern Frame:

Rudders-Sketch Balanced & Semi balanced Rudders, Describe the Construction
& Support Arrangement, Sketch and describe Stern Frame.
Transom stern showing connections to the stern frame
Explain the purpose of rudder carrier and pintles, rudder trunking.
Arrangement of watertight gland around the rudder stock.

UNIT 5. Propellers &Propellor Shaft:

Simple sketch of Propeller & Propeller shaft, Stern Tube & adjacent structures.

Boss, Rake, Skew, Face, Back, Tip, Radius, Pitch Explain Controllable pitch propeller.

Text Book: 1. Ship construction - D J Eyres **Reference Books:** 1. Ship construction notes - Kemp & Young 2. Ship construction – Pursey 3. Ship construction for Marine Students - Reeds 4. Ship construction – Taylor

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code **231NS1A24PD**	Course Name **RULES OF THE ROAD-II**		L	T	P	C
			0	0	2	1
Year and Semester	I Year (II Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To have a thorough understanding of the IMO Routing Guide and the various types of TSSs and their limitations and legal requirements with particular emphasis on Rule 10.
	2	To be able to effectively correlate between Rule 18 and Rule 9 (narrow channels) and 10(TSS)
	3	To thoroughly understand Rule 12(S.V) , Rule 13(overtaking) , Rule 14 (Head on) and Rule 15 (crossing situations)
Course Outcome	CO1	To be able to plan conduct of own vessel within a TSS area, precautions thereof and also to be able to take the most effective collision avoiding action that will still comply with the stipulated TSS norms.
	CO2	To be able to plan and inter-link the guidance of Rule 12,18 in respect of overtaking situations.
	CO3	To be able to prioritise the various duties that an OOW has to multi-task and decide their overlapping consequences.
	CO4	To fully comprehend and plan with case studies the significance of “Rule 13 and Rules 7, 8 and 10 in particular.The reason for ambiguous situations and prudent steps to take under a
	CO5	To readily appreciate, deduce the various aspects of a sighted vessel (Target ship)
	CO6	To be able to plan action to be taken in restricted visibility conditions and correlate the relevance of actions taken in the light of actions recommended by Rules 13,14,15 and 17,18.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
Average	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1:- Rule 12, Rule 14 and Rule 15 including ambiguous situations

- Rule 12 :- Sailing vessels with respect one another.
  - Briefly outline the mutual responsibilities between two sailing vessels in avoiding collision
  - State that a power driven vessel which is also under sails or other types augmental propulsion units are deemed to be a power-driven vessel.

- RULE 14 : Head on situation
  - Explain with examples on How to determine risk of collision in a head-on situation
  - The significance of the words “deemed to exist”
  - The interpretation of the expression “ when in doubt assume ROC exists” and act accordingly
  - Why Rule 14 insists on passing port-to-port
  - Ambiguous Head-On situations where a target is passing’ clear’ at an unsafe CPA either on your Starboard side or Port side. Which part of Rule 14 governs in these situations?
  - How to determine the “when and how much” aspects of action to take under these situations.
  - Application of Rule 32, 34 a, b and f (manoeuvering and warning signals)
  - Practical exercises with table-top models, PPT sketches or simulators

- Rule 15 – crossing situation
  - Explain how to determine Risk of collision in a crossing situation and the importance of “ appreciable change in bearing” .
  - Explain that a close-quarters situation is “deemed” to be a collision situation.
  - Compare between a target “drawing aft and closing in” vis a vis “drawing forward and closing-in”. How to determine by visual bearing such aspects.
  - How to determine the “when and how much” aspects of action to take under these situations.
  - Explain with aid of the manouvering charecteristcs the reason why Rule 15 recommends to avoid crossing ahead of the stand-on vessel

- Explain situations where an alterion away from the target vessel (ie. altering to port for a PDV on stbdside) may be warranted and the precautions to take.
- Practical plotting practices given ships with equal speed from varying directions and ROC exists.
- Practical exercises with table-top models, PPT sketches or simulators
-

UNIT 2:- Rule 13 and Rule 9

- Rule 13 :- Overtaking situation
  - explain how to decide when a vessel is an overtakingvessel from the point of view of one vessel and the other vessel. How the deciding criteria varies and give rise to certain ambiguous situation.
  - Explain why such ambiguity is even more during day time observation between two vessels.
  - Explain why overtaking situations give rise to confusion between two vessels and how Rule 13 resolves this.
  - Explain with examples that an overtaking situation is a prolonged situation and that 'ordinary practice' of seamanship must prevail in taking ealy positive action.
  - compares and analyses the various avoiding actions which may be taken by an overtaking vessel
  - Explain that an overtaking vessel remains an overtaking vessel until finally past and clear irrespective of any change in bearing between the two vessels.
  - Explain the reason why Rule 13 mandates that the overtaking vessel must keep clear whether there is ROC or not.
  - Explain ambiguous situations where , when first sighted, one vessel is on the after edge of the crossing sector.
  - Support all ambiguous situations with case studies.
  - Practical exercises with table-top models, PPT sketches or simulators.
- RULE 9 :- Narrow channels.
  - demonstrate application of Rule 9 by:
    - defining the terms 'narrow channel' and'fairway'
    - describing how to proceed along the course of a narrowchannel
    - describing the navigation of small craft and sailing vessels
    - stating the restrictions on crossing the channel orfairway
    - describing the conduct of vessels engaged infishing
    - stating the procedure for overtaking in a narrowchannel
    - describing the actions to be taken on nearing a bend in a narrowchannel
  - Explain the precautions required by " ordinary practice of seamen" when one vessel iss approachint the entrance and the other is leaving the channel – Support with case studies.

UNIT 3:- Rule 10 – Traffic separation Schemes and IMO Routng Guide and Rule 10

- Rule 10 : A complete explantion of the full contents of Rule 10 with particular emphasis on
  - The navigation within the designated traffic lane does not give a right of way for a vessel. She is bound to comply with COLREGS.
  - Who can navigate within a separation zone
  - The crossing and joining criteria
  - The routes that a merchant vessel may follow going from one port to another in the proximity of a TSS and where crossing a traffic lane may be involved.
  - Observance of 'ordinary practice of seamanship" when doing so, supported by case studies, near-miss reports.
  - Vessels which are required " not to impede the passage or safe passage"
  - Precautions required at termination areas, reasons therof
  - Certain types of vessels are exmpted from complying with Rule 10 (eg surveying vessels, cable laying vessels etc)

- Routeing Guide
  - Explain the various types of routing measures adopted by IMO.
  - State that some TSS or ASL etc are governed by local Rrgulations
  - Explain the introductory section of IMO routing guide in detail and with diagrams.
  - Particular emphasis on inshore traffic zones, dedicated inshore traffic zones, Traffic lanes, separation zone, separation line, precautionary areas, traffic junctions, the various symbols used in a TSS adopted by IMO.
  - The crteria that IMO takes into account before approving a TSS proposed by member states and the significance of these criteria as relevat to COLREGS.
- Practical exercises in showing the different TSS schemes on select parts of the World to apprecaite the differences from the COLREG point of view.

UNIT 4:-, Rule 17 Rule 18

- Rule 17: Stand on vessel
  - Explain that a potential collision situation may be divided into 4 stages as follows
    - Atlongrange,beforeriskofcollisionexistsandbothvesselsarefreeto take anyaction
    - riskofcollisionapplies,thegive-wayvesselisrequiredtotakeactionand the other vessel must keep her course andspeed
    - the give-way vessel is not taking appropriateaction
    - collisioncannotbeavoidedbytheactionofthegive-wayvesselalone
  - Explain with examples and case studies
    - In the second stage The stand on vessel has a "duty" to maintain her course and speed.
    - In the third stage she has an obligation to take action by her manoeuver alone to avoid collision as soon as, in his opinion, the give-way vessel is not taking action or appropriate action. Explain the significance of "her action alone"
    - explain how to decide when to take avoiding action as stand-onvessel
    - describe the actions which may be taken by the stand-onvessel
    - In the third stage the stand-on vessel has a duty to to take most suitable action if the action taken by the give-way vessel is not sufficient.
  - Explain wrt actual case studies how courts have interpreted the words " maintain her course and speed"
  - Explain with case studies or hypothetical situations where the "ordinary practice of seamanship" takes prcedence in decision making.

- RULE 18 :-
  - Explains the mutual responsibilities between different types of vessels in deciding who is the Give-way vessel
  - Explain the opening remark of Rule 18 " Except where Rules 13, 9 aand 10 otherwise require".
  - A PDV, FV or a saling vessel " not to impede" the passage of a CBD.
  - A vessel contrained by her draft shall navigate with particular caution having full regard to the particular condition – How courts have interpreted the same

UNIT 5: Rule 8 and Part F –Rule 39,40 and 41.

- Rule 8 :- Action taken to avoid collision:
  - Explain what should be nature of action to avoid collisions and the minimum aspects to take into consideration
  - Explain that this Rule mandates that action must comply with COLREGs and "good seamanship". Cite case studies and hypothetical situations of "good seamanship".
  - Explain the following:

i. Positive action in ample time.
ii. Large enough to be readily apparent to other vessel.
iii. Alteration of course alone.
iv. Passing at a safe distance.
v. Checking of effectiveness of action taken until finally past and clear.
vi. Reduction of speed, taking all way off.

- Explain with sketches and table top models that a potential collision situation may be divided into four distinct stages.
  - At long range, before risk of collision exists and both vessels are free to take any action.
  - Risk of collision applies, the give way vessel is required to take action, and the stand-on vessel maintains course and speed.
  - Warning stage where stand-on vessel sounds warning if give-way vessel not taking action.
  - Close quarters imminent and stand-on vessel too takes action.
  - The difference and similarity between Close-quarter situation and collision situation

Part F –Rule 39,40 and 41. Verification of compliance with the provisions of the Convention

1) Brief introduction to the new Rules added in 2013
and the purpose of including these Rules as part of ROR.

- These Rules in essence requires periodic Audit of COLREG comlians at various levels, viz onboard audit, Company Audit, Flag State Audit and finally IMO Audit verification.
- Brief (simplified)reference to IMO Reolution A1070(28)- Code III requirements

These three Rules, entering into force 1/1/2016, bring in the requirements for compulsory audit of Parties to the Convention.

Text Book:
IMO Rules of the Road- Bhandarkar
2.UKHO Admiralty Buoyage –NP735
3.ROR Cards
4.Radar Plotting Sheets

Reference Books:
Collision Regulations – A.J.Cockroft
2.A Mariner's Guide to Colregs-Capt.Y.Chaabra
3.Rule of the Road- Manual – Capt.S.K.Puri
4.Intl Lights, Shapes and Sound Signals D.A.Moore
5.Mariners handbook- NP100
6.IMO / NI publications on Bridge Watchkeeping Procedure

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code 231NS1A24PE	Course Name **Ship Operation Technology – Laboratory – II**		L	T	P	C
			0	0	2	1
Year and Semester	I Year (II Semester)		Contact hours per week 2 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To identify the different types of Blocks
	2	To understand the Construction using Bull dog Grips to make Temporary eye
	3	To learn Rigging of single & Double Whip
Course Outcome	CO1	Identify Emergency equipment-SCBA, Immersion suits, Thermal Protective Aid
	CO2	In Heavy Lifts- explain the bandling of heavy cargoes, securing
	CO3	Identify Chipping tools-Manual and Pneumatic
	CO4	In Mooring stations- demonstrate the usage of Heaving line, head line, stern line, breast lines and springs
	CO5	Explain Mooring the ship to a buoy using anchor chains
	CO6	Demonstrate the method to prepare a metal surface for painting.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.83	3	-	2.83	2.83	3	2.83	-	-	-	-	-	2.83	2.83	2.83

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

S.No	Task	Type	Description
1	Rope work	Rigging	Rigging stage
2	Rope work	Types	Canvas sewing
3	Rope work	Seizing	Flat seizing, round seizing, rack seizing
4	Rope work	Aloft	Descending with self-lowering hitch
5	Rope work	Construction	Construction of pilot ladder & jacob's ladder
6	Rope work	Rigging	Rigging of pilot ladder & jacob's ladder
7	Mooring	Securing	Taking out / putting back hawser
8	Mooring	Stopper types	Rope stopper/west country/chain stopper.
9	Mooring	Types	Spm/sts/fire wire
10	Maintenance	Greasing	Greasing of moving parts in a lifting gear.
11	Maintenance	Types of paint	Painting with different types of brushes.
12	Lsa /ffa	L/B	Handling of l/b with oars, getting away &coming alongside
13	Cargo work	Lashing gear	Using bull dog gripes to make temporary eye
14	Cargo work	Blocks	Different types of blocks & their construction.
15	Cargo work	Blocks	Dismantling &over hauling of metal blocks
16	Cargo work	Blocks	Rigging of single /double whip, gun, luff,& gyn tackle
17	Cargo work	Blocks	Rigging of two /three fold purchase.

Text Book:

1. Seamanship Notes by Kemp and Young
2. Theory and practice of seamanship by Danton G
3. Seamanship practice by Capt Dinger

Reference Books:

1. Life Boat and Life Raft – Capt Puri SK
2. Survival at sea – C.H.Wright
3. Brown's signaling

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)				
Course Code 236PH1A21PG	Course Name **Nautical Physics & Electronics Lab - II**		L	T	P	C
			0	02	1	
Year and Semester	I Year (II Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
	Basic Science	Engineering Science	Open Elective	Mandatory		
	✓					

Course Objective	1	To realize the effect of torsional stress in ship structures.
	2	To understand the effect of bending moments in ships structures.
	3	To explain use of Printed Circuit Board (PCB) in electronic devices onboard ships.
	4	To apprise the purpose of digital circuits, integrated chips.
	5	To understand the concept resonance through sonometer.
Course Outcome	CO1	Demonstrate Torsional pendulum-Rigidity modulus of a wire
	CO2	Discuss function of LR circuits
	CO3	Calculate Uniform bending – Young's modulus of elasticity of a bar
	CO4	Define Spring constant- K
	CO5	Apply Logic Gates using IC's
	CO6	Interpret results of experiments and infer the principles governing them.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	3	1	3	1	-	-	-	-	-	-	-	-
CO2	1	2	-	2	2	2	3	-	-	-	-	-	-	-	-
CO3	2	3	-	1	1	2	2	-	-	-	-	-	-	-	-
CO4	1	2	-	2	3	1	2	-	-	-	-	-	-	-	-
CO5	3	1	-	3	1	2	2	-	-	-	-	-	-	-	-
CO6								-	-	-	-	-	-	-	-
Average	1.8	2.2	-	2.2	1.6	2	2	-	-	-	-	-	-	-	-

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Course contents

1. Torsional pendulum-Rigidity modulus of a wire
2. Half adder and Full adder using basic gate
3. Spring constant- K
4. LR Circuit – Power factor
5. NOR as a universal gate
6. NAND as a universal gate
7. Coefficient of Viscosity of water-graduated burette
8. Sonometer- A.C. Frequency
9. Uniform bending – Young's modulus of elasticity of a bar
10. Spectrometer – Wavelength of mercury spectrum

Text Book:

1. D.S. Mathur, P.S.Hemne, 2000, Mechanics, S. Chand & Company Ltd, New Edition, New Delhi, 1-848
2. A. Ghatak, 2017, Optics, McGraw Hill Education, 6th Edition, New Delhi, 1-632.
3. D.P. Kothari, I. J. Nagrath, 2017, Basic Electronics, McGraw Hill Education (India) Private Limited, 2nd edition, New Delhi, 1-552.
4. V. K. Mehta, Rohot Mehta, 2014, Principles of Electronics, S. Chand & company Ltd, 7th Revised edition, New Delhi, 1-792.

Reference Books:

1. David A. Bell, 2009, Fundamentals of Electronic Devices and Circuits, Oxford University Press (India), 5th Edition, New Delhi, 1-212.
2. M. Morris Mano, Michael D. Ciletti, 2007, Digital Design, Pearson Prentice Hall, Fourth Edition, New Delhi, 1-611.
3. SL Gupta & V Kumar, 2013, A Hand Book of Electronics, Pragati Prakashan, 39th edition, Meerut, 1-1448.
4. Halliday, Resnick and Walker, 2009, Fundamentals of Physics, Wiley India, extended 8th edition, New Delhi, 1-1279.

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Program	B.Sc., (Nautical Science)					
Course Code 231NS1A34TA	Course Name **Navigation – II**		L	T	P	C
			3	0	0	3
Year and Semester	II Year (III Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To familiarize Students with basics of Spherical Trigonometry.
	2	To understand Principles of Great Circle Sailing.
	3	To impart fundamental concept of Celestial Navigation and Principles of Sailing using celestial bodies.
Course Outcome	CO1	Interpret the basics of Spherical Trigonometry as applicable to Great Circle sailing
	CO2	Distinguish the Birth of universe, solar system, nautical astronomy
	CO3	Infer the concept of Celestial Navigation, Equinoctial and Horizon System
	CO4	Infer the Principles and practical use of Sextant and its errors
	CO5	Interpret the concept of time, date line, Greenwich meridian, hour angles, etc.,
	CO6	Calculate the shortest distance between two points on earth.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2			2					-	-	-	-	-			
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	3		1	3	3		3	-	-	-	-	-	3	3	3
Average	2.2	3	0.5	2.2	2.2	3	2.2	-	-	-	-	-	2.2	2.2	2.2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Terrestrial Navigation

UNIT 1 - Basics of Spherical Trigonometry and Great Circle Sailing

Briefly explain spherical shape of the Earth& definition of Great Circle &Small Circle with suitable example.

- **Spherical triangle–**Introduction into basics and explain properties of a Spherical triangle& formulae used to find values (Sine formulae, Cosine formulae and Haversine formulae).Explain differences between three types of spherical triangle (Oblique Spherical Triangle, Right angled and Quandrantal Spherical Triangles).
- **Great Circle Sailing** - Basic calculations of Great Circle sailing to find Great Circle Distance between two positions and to find Initial Course and Final Course.
- **Nautical Table (ABC Table)** Demonstrate use of ABC Table for calculations of Initial and Final Course.
- **Vertex and Napier's Rule**- Meaning of Vertex and its significance in Great Circle Sailing. Use of Napier Rule (for Right Angled Spherical triangle) to find position of Vertex and other values and simple calculations thereon.
- **Composite Track** - Basic on finding IC, FC and Composite track distance based on introduction of 'Limiting Latitudes' in GC Track between two positions using Napier Rule and Parallel Sailing Formula.

Celestial Navigation

UNIT 2 – Solar System and Nautical Astronomy

- Basic knowledge on the Universe& distances of celestial bodies, description of a 'Light year'.
- Composition and dimensions of the Solar System; Kepler's laws of planetary motion; Earth's elliptical orbit; Perihelion and aphelion with distances and dates; Eccentricity of the Earth's orbit; Day / Night &Seasons on the Earth; Solstices and Equinoxes.
- Apparent Motion of Celestial Bodies, in particular of the Sun & Planets due to Orbital motion of the Earth. Conjunction, Opposition and Quadrature of the Planets & Moon. Venus as a Morning & Evening Star; Apparent Magnitude of Planets& Stellar Magnitude.
- Earth and Moon system; Sidereal period and Phases of the Moon; Solar and Lunar Eclipses; Condition necessary for

occurrence of Solar or Lunar Eclipse. Occultation.

UNIT 3 – Celestial Sphere & Coordinates of Celestial Bodies based on Equinoctial System and Horizon System

Introduction into Celestial Sphere, Celestial Poles, Equinoctial, Declination & Parallels of Declination, Celestial Meridian, Ecliptic, Obliquity of the ecliptic and First Point of Aries &Libra.

- **Equinoctial System**–Reference Great Circles of the system 'Equinoctial and Celestial Meridian'. System co-ordinates Declination and Hour Angle to denote position of a Celestial Body. Hour Angles- GHA, SHA, RA, LHA & their relationship. Polar Distance & relationship between PD and Declination. Geographical Position of a Celestial Body on the Earth's Surface. Sketches to show their relationship drawn on plane of the Equinoctial.
- **Horizon System–**Reference Great Circles of the system 'Celestial Horizon (Observer's Rational Horizon) and Celestial Meridian /Vertical Circle'. Observer's Zenith & Nadir, Vertical Circles. Significance of the Principal Vertical & Prime Vertical Circles. System coordinates True Altitude and Azimuth to denote a position of a Celestial Body. Zenith Distance & relationship between ZD and True Altitude. Amplitude & relationship between Amplitude and Azimuth of a Celestial Body. Sketches to show their relationship drawn on plane of the Observer's Rational Horizon.
- **Basic PZX Triangle** - Basics of Equidistant Projection of Celestial sphere **(Combining Horizon + Equinoctial Systems)** ona plain paper on the plane of Rational Horizon and marking of Elevated pole, Zenith, Equinoctial, True Altitude, Zenith Distance, Declination, Polar Distance, Latitude & Co-Latitude and the PZX triangle.
- Drawing to scale (9 Point diagram) of equidistant projection with given values of a Celestial Body and finding out other values from scale drawing- Basics only without ambiguities.

UNIT 4 – Hour Angle

- **Hour Angles** – Important Relationship of GHA, LHA and Longitude for Sun, Moon and Planets. Relationship between GHA Aries, Sidereal Hour Angle and Longitude for Stars and simple calculations to deduce values from one another.
- Corrections for GHA and Declinations – 'v' & 'd' corrections
- **Nautical Almanac** – Information in Nautical Almanac relating to Hour Angle / Declination of Celestial Bodies& using it for celestial observations and related calculations.

UNIT 5 –Concept of Time

- **Time (Basics)**–Solar Time & Sidereal Time, Day (Solar Day & Sidereal Day), Sun (Mean Sun & Apparent Sun), Relationship between Mean, Apparent and Sidereal Times (GMT, GAT, GST, LMT, LAT, LST) and Relationship between Longitude and Time (Arc to Time / Time to Arc) & simple calculations thereon.
- **Time Keeping at Sea** – Standard Time, Zone Time, Time Zone, International Date Line, Comparison of Sidereal & Solar Time, Basics on Equation of Time & conversion from Apparent to Mean & vice versa, Universal Time (UT, UT1 & UT2), Advancing & Retarding of Clocks with change of Longitude, Time Signals, and basic calculations to find required time onboard.

Text Book:

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

Reference Books:

3. Nichol's Concise Guide Volume-1 and 2
4. The Admiralty Manual of Navigation
5. Principles of Navigation: Vol. 1- Nautical Institute
6. Navigation Guide Vol. 1: Near Coastal Navigation- Alexander Simpson
7. Practical Navigation for Officers of the Watch- Frost, A
8. The Marine sextant booklet by Capt. H.Subramaniam
9. Spherical Trigonometry by Capt H.Subramanium
10. Introduction to Spherical Trigonometry by J.H.Clough –Smith

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Program	B.Sc., (Nautical Science)				
Course Code 231NS1A34TB	Course Name **Bridge Equipment & Bridge Resource Mgt-II**		L	T	P	C
			2	0	0	2
Year and Semester	II Year (III Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To train the students in radar plotting.
	2	To know the importance of bridge resource management.
	3	To understand the procedure for making entries in log book
Course Outcome	CO1	Perform Radar plotting-Manual and using ARPA
	CO2	Obtain Electronic Position Fixing using Hyperbolic Navigation systems-LORAN-C
	CO3	Distinguish GPS and DGPS
	CO4	Organize Safe Navigational Watch and related entries in log book
	CO5	Interpret Storm warning at Sea.
	CO6	Relate with Bridge Procedures Guide, Pilot embarking & disembarking.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.75	3	1.33	2.75	2.75	3	2.75	-	-	-	-	-	2.75	2.75	2.75

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1 : Speed measuring Instruments – Doppler Speed Log Speed logs- Various types and their limitations:- Electro- magnetic log: Explain: Principleand Errors, Doppler speed log: Explain: Principle, The Limitations, Janus configuration, Calibration of the log, List: The main error sources of Doppler log, Describe: How ship's speed is transmitted to remote displays (block diagram), Draw: A Sketch showing how indication of distance run is derived from a speed log., Acoustic Correlation Logs and their limitations. Differentiate between ground reference speed and water reference speed and principles involved in how these are calculated in various Logs (especially Doppler Log).

Echo-sounders

1.1.1 describes the basic principles of marine echo-sounding equipment

1.1.2 identifies the main components on a simple block diagram of an echo-sounder, and states the function of each

1.1.3 describes the accepted value of the velocity of sound in seawater and the limits within which the true value may lie

1.1.4 describes the physical factors which affect the velocity of sound in seawater

1.1.5 operates a typical echo-sounder and demonstrates an ability to carry out basic user maintenance, e.g. clean plate, change paper, change and adjust stylus

1.1.6 differentiates between range and phase, and demonstrates an awareness of the dangers of using the wrong phase

1.1.7 distinguishes between inaccuracies caused by instrument and scale error and those caused by false echoes

1.1.8 explains the causes of inaccuracies to instrument or scale error and states their likely magnitude and measures that maybe taken to eliminate them

1.1.9 recognizes the various types of "false" echo that may be observed, describes their formation and states the possible action to remove them from the trace

1.1.10 describes the potential errors due to trim, heel and transducer separation

2.1 Unit 2 Loran-C system

2.1.1 Describes the basic Loran-C and eLoran system

2.1.2 draws a block diagram of a Loran-C receiver, showing how time differences are measured

2.1.3 describes how ambiguity in a position line is resolved

2.1.4 explains why third-cycle matching is used

2.1.5 explain show the use of sky waves affects the measured time difference

2.1.6 describes typical radii of coverage areas

2.1.7 identifies the Loran chart and the additional information printed there on

2.1.8 switches on equipment ;selects chain and relates the time differences obtained to the correct station pair

2.1.9 recognizes warnings which indicate that the system may be faulty

2.2 Enhanced Loran (eLoran)

2.2.1 describes the basic operating principles of eLoran

2.2.2 describes the principal difference between eLoran and traditional Loran-C system

2.2.3 explains the use of eLoran when satellite services are disrupted

2.2.4 states that each user's eLoran receiver will be operable in all regions where an eLoran service is provided

2.2.5 describes the control, operating and monitoring systems of eLoran

2.2.6 states that eLoran transmissions are synchronized to an identifiable, Publicly certified, source of Coordinated Universal Time (UTC) by a method wholly independent of GNSS

2.2.7 explains the view mode and signal tracking of eLoran

2.2.8 describes the advantages and limitations of eLoran

UNIT 3 Global navigation satellite systems

- Describes the principles of operation of global navigation satellite systems
- States that the system will provide continuous worldwide position-fixing capabilities
- describes the intended level of accuracy of the system

GPS systems

- Describes the basic principles of the Global Positioning system(GPS)
- describes the system configuration
- states the frequencies that are used
- describes the C/A & P codes
- describes how the basic line measurement is obtained
- describes the Dilution of Precision(DOP)
- describes the various DOPs that are used
- describes the various errors of GPS
- describes the reasons for selective availability and the effect it may have on the accuracy of a fix
- describes differential GPS
- describes the accuracy obtain able with GPs and how the accuracy can be downgraded
- explainsWGs84
- explains why a fix obtained from the GPs receiver cannot be plotted direct onto a navigational chart

- explains datum shifts
- describes the advantages and limitations of GPs

3.6 Augmented satellite systems

- describes the basic principle of Differential GPs
- describes how DGPs stations can transmit the corrections
- describes the Regional satellite Navigation systems such as China's BeiDou (Compass)Navigation satellitesystem,India's Indian Regional Navigational satellite system(IRNSS),Japan's Quasi-Zenith satellite system(QZSS) and France's Doppler Orbitography and Radio positioning Integrated by satellite (DORIs)
- describes the limitation of the DGPs receiver

3.7 GLONASS

- Describes the principle on which the GLONASS works
- explains the different satellite constellation configurations under GLONASS and GPS respectively
- describes the advantage of the receiver capable of operating both GLONASS and GPs "combined GPs/GLONASS receiver equipment"
- describes the limitation of the GLONASS system receiver

3.8 Galileo

- Explains the principle of Galileo as the European satellite navigation system
- Describes that Galileo comprises 30 medium earth orbit(MEO)satellites in 3 circular orbits
- States the satellite geometry and dual atomic clocks in the Galileo system
- States that atomic clock signal information is used to calculate the position of the receiver by triangulating the difference in received signals from multiple satellites
- Describes the limitations of the Galileo system receiver

UNIT 4 Bridge Equipment's – Azimuth Mirror, ROTI, Course Recorder,Magnetic compass

1 **Azimuth Mirror:-** Various types, uses, principle of Arrow up and arrow-down prism, checking accuracy of Azimuth Circle for wear and tear, Explain that it is a precision instrument, care in handling and maintenance.

2 **ROTI:-** General description, Advantages of ROTI, Precautions while using the ROTI, Wheel over point, Relationship between the radius of turn, the rate of turn and the ship's speed.

3 **Course recorder:** General description, Inputs to the course recorder, Recording Paper – Sections, Explain working of course recorder, care, checks and record keeping,
Starting of course recorder, Changing paper of course recorder

4 **Magnetic Compass**

The magnetism of the earth. Magnetic poles and variation. True, magnetic and compass north. Annual rate of change of Magnetic variation; Isogonals and Agonic lines, Magnetic Chart showing variation at different locations. Procedure to obtain variation from data given on the compass rose.

1. The magnetic compass: Liquid and dry card magnetic compass, lubber line. The construction of the binnacle and use of periscope. Basic idea of Correctors.
2. Location of Magnetic compass, Rules thereof, Safe Distance concept.

3. Compass points, Boxing of Compass, Advantages of compass projector, care and maintenance of magnetic compass
4. Practical limitation of the magnetic compasses – Removal of Bubbles
8. Basic idea on newer digital type Magnetic Compasses.

UNIT 5 Maintain Safe Navigational Watch

1.Description of Ship's logbook:-Front cover – Preliminary Pages – Main Pages, Left Half of the Page – Navigational data columns – Meteorological data columns – Noon Particulars – Other entries, Right Half of the Page –Narration Section and Initial Column, Bottom of the Pagedata

2. Entries in Ship's logbook:- Importance of entries, Correction of entries, When should entries be made, Scrutiny by the Chief Officer and Master, Daily Entries at the top, Routine Entries at Sea on the Left side – Navigational data – Engine related data – Noon particulars, Routine Right Half / side of the page - Navigation related entries - Engine related entries in the narration section at Sea, at Sea – Weather related entries – Cargo related entries – Ship Motion related entries –Piracy prone areas at sea entries

3. Routine Entries Leaving port & Arriving Port, Routine entries in port watch

Text Book:

1) Shipborne Radar and ARPA-- Capt. H. Subramaniam
2) Nautical Watch Keeping – Capt. H. Subramaniam
3) Bridge Procedure Guide - ICS

Reference Books:

1) Nautical Watch Keeping – Capt. H. Subramaniam
2) Bridge Procedure Guide - ICS
3) Bridge Team work - Nautical Institute
4) Mariners Handbook – HMSO Publication
5) A Mariner's guide to preventing collisions- Capt. Y.Chhabra
6) Bridge Equipments&Watch Keeping Notes – E. Fernandes.
7) STCW Convention / CODE with latest Amendments- Extracts on Bridge Watch Keeping-duties, functions and procedures.
8) Shipborne Radar and ARPA-- Capt. H. Subramaniam
9) Electronic Navigational Aid—Sonnenberg
10) Modern Electronic Aids—Bhatia and Sinha
11) International; Code Of Signals—HMSO

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)				
Course Code 231NS1A34TC	Course Name **Ship Stability – I**		L	T	P	C
			3	0	0	3
Year and Semester	II Year (III Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To introduce the basic principles of ship stability.
	2	To familiarize with Form Coefficients, Load lines, Centre of Gravity (G).
	3	To learn about Centre of Buoyancy (B) and Transverse Statical Stability
Course Outcome	CO1	Infer the basic principles of ship stability
	CO2	Interpret Form Coefficients, Load lines, Centre of Gravity (G) and Centre of Buoyancy (B)
	CO3	Acquire the knowledge about Transverse Statical Stability
	CO4	Interpret Load line convention rules as applicable to ships, zones etc.
	CO5	Calculate stability of metacentric height, displacement, Dead Weight, etc.
	CO6	To formulate problems related to ship's metacenter.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
Average	2.83	3	1	2.83	2.83	3	2.83	-	-	-	-	-	2.83	2.83	2.83

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit 1: Basic Principles

• Understand the terms Density, Relative Density, Mass, Volume, Ullage, Sounding, Water pressure, thrust and be able to complete simple calculations relating to these terms.

• Understand the laws governing flotation, Archimedes Principle, the terms draught, freeboard and Interpret draught markings, read draughts marks in Mts and Cms, Feet and inches; complete simple calculations relating to these terms on box-shaped vessels.

• Understand the change in draught/ freeboard that will occur when a box - shaped vessel moves between water of different densities and be able to complete calculations relating to these terms on box-shaped vessels.

• Understanding terms: Displacement, Light displacement, Load displacement, present displacement, Deadweight, Deadweight aboard and available deadweight and be able to complete calculations relating to these terms on box-shaped vessels.

Unit 2: Form Coefficients

• Understand the term Coefficient of fineness of the water- plane area (C_w), Block coefficient (C_b), Midships coefficient (C_m), longitudinal prismatic coefficient (C_p), relationship between C_p, C_b and C_m; Reserve buoyancy and complete simple calculations on these terms.

• Understand the term Tonnes per centimetre immersion, derive the formula for TPC; Understand the factors that affect the value of TPC; perform simple calculations.

• Construct Draft - Displacement, TPC and Deadweight curves to scale for a given data (Hydrostatic table/ curve);

• Use Displacement and TPC values from tabulated hydrostatic particulars to perform simple calculations involving draught changes when cargo is loaded or discharged.

Unit 3: Load lines

• Know the dimensions of a set of load lines as would be assigned to a ship.

• Understand the term Fresh Water Allowance (FWA) and derive the formula for FWA.

• Understand the term Dock Water Allowance (DWA).

• Perform calculations relating to FWA, DWA and the loading of a ship to the appropriate load line mark.

Unit 4: Centre of Gravity (G) and Centre of Buoyancy (B)

• Understand the term Centre of Gravity (G); also how Centre of Gravity of a ship can be pinpointed if the 3 references are known – Distance from keel, Distance from Aft Perpendicular and distance from fore & aft centerline.

• Understand the effect on G of - shifting a single weight vertically up/down; loading a single weight in a position vertically

above/below G; discharging a single weight from a position vertically above/below G and calculate the new position of G of the ship.

• Understand shifting, loading or discharging multiple weights and calculate KG of the ship using vertical moments method.

• Understand the term Centre of Buoyancy (B); also how Centre of Buoyancy of a ship can be pinpointed if the 3 references are known – Distance from keel, Distance from Aft Perpendicular and distance from fore & aft centerline;

• Identify the factors that influence its position and perform simple calculations to find KB in salt water and fresh water for different geometric shapes.

• Drawing of the transverse section of a ship and Positioning G, B, W_f, B_f, K, Water line, & shifted positions of G, B.

Unit 5: Introduction to Transverse Statical Stability

• Understand the term "Heel" "Transverse Statical Stability", "Righting Lever" and how righting levers are presented as curve of Statical stability (GZ curve) for different angles of heel.

• Understand the term "Righting Moment". "Initial Transverse Metacentre" and it's relevance to the initial stability of a ship when heeled within small angles.

• Understand the term 'Metacentric height' and its relevance to current IMO stability criteria.

• Understand the term 'Stiff' and 'Tender' ship;

• Calculate the "Moment of Transverse Statical Stability" for a ship at a specified angle of heel.

• Drawing the transverse section of a ship heeled to a small angle and identifying the points K, G, M, W_f, B_f, GZ, Angle of heel, the right angle formed at GZ.

Text Book:

Ship Stability for Masters and Mates- DA Derett

2. Ship Stability at the Operational Level-Capt. H. Subramaniam

3. Problems on MV Hindship – Capt. TK Joseph and Capt. SSS Rewari

Reference Books:

Ship Stability Booklet of MV Hindship

2. Grain Code-IMO

3. Ship Stability for Masters and Mates-Martin A Rhodes

4. Ship Stability by Kemp and Young.

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)				
Course Code 231NS1A34TD	Course Name **Ship Operation Technology – II**		L	T	P	C
			2	0	0	2
Year and Semester	II Year (III Semester)		Contact hours per week Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To introduce the cadets to the rope work practices,
	2	To expose to anchor work routines.
	3	To understand shipboard maintenance done onboard ships.
Course Outcome	CO1	Classify Types of ropes
	CO2	Infer wire ropes and mooring system
	CO3	Interpret the principles of Anchor
	CO4	Acquire the knowledge about the use of Anchor
	CO5	Prepare the vessel for safe operation by maintenance
	CO6	Enumerate the essential aspects of rope work and anchor work

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
Average	2.83	3	0.5	2.83	2.83	3	2.83	-	-	-	-	-	2.83	2.83	2.83

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT -1 Natural & Synthetic Fiber Ropes

- Three kinds of ropes used on ships: - Natural, Synthetic fiber, Steel wire, Material used in & Construction of Vegetable Fiber Ropes – Manila, Sisal, Coir, Hemp, Marline, Spun yarn. Material used in & Construction of synthetic fiber ropes – Nylon, Polythene, Terylene, Polypropylene, Kevlar. Types of lay of rope and their advantages: - Hawser laid, Shroud laid, Cable laid, Plaited ropes. Coiling of Ropes, Flaking Ropes, Cheesing down, Frenchman
- Whipping, types of whipping. Marrying two ropes, Opening a coil of new rope. Characteristics, care and maintenance of natural, Synthetic fiber ropes, Rope stoppers, breaking out Mooring rope coil, Identifying the different kinds of synthetic ropes by the colour yarns, Fid.

UNIT –2 Wire Rope and Mooring System

Materials used of construction of wire rope, Types of wire rope and its uses, purpose of heart(Core), Lang lay wire rope, Mixed fiber wire rope, Plastic Coated wire rope, Bad nip, Ferrule, Specification of Wire rope, Cutting procedure of Wire ropes, Test certificate contents of wire rope, Safe handling procedures, wire rope checks, Discarding conditions of wire rope, Bulldog grips, Moorings, Rat Guards, Chain stopper, Securing ropes on Bitts, securing more than one rope on a single bollard, Heaving line, Messenger line, fenders, Safety precautions at stations ford & aft. Mooring terms: - Avast Heaving, make fast, slack away, hold on, single up, let go, Heave away, pick up slack

UNIT – 3 Anchor Types

- Purpose of Anchor, Number of anchors carried in ship, Types of Anchor:- Stock and Stockless anchor, Types of stock anchor:- Admiralty stock Anchor, CQR Anchor, Danforth Anchor, Grapnel Anchor, Advantages of Stock anchor, Parts of Anchor, Hawse pipe, Spurling Pipe, No. of Anchors to be carried, Reasons for anchoring, Markings on the Anchor, Tests on Anchor:- Drop test, Bending test, Anchor Certificate details, Procedure for coming to

Anchor, Types of Anchor Moorings:- Open Moor, Running Moor, Standing Moor

UNIT – 4 Anchor Cable and Associated Parts

- Chain cable, Parts and uses of lugged and lugless joining shackle(kenter), Anchor shackle('D' lugged joining Shackle), swivel piece and it location, Connection of Anchor with anchor chain, Length of Anchor cable, Number of shackles of chain each anchor carry, Marking of Cable, Chain locker, bitter end, Securing of bitter end, Windlass and its purpose, Windlass brake band system, Split Windlass, Lay out of Forecastle with anchor cable arrangements, Lay out of Chain locker with Windlass arrangement. Securing arrangements of Anchor: - Bow stopper, Devil's claw, wire lashing, Maintenance of Anchor and its associated gear,

Unit 5: Ship Maintenance

- Corrosion, cathodic protection: - sacrificial anode, impressed current, Bimetallic corrosion, Surface Preparation: - Types of de-scaling – tools, Paint: - composition of paint, primer, under coat, top coat, Boot Topping, types of paint, mixing of paint, How to Prepare surface for painting.
- Common methods of painting: - Brush, Roller, Conventional spray, Airless spray, Proper procedures when using tools for surface preparation, Safety precautions to be taken when painting.
- Painting defects and Remedy: - Blistering, Cracking, Crawling, Grinning, Slow Drying, Dulling, Holidays, Peeling, Sagging, wrinkling, skinning, Yellowing.

Planned Maintenance System (PMS)

- Reasons for planned maintenance, construction of a planned maintenance schedule, Three categories – Short-term, Long-term, Maintenance due to operational requirements. Sample PMS of a General Cargo Vessel based on three categories, Testing of Lifting Machineries (Plant) – Examination – Certificates and Reports. Rigging Plans, Surveys on ships, Maintenance schedule for cargo-handling equipment, Safety Precautions when Overhauling cargo appliances, Care and maintenance of mechanical steel hatch covers, Care and maintenance of Pilot ladders and Hoists.

Dry Docking Operations

- Introduction, Frequency, Preparation of repair List:- Standard items, Repair Items, Modification Items. Graving dock, Floating dock

Text Book:

1. Seamanship Notes by Kemp and Young

2. Theory and practice of seamanship by Danton G

3. Seamanship practice by Capt Dinger

Reference Books:

1. Seamanship and Nautical Knowledge – Nicholls

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code 231NS1A34TE	Course Name **CARGO HANDLING AND STOWAGE- II**		L	T	P	C
			3	0	0	3
Year and Semester	II Year (III Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	Know the importance of cargo handling and stowage.
	2	Understand the difficulties to stow cargo such as coal, grain, oil, timber.
	3	Enumerate the checks to be carried out prior to loading.
Course Outcome	CO1	Interpret the principles of Loading and discharging of oil cargoes, tanker work
	CO2	Prepare Cargo lifting gear for cargo handling. Familiarize with dock Workers regulations and chain register
	CO3	Prepare vessel for stowage some difficult cargoes such as coal, grain, timber. Familiarize with BLU code & IMSBC
	CO4	Interpret procedure handling of Grain Cargoes (SOLAS Ch. VI, IMO grain code) & Coal Cargoes
	CO5	Acquire the knowledge about deck cargo, Timber and high density cargoes, containers and cargo plans for these vessels.
	CO6	Relate the responsibility of duty officer while keeping cargo watch on tankers, bulkers, container vessels, timber cargo vessels.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.25	3	0.83	2.25	2.25	3	2.25	-	-	-	-	-	2.25	2.25	2.25

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT-1 - Oil Cargoes

- Crude oil, Basic propertied of petroleum, volatility, Refined products, Spiked crude, Sour crude, Reid vapour pressure, Upper and lower flammable limits, Pour point.
- Density of liquids and gases, Viscosity.
- Flammability diagram, Flammable Range, Lower and Upper flammable limits, Solubility of gases
- Threshold Limit Value, Toxicity
- Pipe line and valves.
- Tanker arrangement (tanks, pump rooms, slop tanks, cofferdams, deep tanks)
- Cargo piping system (Free flow, Ring main, Direct Line and stripping), Cargo heating and cargo pumps
- Sources of Ignition.
- Loading single grades and multiple grade oils.
- Hazards of Tanker. Firefighting principles, Flame screens and flame arresters

UNIT- 2 Ship's Cargo Lifting Gear Derricks

- Parts of a Simple Derrick. l Types of Stuelckenderrick, Advantages of stuelcken derrick
- Importance of preventer guys. The union purchase system. Precautions when working on Union Purchase systems.
- Rigging of derricks for loading and discharging of cargoes.
- Maximum load to be used for angle between runners.
- Swinging derrick with powered guys.
- Putting winches in double gear.
- Hoisting, lowering and securing a derrick.
- Safety Precautions while handling Heavy life derricks.
- Operational checks to be done on ship's cargo gear before handing over to stevedores including checks on limit cut outs;
- Contents and use of the Rigging Plan

- Purpose of Out rigger

Cranes

- Cranes: Deck cranes, Gemini Cranes, Knuckle Boom crane,
- Single girder Gantry crane.
- Rail mounted Gantry crane(RMG).
- Single girder shipboard Gantry cranes.
- Side Running trolley
- Operation of the Gantry cranes
- Safety feature of cranes & General arrangement of Gantry crane
- Advantages and Disadvantages of Derricks and cranes.

Port Cargo Handling and Mobile Equipments:

- Portainers, Types of portainers, Operations.
- Forklift Trucks.
- Straddle Trucks, Trailer spotting tractors, Approved Trucks
- Duties of operator
- Unit Handling conveyors, Chute Conveyor, Bucket conveyor, Vacuum Suctors

UNIT-3- Detailed Study of Bulk Carriers including Grain

- Preparations of holds prior to loading bulk cargoes; Use of various equipment for hold cleaning; Log Book entries.
- Classification of cargoes as per IMSBC Code.
- Main hazards and precautions with the shipment of bulk solids (Ores, Concentrates, HBI/DRI).
- Documentation required prior loading.
- Hazards associated with and precautions to be taken whilst loading/ carrying high density cargoes, Maximum allowable weight for single and adjacent holds, Block Loading.
- Purpose and objectives of Bulk carrier loading and unloading (BLU) code.
- Loading, discharging, ballasting and deballasting operations.
- Test for determining angle of Repose and FMP on board.
- MSDS Sheets;
- Precautions to be taken prior entering cargo holds when pesticides are used for fumigation.
- Ship/Shore safety checklist.

UNIT-4 - Grain Cargoes (SOLAS Ch. VI, IMO grain code)& Coal Cargoes

- Definition of Grain, Filled and Partly filled compartments.
- Trimmed and untrimmed cargo, Specially suitable compartment.
- Preparation of holds for carriage of grain cargo especially for insect or rodent infestation.
- Pre loading inspections/surveys.
- Securing free grain surface in filled and partly filled compartments.
- Separation of different grain cargoes loaded in same compartment.
- Use of shifting boards and bundling arrangements.
- Document of Authorisation.
- Grain loading stability criteria for ships with and with a DoA.
- Contents of Grain loading booklet.
- Methods to reduce Grain heeling moments in order to meet Grain stability criteria.

Coal Cargoes:

- Introduction, Segregation and stowage requirements for all types of coal.
- Coal emitting Methane.
- Self Heating coals, Coals and whose behavioural pattern unknown.

- Procedure for Gas monitoring of coal cargo
- Sampling and Measurement Procedure.
- Fire fighting in coal ships.
- Preparations of holds prior to loading bulk cargoes.
- Hazards associated with bulk cargoes and precautions prior, during and after loading of Coal, Sulphur, Iron ore, Urea.
- Protection of deck machinery from dust.

Unit 5 Deck cargo including Timber and stowage plans

- Dangerous Cargoes not permitted below deck.
- Various types of Deck Cargo.
- Efficient means of securing deck cargoes.
- Need of battening of cargo hold before loading deck cargo.
- Safe access to equipment and spaces.
- Standard Safety precautions during cargo work.
- Maximum permissible load.
- Unobstructed view from the navigating bridge.
- High Density Cargo: Structural Hazard and Precautions, Trimming Requirements, Problems.
- increased reserve buoyancy of a timber deck cargo
- describes in outline the recommendations on the stowage and lashing of timer deck cargoes as set out in the IMO Code of Safe Practice for Ships Carrying Timer Deck Cargoes

Stowage Plans:

- Planning stowage of general cargo taking into account stowage factor, port rotation, hazardous nature, special stowage requirement relating to cargoes not covered by special codes.
- demonstrates the uses of a hold capacity plan to estimate the depth of cargo in a hold or the area of tween-deck required for a given cargo.
- demonstrates the uses of a capacity plan to estimate the quantity of cargo which can be loaded in part of a tween-deck

Text Book:

1. Safe cargo handling procedures Vol 1 and Vol 2 by P.J.Samson

Reference Books:

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

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)				
Course Code 231NS1A34TF	Course Name **Maritime Law-I**		L	T	P	C
			2	0	0	2
Year and Semester	II Year (III Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To familiarize the cadets the contents of various International conventions.
	2	To enable interpretation of international regulations.
	3	To deliver the knowledge about implementation of protocol's
Course Outcome	CO1	Familiarize with IMO conventions, IMO Organisation, functions and Basic laws
	CO2	Relate to law of sea
	CO3	Infer Load line and Tonnage convention
	CO4	Relate SOLAS with importance to subdivision and Fire safety
	CO5	Interpret SOLAS regarding application of LSA requirements
	CO6	Examine the knowledge of LSA AND FFA equipments

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

MARITIME LAW AND CONVENTION- I

UNIT 1 BASIC LAW – VARIOUS ORGANISATIONS AND CONVENTIONS & RATIFICATION

common law -statute law- civil law – criminal law – private law – public law -convention- elements and significance of various conventions –ratification – various organisations - UNITED NATIONS (UN), IMO- COMITE MARITIME INTERNATIONAL(CMI) -BIMCO,-ITF, WORLD HEALTH ORGANIZATION (WHO): INTERNATIONAL LABOURORGANISATIONS (ILO), CMMI, ISMA, NAUTICAL INSTITUTE, INTERCARGO, INTERTANKO, IHO, IACS- surveys- inspections-penal sanctions- operations of ships under national and international laws(port state and flag state)- various jurisdiction(flag state – port state- coastal)

UNIT2 LAW OF THE SEAS

conventions on the law of the sea -territorial sea and the contiguous zone - international straits - exclusive economic zone and continental shelf - high seas

UNIT 3 LOADLINE CONVENTION & TONNAGE CONVENTION

INTERNATIONAL CONVENTION ON LOAD LINES, 1966 (LL 1966), AS AMENDED (4 HOURS)

application – loadline certificate – freeboard – various markings of loadline – provisions with respect to openings,, closing and protection to crew for various access

INTERNATIONAL CONVENTION ON TONNAGE MEASUREMENT OF SHIPS, 1969 (2 HOURS)

Defines, for the purposes of theconvention – International voyage - Gross Tonnage - Net Tonnage - new ship - existing ship - explains the applications of the convention to new and existing ships - tonnage certificate – provisions- validity- national rules

UNIT 4 SOLAS - GENERAL PROVISION, SUBDIVISION MACHINERY, STABILITY & ELECTRICAL

INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA,1974 AS AMENDED (SOLAS) – GENERAL PROVISIONS (2HOURS)

Application – definitions (international voyage – passenger- passenger ships- tanker)- surveys as per SOLAS- surveyors- surveys on a passenger ships- mandatory surveys- accidents – reporting in case of accidents to flag state- owners as per SOLAS- various certificates issued including supplements – validity- exemption- acceptance by contracting governments

SOLAS – SUBDIVISION AND STABILITY, MACHINERY AND ELECTRICAL INSTALLATION(4 HOURS)

Definitions: subdivision loadline- deepest subdivision loadline – length – draught – bulkhead deck - permeability of a space – machinery space – passenger spaces - watertight - breadth - margin line - explains what is meant by ‘floodable length’ - ‘factor of subdivision’ .

Requirements for : factor of sub division to a passenger ship's ability to withstand the flooding of adjacent main compartments – unsymmetrical flooding – cross flooding fittings - datas to be provided to master on various conditions of stability – markings of subdivision loadline on passenger ships and passenger ship safety certificate -
Compliance with regard to the international convention on load lines – classification of water tight doors (class1–hinged doors; class 2 – hand-operated sliding doors; class3 – sliding doors which are power-operated as well as hand-operated) – provisions of water tight doors in passenger ships – side scuttles – dead lights – regulations regarding record of operations – entries on log book – damage control plans for various ships like dry cargo- passenger – RO-RO – provision of plans to ship master/officers – detection and monitoring of spaces in case of flooding

SOLAS – FIRE PROTECTION, FIRE DETECTION AND FIRE EXTINCTION (3 HOURS)

Basic principle of the regulations on fire protection – class A & B Division – definitions of spaces (main vertical zones – accommodation spaces – public spaces – service spaces - RO-RO cargo spaces, open & closed - special category spaces - machinery spaces of category a - cargo space - control station) SOLAS training and maintenance manual – fire control plan – fire hose : purpose – testing – drills and surveys – location of fire control plan – fire extinguishing appliances – maintenance and operation instructions – fire alarm- location – fire control station – bridge panel –fire patrol – special requirements of ships carrying dangerous goods – compliance as per administration

UNIT 5 SOLAS - LSA

SOLAS – LIFE-SAVING APPLIANCES AND ARRANGEMENTS

Various launching arrangements as per chapter III of SOLAS –requirements- muster list – display of illustration and emergency instructions in various spaces - operating instructions for LSAeqpts – training manuals – maintenance manuals – drills – requirements and guidelines – trainings and use of LSAeqpts carried out on board – record of drills and on board training – instruction for maintenance of LSAeqpts – tests – records of entries – servicing of LSAeqpts including inflatable liferafts, inflatable lifejackets, inflated rescue boats and hydrostatic release gear.Special mention on passenger muster station requirements – drills – periodicity.

Text Book:

The Shipmaster's Business Companion – MALCOM MACLACHLAN

2. Business and Law for shipmaster's – F.N. HOPKINS

Reference Books:

1. International Convention on Load lines
2. International Convention on Tonnage
3. SOLAS

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)				
Course Code	Course Name **Marine Engr. Automation Control System-I**		L	T	P	C
			2	0	0	2
Year and Semester	II Year (III Semester)		Contact hours per week 2Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
	Basic Science	Engineering Science	Open Elective	Mandatory		
		✓				

Course Objective	1	To introduce the concepts of automation.
	2	To learn the principles of thermodynamics.
	3	To understand the science of steel.
Course Outcome	CO1	Infer the Strength of materials
	CO2	Acquire the fundamentals of Fluid mechanics
	CO3	Interpret the principles governing the properties of Thermodynamics
	CO4	Compare the Mechanical Engineering Science of Metals and alloys
	CO5	Distinguish Mechanical Engineering Science of Steel, mechanical drawingetc
	CO6	Summarize the principles of Marine Engineering Automation and control system.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	2	2	2	3	2	-	-	-	-	-	2	2	2
CO2	3	1	3	3	3		3	-	-	-	-	-	3	3	3
CO3	2	-	2	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	-	2	2	2	3	2	-	-	-	-	-	2	2	2
CO5	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	2	-	2	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.2	0.5	2.2	2.2	2.2	3	2.2	-	-	-	-	-	2.2	2.2	2.2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT-1 STRENGTH OF MATERIALS

Hook's Law, stress & strain, Tensile, Compressive and Shear forces, Failure of materials under tension, compression, shear & fatigue. Beams: Various Types - Cantilever and Simply supported Beams . Examples related to Marine Engineering.

UNIT-2 FLUID MECHANICS

Properties of fluids – ideal fluid – actual fluid – fluid pressure. Forces on walls of container – surface tension – atmospheric equilibrium. Fluid in motion – one dimensional flow – continuity equation – Euler's equation – Bernoulli's equation – Energy equation for unsteady flow.

Newton's law of fluid friction – Laminar flow – Poiseuille's flow – Turbulent flow – Reynold's number –Friction coefficient Loss of energy of fluid due to bends, friction, valves, etc. Simple hydraulic equipment.

UNIT-3 THERMODYNAMICS

Basic Laws of Thermodynamics. Heat and work interaction, Joule's Law. Behavior of ideal Gases – Boyle's &Charle's Laws, Gas Law and Gas equation. Properties of steam, Boiling point and effect of pressure on Saturated / Dry / Superheated steam. Dryness fraction. Meaning of sensible heat & latent heat.

UNIT-4 MECHANICAL ENGINEERING SCIENCE:- METALS and Alloys

Common engineering materials. Various metals & alloys. Properties & uses. Ceramics & their uses. Simple Heat treatments of Metals- obtaining desired properties for various applications. Hardness, Ductility, Malleability, Melting Point etc. Destructive and Non-destructive testing of Materials

UNIT-5 MECHANICAL ENGINEERING SCIENCE:- STEEL

Elementary metallurgy of steels. Steel production- smelting & refining. Iron- carbon diagram to show role of carbon in

steels & effect on properties. Types of steel & use. Heat treatment of steels. Obtaining desired properties from steel for use in different areas

MECHANICAL DRAWING:

Brief description of drawing papers, pencils, instruments & their use. Types of lines & dimensioning. Loci of points. Orthography projection of points. Straight lines, planes, solids. Isometric projection. Concept of form and shape, plan, elevation and end views of objects. Contours, change of sections, hidden (Internal) construction, dotted lines, etc. Discussion on Ship's plans- cut, cross sections. Engineering drawing by free-hand sketching practice.

Text Book:

1) Motor Engineering Knowledge for Marine Engineers – Reeds Vol. 12
2) Basic Marine Engineering – J.K. Dhar
3) Basic Electro technology – Reeds Vol. 6
4) Instrumentation & Control for Engineers –Reeds Vol.10

Reference Books:

General Engineering Knowledge for Engineers – Reeds Vol. 8
2. Engineering Drawing – Reeds
3. Marine Electrical Equipment & Practice – McGeorge
4. Marine Engineering Practice Vol. 2 Part 17 Slow Speed Diesel Engines by Institute of Marine Engineers (England)
5. Materials for Marine Machinery – Fredrick & Capper
6. Marine Auxiliary Machinery – McGeorge
7. Marine Machinery – Harrington
8. Diesel Engines Q and A – A.J. Wharton, KandySeries
9. Marine Engineering Practice Vol. 1 Part 3 Marine Medium Speed Diesel Engines byInstitute of Marine Engineers (England)
10. Internal Combustion Engine Fundamentals – J.B. Heywood
11. Marine Auxiliary Machinery – Taylor
12. Marine Air Conditioning – S.D. Srivastav
13. Marine Engineering Practice Vol. 2 Part 16 Ships Gear: Review of Deck Machinery by Institute of Marine Engineers (England)
14. Marine & Offshore pumping and piping systems – Crawford

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code 231NS1A34PG	Course Name **RULES OF THE ROAD-III**		L	T	P	C
			0	0	2	1
Year and Semester	II Year (III Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	1. To have a thorough understanding of the sectors, overlapping sectors and the reason for special positioning of lights and shapes.
	2	2. To thoroughly understand and demonstrate the importance of the longitudinal, athwart ship and positioning of various lights and shapes and the purpose thereof.
	3	To readily recognize the aspect of a target ship by visual observation with sufficient confidence to decide when, why, how and quantum of action to avoid collision.
Course Outcome	CO1	Understand and demonstrate by case-studies that the "action-taking" Rule 13, 14, 15 are not as simple as they sound but All other Rues of Part B are significance in decision- making.
	CO2	Be able to prioritize the various duties that an OOW has to multi-task and decide their overlapping consequences.
	CO3	Fully comprehend and demonstrate with case studies the significance of "Rule5and 6 " and its assumptions.
	CO4	Readily appreciate and interpret the various aspects of a sighted vessel (Target ship)
	CO5	Comprehend the various ambiguous situations in a Head-On collision situation with a PDV or 'privileged craft' and be able to take the most appropriate action.
	CO6	Identify the reason for spatial positioning of lights and shapes and the significance thereof.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
Average	2.2	3	0.67	2.2	2.2	3	2.2	-	-	-	-	-	2.2	2.2	2.2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1:- Rule 19

- Rule 19:- Detailed explanation and demonstartion using table top models or simulator, PPT in respect of follwing
  - Rule 19 conduct of vessels in RV applies to in and near an area of RV –
  - Rule 19 re-emphasis the “safe-speed” criteria with prevailing conditions
  - Engines must be ready to use.
  - There is no stand-on vessel in RV and in case of ROC both vessels to take action
  - The general principles and obigation under Section1 (Rule 4 to 10) still applies in RV condtions and when taking action Rule 4-10 stipulations and or guidance apply in RV as well.
  - Every vessel fitted with operational radar must keep an efficient radar watch in target tracking and asses a potential close-quarter situation.
  - If there is a close quarter situation every vessl must take action to avoid collision.
  - If the action decided is an alteration of course
    - a vessel having another vessel forward of her beam should avoid altering course to port, unless it is an overtaking situation
    - a vessel should avoid alltering course towards a vessel close to her beam.
  - In any case, if a vessel hears “apparently” forward of her beanm the fog signal of another vessel should immediately reduce speed to steerageway and if necessary take all her way off and observe the situation. This is not warranted if you are sure that the fog-signal is from a vessel that you had been radar-tracking and passing clear.
  - Highlight aspects such as ships coming “in sight of one another” wihin an area of RV.
  - Compare the actions between “ in sight” and “RV”

  Explain the limitations of Radar , scanty information and related aspects

UNIT 2: ROR: ANNEXE I

1. Annex I - Positioning and technical details of lights and shapes
2. Special emphasis on horizontal and vertical positioning of various lights the reasons for such spacing- sections 1,2,3,4,5,6,9,10 and 12

3.Special emphasis on the horizontal and vertical sectors of Main navigation lights and the reason for extended practical cut-off sectors. (perspective from a distance and perspective when closer)

4. A basic explanation on the technical details such as luminosity, chromacity and an explanation on the purpose of such specifications.

UNIT 3: Annex II and Annex III

Annex II Additional signals for fishing vessels fishing in close proximity, with special emphasis on pair-trawling.

Annex III Technical details of sounds signal appliances- An overview of Annexe-III in respect of Sound Signal specifications in simple terms

UNIT 4 : Annex IV

Distress signals, which lists the signals indicating distress and need of assistance. Practical demonstrations thereon.

UNIT 5: Ship Handling

- The need for COLREGS and its significance as applied to floating objects
- The challenges for a ship with its various limitations with respect to its maneuverability, momentum, the effect of prevailing weather on maneuvering characteristic- a thorough understanding of the Turning Circle diagram with respect to turning delay, advance , transfer, track reach and similar constraints - as applicable to COLREGS
- Limitations and cautions on over-reliance on the Turning Circle diagrams provided by Shipyards.
- Stopping distance, Head reach, Crash-stop distances and related aspects

Text Book:

1. IMO Rules of the Road- Bhandarkar
2.UKHO Admiralty Buoyage –NP735
3.ROR Cards
4.Radar Plotting Sheets

Reference Books:

1. Collision Regulations – A.J.Cockroft
2.A Mariner's Guide to Colregs-Capt.Y.Chaabra
3.Rule of the Road- Manual – Capt.S.K.Puri
4.Intl Lights, Shapes and Sound Signals D.A.Moore
5.Mariners handbook- NP100
6.IMO / NI publications on Bridge Watchkeeping Procedure

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Program	B.Sc., (Nautical Science)				
Course Code 231NS1A34PH	Course Name **Ship Operation Technology Laboratory-III**		L	T	P	C
			0	0	2	1
Year and Semester	II Year (III Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To train the cadets on practical handling of deck equipment's.
	2	To acquire hands-on skill in seamanship.
	3	To prepare to assemble and dismantle components of lifting gear
Course Outcome	CO1	Prepare Emergency equipment such as SCBA, Immersion suits, Thermal Protective Aid
	CO2	Plan Heavy Lifts operation and care in Handling and securing them
	CO3	Demonstrate the ability to use Chipping tools-Manual and Pneumatic
	CO4	Perform Mooring stations-Heaving line, head line, stern line, breast lines and springs
	CO5	Participate in Mooring the ship to a buoy using anchor chains
	CO6	Demonstrate communication while entering and leaving port.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.50	3	1	2.50	2.50	3	2.50	-	-	-	-	-	2.50	2.50	2.50

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

S No	TASK	TYPE	DESCRIPTION
1	Rope Work	Types	Types Of Ladder Onboard Ship
2	Rope Work	Types	Rigging Bosun's Chair / Safety Harness
3	Rope Work	Ladder	Rigging Combination Ladder Procedure
4	Mooring	Swp	DrydockPreparation /Arrival/Departure Procedure
5	Mooring	Types	Rigging Gangway/ Mot Gangway/ Ramps.
6	Mooring	Procedures	Sending Mooring Ropes/ Passing More Than 1 Rope On Bollard
7	Mooring	Swp	Precautions While Mooring
8	Mooring	Procedure	Bunkering Procedure
9	Anchor	Procedure	Securing Anchor For Sea
10	Anchor	Maintenance	Dismantling & Assembling Lugless Joining Shackle.
11	Maintenance	Lashing	Cargo Securing-Containers , Lashing Gear
12	Maintenance	Types Of Tools	Various Types Of Chipping
13	Lsa /Ffa	Donning	Donning Scba & Smoke Helmet
14	Cargo Work	Lifting Gear	Demo. Of Various Heavy Lifts, Velle,Stulken Etc.
15	Cargo Work	Draft Mark	Taking Free Board Draft / Hog & Sag Determination
16	Cargo Work	Demo	Hatches Opening Closing- Simple Model Demo.
17	cargo work	Sounding	Taking Sounding & Calculating Volume With Trim Corrections

Text Book:

1. Seamanship Notes by Kemp and Young
2. Theory and practice of seamanship by Danton G
3. Seamanship practice by Capt Dinger

Reference Books:

1. Life Boat and Life Raft – Capt Puri SK
2. Survival at sea – C.H.Wright
3. Brown's signaling

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Program	B.Sc., (Nautical Science)					
Course Code	Course Name **Interpersonal Communication**		L	T	P	C
			0	0	2	1
Year and Semester	II Year (III Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	Learn various aspects of different cultures and the need for the effective interpersonal communication
	2	Understand the techniques of communication among members in group.
	3	Use of language effectively to avoid conflict and tension.
	4	Mould the personality so as to reduce and repair conflicts
	5	Learn the need for socialization.
Course Outcome	CO1	Recognize aspects of various cultures and the need for interpersonal communication. Give presentation without any inhibition
	CO2	Demonstrate the need for effective communication between two people/groups.
	CO3	Make use of effective and appropriate language at various interpersonal situations to avoid conflict, tension and stress. Participate in debates and discussions to argue effectively and persuasively.
	CO4	Practice the IP principles so as to reduce and repair conflict in interpersonal relationships.
	CO5	Explain family and social relationships and need for socialization.
	CO6	Discuss case studies in relation to IPC

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	3	2	2	3	3	-	3	-	-	-
CO2	-	-	-	-	-	2	2	2	3	3	-	3	-	-	-
CO3	-	-	-	-	-	3	2	2	3	3	-	3	-	-	-
CO4	-	-	-	-	-	2	2	2	3	3	-	3	-	-	-
CO5	-	-	-	-	-	3	2	2	3	3	-	3	-	-	-
CO6	-	-	-	-	-	2	2	2	3	3	-	3	-	-	-
Average						2.5	2.0	2.0	3.0	3.0		3.0			

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit I: PRESENTATION SKILLS

Axioms of interpersonal Communication - One minute presentation – Extempore - Formal Presentation on the chosen topics - Greeting and Introducing - Offering Help.

Unit II: APPREHENSION AND ASSERTIVENESS

Group Discussion - Aggressiveness and assertiveness - perception in interpersonal communication-Making Requests - Telephonic Conversation

Unit III: VERBAL AND NON VERBAL MESSAGES

Word Stress - Sentence Stress and Intonation-Body language-signs- gestures- postures- kinesics- paralinguistic features (accent, pronunciation, volume, pause, and pitch).

Unit IV: POWER IN INTERPERSONAL RELATIONSHIP

Conflict in interpersonal relationships - Conflict Resolution - Relationship maintenance and repair-Asking and Giving Permission-Giving Instructions and Directions

Unit V: SOCIALIZATION

Benefits of socialization- Effect of social media - Case studies (common /domestic /academic /work situations).

Reference Books:

1. DeVito, Joseph,The *Interpersonal Communication* Book, 13th Edition**,** Published by *Longman* Pub Group, Updated in its *13th edition*, 2000.
2. Kathleen S. Verderber,Inter-Act: *Interpersonal Communication Concepts, Skills and Contexts*, Rudolph F. Verderber, 2000.
3. Clifford Whitcomb,*Effective Interpersonal and Task Communication Skills for Engineers*, Atlantic Publishers.2010.

Reference web site:

https://www.ted.com/talks
https://www.skillsyouneed.com/ips/communication-skills.html

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code **231NS1A44TA**	Course Name **Navigation – III**		L	T	P	C
			3	0	0	3
Year and Semester	II Year (IV Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To utilize Sextant instrument to observe Celestial Bodies altitude
	2	To obtain ‘in-depth knowledge’ on Celestial Navigation.
	3	To utilize celestial position lines and nautical almanac and use of celestial bodies for position fixing of Ship.
Course Outcome	CO1	Relate to Sextant instrument & measure altitude of celestial body
	CO2	Predict Rising and setting of celestial bodies- Azimuth and Amplitude, twilights
	CO3	Deduce out Gyro / Compass error using Celestial bodies Azimuth
	CO4	Classify Different methods of getting position lines and observe positions
	CO5	Demonstrate Practical measurements of altitudes of Celestial Bodies
	CO6	Show the procedure and preparations needed for taking sights of CBs.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2	3	0.60	2	2	3	2	-	-	-	-	-	2	2	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1 –Sextant and Altitude Correction & Computation of True Altitude / Use of Nautical Almanac

Sextant Instrument – Sextant Principles, Instrument Errors and its adjustments / correction. Finding Index Error of a Sextant before measuring altitude of a Celestial Body.

Altitude Measurement of Celestial Bodies / Corrections – Observers' Visible Horizon, Sensible Horizon and Rational Horizon and DIP correction to cater for Observer's height of eye.

Differences between the Sextant Altitude, Observed Altitude and True Altitude of a Celestial Body and various corrections to be applied to obtain the true altitude of Sun, Moon, Planets and Stars.

Refraction of light rays passing from one medium to another and corrections to be applied. Necessity for Semi-Diameter Correction for Sun & Moon. Parallax correction from surface of Earth (sensible horizon) to Centre of Earth's sphere (rational horizon) to obtain True Altitude of a celestial body, with specific thrust to 'Parallax in Altitude' and 'Horizontal Parallax (HP)'.

Computing Altitude of Celestial Bodies – Basic calculations involved from Sextant Altitude to True Altitude and True Zenith Distance for a Celestial Body.

Nautical Almanac – Information in Nautical Almanac relating to 'Dip' to cater for Height of Eye of an observer & 'Total Correction' of Celestial Bodies (Sun, Moon, Planets & Stars) and its usage to obtain True Altitude from Observed Altitude.

UNIT 2 –Rising / Setting Azimuth (RSAz) / Amplitude &Twilight

Relationship between Earth's Motion & Rising / Setting of all celestial bodies in the Solar system.

Basics of 'Theoretical & Visible Sunrise & Sunset' and Calculations to find the time of rise / set. Application of 'Napier Rule' for Quandrantal side spherical triangle to find parameters of PZX triangle when ZD = 90° during theoretical rising / setting of Sun and simple calculations thereon.

Relationship between Amplitude / RSAZ & Declination of Sun with Latitude of Observer & proving of Equation "Sin Amp = Sin Decl x Sec Lat".

Explanation on use of Nautical Almanac to find rising / setting time of Sun.

Twilight– Civil, Nautical and Astronomical Twilight and calculations to find out timing of each from nautical almanac for a position. Also explain the relationship between observer's Latitude and Declination of Sun (Conditions necessary)

for twilight period to last long all through the night.

UNIT 3 –Gyro Error – From RSAz&Az of Celestial Body

- Explain basic calculations to obtain True Amplitude & Azimuth of Rising / Setting Sun to find out Gyro Compass Error, including the use of ABC Table (Nories Table). Practical calculations to obtain Gyro Error
- Calculation of Azimuth of Celestial Bodies in all other times other than rising / setting. Using ABC Table as well as formula to calculate AZ and find gyro error. Also find True to Compass (CADET Rule) to find magnetic heading as using deviation & variation. Practical calculation to obtain Gyro Error, Deviation of Magnetic compass.

UNIT 4 –Position Lines from Celestial Observation / CLOP

- **Position Lines** – Principle of Celestial position fixing and Geographical position of a Celestial Body. Basic relation between terrestrial position lines and celestial position circles / lines drawn perpendicular to Azimuth of a Celestial Body.
- Figure drawing for astronomical calculations to arrive at Celestial Line of Position (CLOP). Elementary introduction into different methods of position fixing in Celestial Observations.
- Basic introduction into use of Sight Reduction Table (SRT) in finding suitable stars while proceeding to observe Stars during Morning / Evening Twilight

UNIT 5 –DEMONSTRATION - Measurement of Sextant Altitude of Sun/Star/Planet

- **Celestial Sight Observation (Sextant Altitude)–** Explain preparative action before proceeding to observe a Celestial Body, actions to be taken by an observer and actions (including calculation & plotting) to be undertaken by observer post observation.
- Conduct demonstration classes on the Bridge Top to observe physically the altitude of Sun or Star or Planets or all, using a Sextant and calculating the True Altitude.

Text Book:

1. Principles of Navigation by Capt. S.S.S Rewari& Capt. T.K.Joseph
2. Practical Navigation by Capt. H.Subramanium
3. Nichol's Concise Guide Volume-1 and 2

Reference Books:

1. The Admiralty Manual of Navigation
2. Principles of Navigation: Vol. 1- Nautical Institute
3. Navigation Guide Vol. 1: Near Coastal Navigation- Alexander Simpson
4. Practical Navigation for Officers of the Watch- Frost, A

The Marine sextant booklet by Capt. H.Subramaniam

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Program	B.Sc., (Nautical Science)					
Course Code **231NS1A44TB**	Course Name **Bridge Equipment & Bridge Resource Mgt-III**		L	T	P	C
			2	0	0	2
Year and Semester	II Year (IV Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To learn about inertial navigation (Gyro compass) systems.
	2	To understand the activation and working of alarm systems on bridge.
	3	To understand the different features of ARPA and safe watch keeping methods
Course Outcome	CO1	Infer working and understanding of Automatic Identification System (AIS) Integration ARPA data into ECDIS
	CO2	Interpret principle and operation of Voyage Data Recorder (VDR), BNWAS, SSAS, LRIT
	CO3	Analyze the advantages and limitations of ARPA, Gyro compass.
	CO4	Distinguish Bridge Manning levels and the importance of standing orders.
	CO5	Deduce the importance VTS and reporting systems
	CO6	Integrate all bridge equipment's into effective Bridge team management.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Average	2	3	2	2	2	3	2	-	-	-	-	-	2	2	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT-1.Alarms, Record Keeping, transmitting and receiving Instruments

Automatic Identification System (AIS):

1.Purpose of AIS , Standard format of information exchanged, Ship to ship data exchange, Information provided by AIS, minimum mandatory display, Working procedure,
AIS Messages:- Static Data – Dynamic Data – Voyage Related Data – Safety Related Message
Limitations of AIS and precautions during use of AIS for collision avoidance. Integration with ARPA / ECDIS.
2. VDR (Voyage Data Recorder): Concept and purpose of VDR, Details of data recorded onVDR and the duration of data stored;
Modules of VDR:- Data Management Unit – Audio Module – Final recording unit – Remote alarm module – Replay Station(optional), float free S-VDR (Simplified VDR) – Basic idea

3. Bridge Navigation Watch Alarm System: Purpose of BNWAS, Providing Alertness – different stages of alarm

4. Ship Security Alert System (SSAS):Purpose, Activation Points, Testing Procedure, Alert Message contents, Frequency of Alert Transmitted

5. LRIT (Long Range Identification and Tracking): Purpose of LRIT, Data transmitted byLRIT. Authorised receivers/ users of LRIT. Difference between LRIT and AIS. Ships exemptedusing LRIT.

UNIT 2 :ARPA

a. Principal ARPA Systems: Vectors (relative and true), digital read-out, potential points of collision predicted areas of danger

b. IMO Performance Standards for Automatic Radar Plotting Aids (ARPA): Requirements for acquisition and tracking of targets, operation warnings, gyro and log inputs

Acquisition of Targets: Manual and automatic acquisition of targets, guard rings and guard zones

c. Caution to be taken when used in conjunction with Doppler Acquisition of Targets: Manual and automatic acquisition of targets, guard rings and guard zones

d. Tracking Capabilities and Limitations: Principle of tracking by ARPA, target swap

e. Processing Delays: The reason for delay in display

f. Setting Up and Maintaining Displays: Optimum display of echoes, use of echo referencing in the true motion mode

g. Representation at Target Information:, results of trial manoeuvres, benefits and limitations of operational warnings

h. Errors of Interpretation: Lost target, incorrect interpretation of ARPA data

i. Errors in Displayed Data: Errors in bearing by backlash, ship motion, asymmetrical antenna beam, azimuth quantization, error range by rolling of "own ship", range quantization, effects of heading and speed errors on derived information

j. System Operational Tests: Self-diagnostic routines

k. Risks of Over-reliance on ARPA

l. Obtaining Information from ARPA Displays: Critical targets, relative and true course and speed of target, CPA and TCPA targets

m. Application of COLREG 1972: Analysis of displayed situations, action to avoid close quarter situations

n. Ground stabilization: Errors involved, advantages and limitations of ground stabilization and sea stabilization

Caution to be taken when used in conjunction with Doppler Log (Doppler feed to ARPA).

s. Use of Trial manoeuvre and predictive motion vectors

UNIT 3 RADAR Plotting :

- The relative motion triangle: General Ideas on Radar Plotting, Drawing of relative motion triangle and identification of various vectors and angles
- Plotting devices: Drawing the relative motion triangle on a Plotting Sheet

- Closest point of approach (CPA) and time to CPA (TCPA), bow pass, Set and drift of current in relative and true presentation and plot., Performance delay

- Action taken by Target vsl, Own vessel as per COLREGS at various situation.

- Standardized report format and reporting procedure: Elements of the parts of a report (bearing and change, range and change CPA, TCPA course, aspect and speed),

- **RADAR Log Book Entries:-** Importance of MaintainingRadar Log Book, Contents and Details of the four Sections of Radar Log Book

5. GYRO COMPASS

1.The properties of free gyroscope. The relationship between applied force and precession.The effect of earth's rotation on a free gyroscope. Drift, tilt and damping. Errors associated with gyro compasses including latitude, course and speed error, ballistic deflection and its relation to change of speed error. Latitude, course and speed correction, rolling error and how it is

minimized.

2. The principal parts of gyro compass, follow up and repeater systems. To demonstrate the starting of the gyrocompass and explains how to minimize settling time by slewing and leveling it to the correct heading.The necessary time for the compass to settle after switching on prior to sailing. Lists the settings to be made or adjusted while the compass is in use. Explain show the repeater system is switched on and aligned with the master gyro compass. Describes the alarms fitted to a gyrocompass

3.The Digital Gyro: Basic Introduction to the principle, the design, integration of gyro compasses / digital magnetic compass and limitations, Care and maintenance on Gyro compass on board ship.

4. Fluxgate compass : defines single axis and dual axis explains basic operation and principle.

UNIT 5 . Maintain a Safe Navigational Watch and Watch-Keeping-1

1. Watch keeping at sea under different conditions in different area: Precautions In clear weather. In hours of darkness. In coastal and congested waters In rough whether Ice navigation & Ice patrolling as per SOLAS (SAFETY OF NAVIGATION)

2. Bridge manning levels: Circumstances in which the OOW should call Master, extra lookouts, Explain responsibilities of OOW as in-charge of Navigational watch, Navigation with a pilot embarked.

3. Effective use of information from navigational equipment for maintaining a safe navigational watch and regular checks to monitor their proper operation:- Checks to be carried out in Navigational watch by OOW, Operational test – Routine Test and checks, Guidance on steering gear test routines

4. Ship reporting systems: The use of reporting in accordance with general principles for ship reporting systems and with VTS reporting procedures INDSAR as per M.S. Notice of DGS

5. Principles observed in keeping safe navigational watch:- Factors to be taken into account when deciding Composition of navigational watch – General principles apply to watch keeping at sea – protection of marine environment – Lookout – Watch Arrangements- Sole lookout

6.Tests as per SOLAS: Preparation for proceeding to sea, Arrival in port and entering harbour, controls testing, Precautions when Navigating Restricted Visibility Areas

7.Ship's Routeing: The use of routeing in accordance with the General Provisions of Ship's Routing forms a part of Passage planning.

8.Handing/Taking over Navigation watch:-Relieving of duties - Procedure for handing over and taking over bridge watches

Text Book:

1. Bridge Procedure Guide - ICS
2. Mariners Handbook – HMSO Publication

Reference Books:

1. A Mariner's guide to preventing collisions- Capt. Y.Chhabra
2. Nutshell Series Booklet - Gyro compass- CaptHSubramaniam
3. Bridge Equipment &Watch Keeping Notes – E. Fernandes.
4. STCW Convention / CODE with latest Amendments- Extracts on Bridge Watch Keeping-duties, functions and procedures.
5. Shipborne Radar and ARPA& Nautical Watch Keeping -- Capt. H. Subramaniam
6. Electronic Navigational Aid—Sonnenberg
7. Modern Electronic Aids—Bhatia and SinhaK
8. Electronic Navigational System --- L. Tetley & D. Calcutt
9. Admiralty Manual of Navigation – HMSO
10. A guide to the Collision Avoidance Rules – Cockcroft and Lameijer
11. IMO Rules of the Road – Bhandarkar Publications
12. Radar at Sea – G.I.Sonnenberg
13. Radar and ARPA Manual – A..G. Bole and W.O.Dineley
14. Compass Work – Kemp & Young
15. ships Compass – Klinkert& Grant
16. Gyro Compass for Ship's officers—A. Frost
17. Marine Electronic Navigation – S.F.Appleyard
18. A Seaman's Guide to the RULES OF THE ROAD- Morgans Technical Books Ltd

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Program	B.Sc., (Nautical Science)				
Course Code **231NS1A44TC**	Course Name **Ship Stability – II**	L	T	P	C
		3	0	0	3
Year and Semester	II Year (IV Semester)	Contact hours per week 3 Hrs.			
Prerequisite course	Nil				

Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective
			✓	
	Basic Science	Engineering Science	Open Elective	Mandatory

Course Objective	1	To introduce the Conditions of Stability.
	2	To learn about Free Surface and its effects
	3	To understand List, Curves of Statical Stability and the effects of suspended Weights.
Course Outcome	CO1	Identify various conditions of Stability and Initial Transverse Metacentre
	CO2	Relate Free Surface Effect, List, Curves of Statical Stability
	CO3	Measure effects of suspended Weights on metacentric height
	CO4	Analyze stability calculations and see if vessel assumes a negative stability
	CO5	Calculate Righting and capsizing moments, Stiff and tender ships
	CO6	Compare stiff and tender vessels.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.67	3	1.80	2.67	2.67	3	2.67	-	-	-	-	-	2.67	2.67	2.67

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit 1: Conditions of Stability and Initial Transverse Metacentre

• Understand the term “Stable”, Unstable”, “Neutral” conditions of stability ‘angle of loll’ and the diagrams representing the relative positions of G, B and M respectively.

• Understand more comprehensively the term initial Transverse Metacentre, Moment of Inertia (second moment of area) of the water-pane area, Calculate KM Values for a box - shaped vessel and produce a metacentric diagram.

• Use a metacentric diagram to determine the condition of stability of a ship at various draughts for a given assumed KG. Use a metacentric diagram to determine the required final KG to ensure that a ship completes loading with a required GM.

• Understand the factors affecting KM.

• Explain in detail with diagrams, how a vessel takes to angle of loll. Explain the danger to a ship at angle of loll.

• Apply knowledge of above topics & calculate numerical from M.V.Hindship.

Unit 2: Free Surface Effect

• Understand the effect of a free liquid surfaces on the transverse Statical stability of a ship. Diagrammatically represent the virtual rise of G and the reduction of GM due to FSE.

• Derive the formula for calculating virtual loss of GM due to Free Surface Effect.

• Calculate the effect of free surface in a rectangular tank and determining the effective (fluid) KG and GM of a ship. Calculating FSM’s and using them in the tabular method of calculating KG by taking moments about the keel.

• Understand the methods of representation of free surface data used in ship’s tank Sounding/ Ullage tables and use such data in typical calculations.

• Understand the factors that influence free surface effect.

• Apply knowledge of above topics & calculate numerical from M.V.Hindship.

Unit 3: List

• Understand the term ‘List’ and the difference between the terms ‘List’ and ‘Heel’.

• Diagrammatic representation of a listed vessel due to transverse, transverse and vertical shift of a single weight, identifying the list triangle and obtaining the formula for ‘List’. Calculating the list caused by a single weight being loaded and discharged or shifted and the procedure to get a listed vessel upright.

• Calculating the final list due to multiple operations in a vessel initially upright and initially listed. Calculate the increase in

draught due to list.
• Calculate the weights to load/discharge off the centre line to ensure that the ship completes upright.
• Understand the effect of free surface on list with the help of a diagram.
• Apply knowledge of above topics & calculate numerical from M.V.Hindship.

Unit 4: Curves of Statical Stability (GZ Curves)

• Understand the term KN and how KN values may be used to obtain GZ values for specified angles of heel. Construct GZ curves using KN Curves.
• Know the procedure for producing a curve of Statical stability and identify the basic features of a curve of Statical stability. Understand the terms "stiff' ship and "Tender" ship by their curves of stability.
• Curves of Statical Stability for varying Conditions; Features of the curve of Statical stability for a ship in stable, neutral, unstable (Angle of loll) and in listed condition.
• Know the safe procedures for correcting an angle of loll and an angle of list.
• Factors affecting the shape of the curve of Statical Stability.
• Understand the effect of a change of KG on the curve of Statical stability, transverse shift of weight (list) on the curve of Statical stability; Change of freeboard on the curve of Statical stability;
• Appreciate the differences between stability of a ship in the light and loaded conditions.
• Understand the influence of ship's beam on the curve of Statical stability; understand the influence of trim on the curve of Statical stability.
• Apply knowledge of above topics & calculate numerical from M.V.Hindship.

Unit 5: Suspended Weights

• Understand the effect on KG of lifting a weight using ship's gear.
• Calculate vertical and horizontal components of the movements of ship's Centre of gravity during lifting operation and use these to determine the maximum angle of list that will occur.
• Calculate the maximum permissible KG requires prior to loading or discharging a weight to ensure that a certain list limit is not exceeded during the operation.

Text Book:

Ship Stability for Masters and Mates- DA Derett
2. Ship Stability at the Operational Level – Capt. H. Subramaniam
3. Problems on MV Hindship-Capt. TK Joseph and Capt. SSS Rewari

Reference Books:

Ship Stability Booklet of MV Hindship
2. Grain Code-IMO
3. Ship Stability for Masters and Mates-Martin A Rhodes
4. Ship Stability by Kemp and Young

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Program	B.Sc., (Nautical Science)					
Course Code **231NS1A44TD**	Course Name **Ship Operation Technology – III**		L	T	P	C
			2	0	0	2
Year and Semester	II Year (IV Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To acquire detailed knowledge of life saving appliances
	2	To become adept with use of firefighting appliances.
	3	To introduce to fundamentals of steering a ship
Course Outcome	CO1	Classify Life Saving appliances – Life boats and Rescue boats
	CO2	Identify Life Saving Appliances –Life raft and embarkation equipment
	CO3	Identify Firefighting appliances-extinguishers, fire hydrants and hoses, nozzles
	CO4	Relate registration of recruitment and placement agencies rules as per MS Act
	CO5	Describe fundamentals of steering system on ships
	CO6	Role-play abandon ship and firefighting.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.50	3	1	2.50	2.50	3	2.50	-	-	-	-	-	2.50	2.50	2.50

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

LIFE SAVING APPLIANCES, FIRE FIGHTING APPLIANCES AND STEERING SYSTEM

Unit 1 Life Saving Appliances - Lifeboats and Rescue Boats

Lifeboats - General Requirements of lifeboat: Construction, carrying capacity, buoyancy, Means of propulsion and Fittings of life boat, Access.

Different types of lifeboats (totally enclosed lifeboats, partially enclosed lifeboats). Capsizing and re-righting, L/B Equipments including rations and distress signals, Markings of a Lifeboat. Regular Maintenance and checks, L/B preparation and Launching procedure, Lifting hook release system: On Load & Off Load release mechanism, Air supply system. Fire protected lifeboats: - General, Water spray system. Freefall Life boat: - Carrying capacity, performance requirements, construction, protection against harmful acceleration, Fittings, certificate of approval, Launching appliances of free-fall L/B.

Rescue Boats - Construction of Rescue boats, Propulsion, purpose of Rescue boats, Equipments, Additional requirements of inflatable rescue boat & rigid rescue boat (fast rescue boat)

Unit 2 Life Saving Appliances

Life Raft - General Requirements for Life rafts: - Construction of Life rafts, Minimum carrying capacity and mass of life rafts, Life raft fittings, Davit-launched liferafts,Types of life rafts, SOLAS Packs, Life raft equipment in each type of SOLAS pack, Float-free arrangements for life rafts: - Painter system, Weak link, HRU.

Inflatable Life rafts - Construction, carrying capacity, Access, Stability, containers, Life raft Container Markings, Markings

on inflatable life rafts, Davit –launched inflatable life rafts, additional equipment for inflatable life rafts, inflating system on life raft,

Rigid life rafts: - construction, carrying capacity, access, stability, markings, Davit-launched rigid life rafts

Lifeboat and Life Raft Launching and Embarkation Equipment - Types of Davits, Parts of Davits, Safety cut of switch, Marine Evacuation system, Markings on evacuation system, Launching procedure of Life rafts, Embarkation ladder, Recovery of survival crafts and rescue boats

UNIT3: Portable, Semi Portable (Wheeled)and Fixed Fire Fighting System Portable Extinguishing System- SOLAS requirements, Type approval, Various types and their suitability for different types of fires, Colour code, marking of extinguishers, Periodical inspections and maintenance, Portable foam applicator, Refilling of fire extinguishers

Fixed Fire Extinguishing system - Fixed CO_2 system, Water-mist fire-extinguishing system, Fixed Foam fire-extinguishing system :- Low expansion and High Expansion, Fire main system including fire hydrant, Hoses, Coupling and Nozzle and their requirement as per SOLAS, Types of Nozzles, Fire pumps, Emergency fire pumps, Requirement of Fire pumps in Passenger and Cargo ships, Deck Foam system for tankers.

UNIT 4: RPSL – MS Act Section 95.

MS Act 1958 Overview, (registration of recruitment and placement agencies), Recruitment and placement rules 2005, Introduction & definitions, Significance andpurpose of RPS rule. Benefit to seafarers under the rule. Responsibilities of employer, Rights and responsibilities of the seafarer. How to access information regarding registered recruitment and placement agencies. Stranding of seafarers (by Fraudulent agents) and procedures for recognizing stranding in ships. Steps to report stranding in ships.

Article of Agreement (Indian Ships), General content of Agreement, Responsibilities of employer & seafarer, Article of Agreement (foreign flag ship), Relevance of RPSon foreign ships. List of certificates to be obtained by licensed shipping companies and ships.

Unit 5: Steering control systems

Types of Steering systems. Principle of an automatic pilotsystem, procedures for changeover from automatic tomanualsteering and viceversa. Course monitor and the off-coursealarm, operation of the course recorderlog, otheralarmsfitted to the system, automatic pilot should be included in the steering geartesting prior to the ship'sdeparture, regulation regarding the use of the automaticpilot, SOLAS regulations regarding Auto Pilot system.

Text Book:

1. Seamanship Notes by Kemp and Young

2. Seamanship practice by Capt Dinger

3. Nicholl's Seamanship by Nicholl

Reference Books:

1. Life Boat and Life Raft – Capt Puri SK
2. Survival at sea – C.H.Wright
3. MS Act
4. Seamanship and Nautical Knowledge – Nicholls
5. Admirality Manual of Seamanship – British Admirality

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Program	B.Sc., (Nautical Science)					
Course Code **231NS1A44TE**	Course Name **CARGO HANDLING AND STOWAGE- III**		L	T	P	C
			3	0	0	3
Year and Semester	II Year (IV Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	Teach Cargo handling and Stowage as detailed in Syllabus below.
	2	Use reference books, Blackboard, projectors, videos and flipped class as tools to teach..
	3	Assess by continuous tests, assignment and questioning in class
Course Outcome	CO1	Identify Ballast tanks, Deep Tank and Heavy Lift and uses and intricacies
	CO2	Identify different Containers, their cargo and operations
	CO3	Plan reefer ship preparation, and their cargo operations. Relate about cargoes that liquefy.
	CO4	Distinguish hatch covers, their uses, precautions and tests to be carried out to ascertain efficiency of hatch covers.
	CO5	Plan oil tanker operations, comprehend Pollution regulations and usage of Check Lists.
	CO6	Perform tanker cargo calculations, Container stowage.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
Average	3	-	1.13	3	3	-	3	-	-	-	-	-	3	3	3

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT-1 Ballast tanks inspection

- describes the purpose of ballast tank
- reproduces the construction sketch of a ballast tank
- identifies the parts in the ballast tanks which are most likely to experience corrosion
- lists the period of interval for the inspection of ballast tanks
- describes the corrosion prevention methods for ballast tanks

Deep tank cargoes:

- Procedures for cleaning and preparation of deep tanks for loading.
- Securing of deep tank lids**.**

Heavy Lifts:

- Effect of the heavy lifts on the seaworthiness and the stability of the ship
- Precautions to be taken whilst loading/discharging heavy lifts.

UNIT-2 – Container Cargo

- Arrangement of a container ship, and how the position of container is designated.
- Factors affecting a container stow.
- Stability, trim, list, stresses, stack height, weight, dangerous goods, special requirements.
- out of gauge containers
- . Types, sizes and markings of containers.
- Bay plans and stack weight.
- Anti-heeling tanks.
- Torsional stresses.

- Container code (CSC
- Special requirements of Dangerous Cargo, reefer containers and out-of-gauge containers.
- Securing and lashing arrangement of containers.

Containers

- Parts of a container.
- Features of a container.
- Types of containers.
- Container stowage principles.
- Container carried below deck without cell guides/in cell guides and on deck.
- Container and container ship problems.
- IMO Container safety convention l Segregation and care of containers carrying dangerous goods, reefer containers and out-of-gauge(OOG) cargoes.
- Stowage and securing gear of containers viz. container shoes, stacking cones, interlayer stackers, twist locks, bottle screws and turnbuckles.

UNIT – 3 Refrigerated cargo:

- Basics of Reefers
- Cooled, chilled and frozen cargoes with examples.
- Controlling the atmosphere/Temperature.
- Preparation of holds.
- Dunnage requirements.
- Inspections of the cargo
- Procedures during loading/Discharging.
- Use of brine traps.
- Purpose of temperature recording.

Reefer Ships

- General outline of refrigeration systems (Direct, Indirect and air-cooled systems)
- Care, Monitoring and records of cargo during passage.
- Inspection of cargo and brine traps.l Pre-cooling and preparation of cargo spaces.
- General precautions to be observed whilst working cargo.

Cargoes which may Liquefy:

- Hazards of Concentrates.
- Test Procedure
- Moisture Migration, Moisture Content, Flow Moisture Point
- Transportable Moisture Limit(Prohibition & Exception, Unsafe or inadequate arrangements) l Allowable shear forces and bending moments.
- General Safety Requirements.

UNIT-4 - Hatch-covers

- Types of hatches. Opening and closing of chain-pull and hydraulic hatch covers. Closing arrangements. Battening down a hatch.
- Maintenance of hatch covers.
- Procedures to check weather tightness of hatch covers.
- Securing of hatch pontoons.
- Maintenance and use of side cleats and cross-joint wedge mechanism.

- Importance of clear drainage channels and drain holes.
- Importance of compression bars and sealing gaskets.
- Need to check hydraulic system for leakages.
- Procedure for securing hatches in open position to guard against accidental movement.

UNIT-5 - Oil tanker operations and related pollution-prevention regulations

- History of oil carriage and pollution prevention.
- Segregated ballast, Clean ballast, Dirty ballast, Slop tank and handling of slops, Load-on-top, ODMCS.
- Inert gas system including boiler uptake valve, scrubber, blowers, oxygen analyser, deck seal, non-return valve, PV valve, PV breaker and mast riser and simple diagram of Inert Gas Plant.
- Crude Oil Washing, its hazards and benefits, Items of COW checklist, MARPOL regulations for COW. Advantages and
- Disadvantages of Crude Oil Washing.
- Items of pre-arrival checklist.
- Loading and discharging operations on a tanker.
- Procedure for man entry in enclosed spaces on tanker.
- Contents and application of the International Safety Guide for Oil Tankers and Terminals
- Contents and application of the International Safety Guide for Oil Tankers and Terminals, ISGOTT.
- Cargo calculations for quantity and ullage of oil cargo based on volume and height of space, density of cargo and temperature change.

Text Book:

1. Safe cargo handling procedures Vol 1 and Vol 2 by P.J.Samson

Reference Books:

1. Cargo Work for Ship officer – Capt Errol Fernandes
2. Cargo Work – Kemp and Young
3. Cargo Works – Taylor
4. Cargo Works – D.J. House
5. Cargo Notes – DhananjaySwadi
6. Chemical Tankers – Capt KSD Mistree
7. Safe Gas Tanker Operation – Capt KSD Mistree& BK Sharma
8. Liquefied Petroleum Gas Tanker Practices – TWV Woolco

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<table>
<tr><td>Program</td><td colspan="6">B.Sc., (Nautical Science)</td></tr>
<tr><td>Course Code
231NS1A44TF</td><td colspan="3">Course Name
Meteorology – I</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td></td><td colspan="3"></td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Year and Semester</td><td colspan="3">II Year (IV Semester)</td><td colspan="4" rowspan="2">Contact hours per week
3 Hrs.</td></tr>
<tr><td>Prerequisite course</td><td colspan="3">Nil</td></tr>
<tr><td rowspan="4">Course category</td><td colspan="2">Humanities and Social Sciences</td><td>Management courses</td><td colspan="2">Professional Core</td><td colspan="2">Professional Elective</td></tr>
<tr><td colspan="2"></td><td></td><td colspan="2">✓</td><td colspan="2"></td></tr>
<tr><td colspan="2">Basic Science</td><td>Engineering Science</td><td colspan="2">Open Elective</td><td colspan="2">Mandatory</td></tr>
<tr><td colspan="2"></td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td rowspan="3">Course Objective</td><td>1</td><td colspan="6">To impart basic knowledge of marine meteorology.</td></tr>
<tr><td>2</td><td colspan="6">To familiarize about Earth’s atmosphere, Water Vapour, Wind, clouds, Atmospheric Pressure</td></tr>
<tr><td>3</td><td colspan="6">To elucidate about Ocean circulation system, sub surface circulation, Oceanic Waves, Tides, Sea Water and ship borne meteorological instruments.</td></tr>
<tr><td rowspan="6">Course Outcome</td><td>CO1</td><td colspan="6">Encapsulate with marine meteorology -earth's atmosphere and Water vapour.</td></tr>
<tr><td>CO2</td><td colspan="6">Demonstrate the formation of wind, cloud and precipitation.</td></tr>
<tr><td>CO3</td><td colspan="6">Compute the impact of Atmospheric pressure and visibility</td></tr>
<tr><td>CO4</td><td colspan="6">Identify Ocean circulation system, Sub surface circulation and Oceanic waves.</td></tr>
<tr><td>CO5</td><td colspan="6">Comprehend the Properties of sea water, tides and use of Ship borne meteorological instruments.</td></tr>
<tr><td>CO6</td><td colspan="6">Analyze the weather reports</td></tr>
</table>

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.40	3	0.83	2.40	2.40	3	2.40	-	-	-	-	-	2.40	2.40	2.40

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Instruments

UNIT 1 - Earth's Atmosphere & Water Vapour

Earth Atmosphere : Characteristics of the Earth's atmosphere; Composition and physical properties; Vertical layer of the atmosphere: Troposphere, tropopause, stratosphere, stratopause, mesosphere, mesopause and thermosphere; Insolation; Saturation; Evaporation, Condensation, Latent Heat, and Vapour Pressure; Ozone depletion, air pollution; Radiation Laws, Emission, Reflection, absorption and scattering; Solar and terrestrial radiation, Greenhouse effect and global warming; Radiation laws, Heat exchange process (conduction, convection and radiation); Radiation budget of the earth/atmosphere system; Environmental lapse rate and inversion; Generaldistribution of surface temperature; Diurnal, seasonal and geographical variation of temperature;

Water Vapour in the Atmosphere: Changes of state, specific, absolute and relative humidity, dew point temperature, humidity mixing ratio, unsaturated and saturated states, super cooling, frost point. Diurnal and seasonal variation of water vapour. Adiabatic processes; Dry Adiabatic Lapse Rate (DALR) and Saturated Adiabatic Lapse Rate(SALR). Stability analysis**.**

UNIT 2 - Wind, Cloud and Precipitation

Wind: Factors affecting atmospheric motion & the resulting winds; Newton's Law & equation of motion; Beaufort scale of wind force; Geostrophic wind; Gradient and cyclostrophic winds; Pressure gradient forces, Coriolis force, Buys Ballot's

law, True and apparent wind and its vector calculation; Interpreting WindRose. Demonstrate the use of Geostropic wind scale.

Cloud and Precipitation: Condensation and Precipitation phenomen, Formation of Clouds, the Different types of Clouds, Development and classification of clouds as per height, Cloud Atlas; Formation and various stages of Thunder storm, Drizzle, Hail, Snow, Sleet; Dew**.**

UNIT 3: Atmospheric Pressure & Visibility

Atmospheric Presssure : Definition of pressure; Unit used for recording pressure; Pressure gradient, barometric tendency, isobar, isallobar and the relationship between atmospheric pressure and height above sea level; Horizontal and vertical distribution of atmospheric pressure and the resulting circulation; Diurnal variation ofpressure,Basic pattern of air movement.Upper air waves and Jet stream. Variation of pressure from 940 mb – 1050 mb.

Visibility: Formation of fog, mist, haze, frost; Different types of fog; Effect of fog, mist, haze, and other meteorological conditions on visibility. Formation of Sea smoke,Estimating methods to find visibility day/night and the difficulties involved**.**

UNIT 4: Ocean Circulation System, Sub Surface Circulation, Oceanic Waves

Ocean Circulation System and Sub-Surface Circulation : 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; The currents of Pacific, Atlantic and Indian oceans. Formation, source region and movement of water masses.

Oceanic Waves : 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,.

UNIT – 5 Tides, Sea Water & Ship Borne Meteorological Instruments

Tides: Tide producing forces, types of tides, tide prediction and analysis; bore tides, tidal streams; co-tidal charts; interpretation of tidal charts; relationship between tides and phases of moon.

Sea Water : Properties of ocean water- Temperature, salinity, density and pressure - their relationship and measurement; and vertical and horizontal distribution.

Ship Borne Meteorolocical Instruments : Principle, construction, use and operation of Aneroid Barometer, Barograph, Hygrometer, Hydrometer, Stevenson's screen, Whirling psychrometer and Anemometer. Basic principle of wind sensor and readings

Reference Books:

1. Marine Meteorology – Capt. H.Subramaniam
2. Meteorology for Mariners-HMSO
3. Meteorology for Seafarers- Frampton,R.M
4. Meteorology Demystified: self teaching guide- GibiliscoStan
5. Dynamical Meteorology: an introductory selection – Atkinson, BW
6. Notes on Meteorology - Kemp
7. Meteorology at Sea- SandersonRay
8. Meteorology - Charles W. Roberts
9. Mariners Handbook (NP 100) -Admiralty
10. Cloud Types for Observers-HMSO
11. Ship's Code and Decode Book - The Met Office

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code **231NS1A44TG**	Course Name **Maritime Law II**		L	T	P	C
			2	0	0	2
Year and Semester	II Year (IV Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To familiarize the cadets the contents of various conventions and codes
	2	To introduce the ability to interpret these conventions
	3	To application of law in shipboard operations.
Course Outcome	CO1	Comprehend port procedures
	CO2	Infer various Codes and application
	CO3	Infer various conventions like STCW, ISM and MLC
	CO4	Comprehend importance of Merchant Shipping Act, Maritime Administration in India-DG Shipping, MMD's
	CO5	Interpret Marine Insurance-Hull and P&I
	CO6	Analyze the application of law in shipboard operations.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Average	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1PASSENGER / FAL / SPECIAL TRADE PASSENGER & ATHEN CONVENTION

FALconvention port procedures: procedure for obtaining port health clearance, of health, procedure in case of infectious diseases, port clearance port procedures : Arrival &Dep procedures formalities for entering and clearing ship;

SPECIAL TRADE PASSENGER SHIPS AGREEMENT, 1971, AND RULES, 1971 (STP 1971) :

Application – convention – definitions – certificates – carriage of dangerous goods in Special Trade Passenger ships – compliance with International Health Regulations

PROTOCOL AND RULES ON SPACE REQUIREMENTS FOR SPECIAL TRADE PASSENGER SHIPS, 1973 (SPACE STP 1973)

Application – certificate – suitability of space and allotted space – compliance with International Health Regulations - exemptions

ATHENS CONVENTION RELATING TO THE CARRIAGE OF PASSENGERS AND THEIR LUGGAGE BY SEA (PAL 1974)

Definitions - liabilities – limits of liability

PSC :Purpose, Implementation, MOU Of Port State Control and Practical aspects of Inspections . Seaworthiness, Statutory Sea-Worthiness, Unsafe Ships & Unseaworthy Ships

UNIT 2 SOLAS- VARIOUS CODES

SOLAS – CARRIAGE OF GRAIN - Intact Stability Requirement – Contents - Document Of Authorization

SOLAS – CARRIAGE OF DANGEROUS GOODS– application – provision – IMDG code – requirements – IMDG cargo manifest – stowage plan – precautions – list of explosives may be carried in a passenger ship

INTERNATIONAL BULK CHEMICAL CODE (IBC CODE) Application – Design Construction Standards – Equipment Carried For Pollution Prevention – Requirements Of PSC

INTERNATIONAL GAS CARRIER CODE (IGC CODE) Application – Various Designs & Construction

GUIDELINES ON THE ENHANCED PROGRAMME OF INSPECTIONS DURING SURVEYS OF BULK CARRIERS AND OIL TANKERS Guidelines – Definitions Of Various Surveys Like : Over All Survey - Close-Up Survey – Substantial Corrosion - Corrosion Prevention System - Critical Structure Areas - Intermediate Enhanced Survey ; Requirements : Enhanced Survey Carried out During Periodical Survey – Enhanced Survey Carried out During Annual

Survey - Intermediate Enhanced Survey - Preparation For Survey

UNIT 3 - ISM/ STCW/MLC/RPSL

INTERNATIONAL SAFETY MANAGEMENT (ISM) CODE

Application – Ship Safety Management Manual & Its Details

INTERNATIONAL CONVENTION ON STANDARDS OF TRAINING, CERTIFICATION AND WATCHKEEPING FOR SEAFARERS, 1978, AS AMENDED (STCW) (STCW 2010)

General obligations/ purpose – definitions - application – certificate – dispensation – mandatory requirement of certificates by officers and crew – detainment – requirements of qualification for oil, chemical and gas tankers - updating of proficiency as master, deck, engineer, radio officers and ratings - mandatory minimum requirements for the issue of a certificate of proficiency in survival craft and rescue boats other than fast rescue boats - basic principles to be observed in keeping navigational and engineering watches

MLC : Contents, implementation and inspections, crew accommodation

RPSL: Introduction purpose, benefit to seafarers, responsibilities of employer, rights and responsibilities of the seafarer, owners liability towards passengers and crew: contract of employment AOA, general content , wages responsibilities of foreign employer & seafarer.

UNIT 4 MS ACT (INDIAN)

MARTITME ADMINISTRATIONS: General Administration: D.G. Shipping, MMD's, Shipping Offices, Shipping Master (Part I To V- Relevant Extracts).Procedures for and Certificates of Ship's Registry; (Sections 20 To 74 –Outline) Desertions, Deceased Seaman, Discharge Of Seamen, Repatriation; Discipline and Treatment of Disciplinary Offences; Offences Relating to Misconduct Endangering Ship and against Persons on Board; Official Log Book and The Law relating to entries Therein; Investigation and Enquiries (M.S. Act Sections 357 to 389) Master's Duties in Case of Accidents And When Encountering Dangers to Navigation Assistance to Vessel in Distress and Duties of Master in Case of Collision and Other Accidents;(NOTE: M.S. ACT IS UNDER REVISION. FACULTY TO KEEP CLOSE MONITORING OF SAME)

UNIT 5 MARINE INSURANCE

Brief outline of types of marine insurance:- important clauses in marine insurance policies including subrogation clause, assignment of policy. Common law warranties and modifications thereto, common and private carriers., difference between marine and other insurance policies Hull & Machinery -Institute Time policy , voyage policy – valued and unvalued. Cargo insurance- recording of evidence as a ship's officer. Note of protest and extended protests. Type of losses:- total loss-ATL/CTL/PTL and partial loss

Text Book:

1. Merchant Shipping Act by Bhandarkar
2. Carriage of Goods at Sea Act-IMO
3. The Shipmaster's Business Companion – MALCOM MACLACHLAN
4. Business and Law for shipmaster's – F.N. HOPKINS

Reference Books:

1. ISM
2. STCW
3. VARIOUS CODES UNDER SOLAS (GRAIN CODE, IBC, IGC etc.)

Document Prepared in " Board of Studies" held on **Date:09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code **231NS1A44PH**	Course Name **Chart work and Voyage Planning - I**		L	T	P	C
			0	0	3	2
Year and Semester	II Year (IV Semester)		Contact hours per week 3 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To evaluate the methods of charting techniques and differentiate between the various methods of projections of a spheroid.
	2	To become proficient in comprehending all symbols and similar data used in Navigatioal charts.
	3	To thoroughly comprehend the effect of wind and current on the track keeping ability.
Course Outcome	CO1	Compare and differentiate the various methods of projecting a spheriod on a plane surface and the unavoidable distortions.
	CO2	Interpret the symbols used in a Navigation chart indicating underwater dangers, depth contours, cable structures and also various topographical navmarks.
	CO3	To fully understand the various factors that cause a ship to drift from its planned track and determine the degree to which such drifting may render his ship into dangerous waters
	CO4	Validate all theories of Terrestrial Navigation through advanced problems solving and Navigational watch.
	CO5	To be able to determine the position of a ship using verious terrestrial Navigational techniques inclusing use of Navigational marks, sector lights.
	CO6	Compare the advantages and limitations of position fixing by navigational aids.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1	3	3		3	-	-	-	-	-	3	3	3
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3			3					-	-	-	-	-			
CO4	3		1	3	3		3	-	-	-	-	-	3	3	3
CO5	3		1	3	3		3	-	-	-	-	-	3	3	3
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.75	3	1	2.75	2.75	3	2.75	-	-	-	-	-	2.75	2.75	2.75

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1 Chart Work: Earth –Direction and Distance.

1. Introduction to Chart Work, the Bridge, Chart-room. Modern ECDIS displays.
2. Tools for Chart Work.
3. Shape of Earth; Earth's axis, earth's poles, Sphere & Spheroid. Great Circles, Small Circles and Rhumblines
4. Position on Earth - Equator, Meridians, Parallels of latitude, Prime Meridian and Longitude, Position by Latitude and Longitude.
5. Mercator Chart; Mercator Projections; Meridional parts; DMP;
6. Explain why the scale distance increase along the Latitude scale and remans constant along Longitude scale.
7. Explain that projecting a sphere on a plane paper gives rise to distortion. This is overcome by increasing the latitude scale progressively in the ration of Secant Latitude.
8. Distance - Nautical mile, Geographical mile; Statute mile, Kilometre and Comparison of all units of distance. Explanation of 'Cable' and 'Knot' as a unit of distance and speed; Effect of polar compression on nautical mile.
9. Measurement of distance between two positions on a Mercator chart is always done along the Latitude Scale.
10. Natural scale- why valid only at a given Parallel of Latitude.
11. Small Scale, large scale charts, ocean charts, coastal charts, harbour charts, PLAN Charts.
12. State why Mrcator chart is unrliable beyond 70-75 degree Latitudes.
13. Brief introduction to Gnomonic charts.

UNIT 2Chart Work: Coastal navigation – position finding using terrestrial objects.

1. Procedure to read latitude and longitude; Use of parallel rulers, set squares and dividers; Compass Rose;
2. Cardinal directions, define bearings,
3. Use of navigational aids and other terrestrial objects for fixing position.
4. Use of terrestrial topology for position fixing, such as end of land, mountains, small islands.
5. Names of objects and their positions, and light characteristics as indicated on chart.
6. Bearings– Basic understanding on the directional concept used onboard a ship. Explain difference between True bearing from ship's observation and direction of ship from terrestrial objects and precautions on use of bearing (reverse bearing) or directions from objects before plotting position lines.
7. Distance scale; Reason for using the nearest latitude scale for measuring distance;

UNIT 3 Chart Work: Plotting fix, drawing courses and finding distances.

1. Definition of position lines. Different type of position lines.
2. Plotting position on chart by latitude/ longitude, by bearing and distance from a navigational mark, by gyro compass bearings of two or more shore objects. Definition of fix or observed position.
3. Setting course without current and leeway. True course and Gyro course. Applying gyro error.
4. Calculations to find various courses from one another. (excluding Magnetic)
5. Simple problems on finding Course, Distance, beam bearing, ETA, DR.

UNIT 4 :- **Chart Work: Chart Symbols**

1. Brief Introduction to 5011 and chart Layout:- Charts (Source data, scale, colors used, corrections, date of publication, edition, publisher, hydrographer, chart title and chart number, title block.
2. Brief introduction to Chart corrections, Notices to Mariners.
3. Brief introduction to how charts are drawn.
4. Brief explanation on Surveys – traditional and modern.
5. Units of soundings used, Chart Symbols as given in INT 5011 limited to topographical symbols such as used in coastal Navigation (Lighthouse, Lightvessels, Buoys, Beacons, Radio Towers etc- marking of their exact location on the chart).
6. Difference between plan view and profile view symbols and their location point on chart.
7. BASIC Information regarding lights (geographical range, nominal range, luminous range.
8. Names of objects and light characteristics as indicated on chart.
9. Datums. Chart Datum, Height Datum, Horizontal Datum as given in INT 5011 (Section H in Edition 5) by sketch. Reduction of soundings to Chart Datum, corrections to heights of Lighthouses/Beacons for VSA.
10. Understanding the significance of various Chart Symbols as given in INT 5011 (limited to the list given below) in respect of sub-surface dangers.
    a. Drying heights, depths and nature of sea bed, depth and height contours, tidal stream, current.
    b. Offshore installation, platform, mooring, submarine cable, submarine pipeline, fishing stakes, mining.
    c. Naval exercise, prohibited areas, symbols for designated anchorages, anchoring prohibited etc.
    d. Tracks, routes, areas and limits, traffic lanes and separation zones.
    e. Bridges, overhead Cables etc.
    f. Abbreviations used on a nautical chart.
    g. Recognition of the coast and radar responsive targets, buoys, radio beacons and other navigational aids.
    h. Use of leadinglights and sector lights for safe navigation in harbour and for laying courses.
    i. Horizontal sectors of light, use of clearing marks.
    j. Notes and cautions below Chart Title. (Degree of reliability of information shown on charts)
    k. Other reference points used for heights.
    l. Information regarding lights (geographical range, nominal range, luminous range.
    m. Traffic lanes and separation zones etcetra as found below Chart Title and Cautionary notes.

UNIT 5Chart Work: Current and Leeway – "allowing" exercises

1. Brief introduction to ocean currents and tidal streams. How current and tidal stream affect the vessel. Factors causing drifting of vessel, Set and drift of current.
2. Estimated position (EP); difference between Fix, DR and EP. SYMBOLS USED for above and for Electronic positions.
3. Define course to set, Course steered, Course through water, CMG, SMG- Standard IMO recommended terms in respect of above. Intended track, Water Track, Ground track, , Speed through water, SOG etc.
4. Tidal Diamonds ,Tidal streams, Tidal information given on a chart; Obtaining current direction and rate from approach charts use of light sector in Navigation / approaches- practical demonstration on selected charts.
5. Tidal stream atlas.
6. Finding out Compass course to set between two positions on the chart or to pass abeam of or at cardinal bearings of lighthouses, Plotting intended track, significance of beam bearings in laying out Waypoints. Exercises based on above and estimating ETAs at waypoints.
7. Vector resolution of Course Made Good, Speed Made Good due to current and leeway; finding out actual set and rate of current; drift.
8. Exercises based on " allowing" (No variation / deviation)

Text Book:

1. Fog Signals.
2. INTERCO Signals
3. Compass error Book-
4. Deck Log Book (Bridge Log Book)
5. Bell Book (Movements Book)-
6. Nautical Almanac-.
7. VHF Log
8. Radar Log
9. Deviation chart
10. Guide to Port Entry-
11. Admiralty Distance Tables-
12. Brown's Almanac-
13. Echo Sounder Log
14. Radar Plotting Sheets
15. Tidal Atlasses for English Channel and Malacca Straits.
16. IALA – NP735 –.
17. Admiralty Tide Tables- All volumes current year
18. Admiralty Tide Tables, abridged for 1992, all volumes
19. Indian Notices to Mariners, Annual etc – One full set IMO Publication on Routeing

Reference Books:

1. Chartwork by S.K.Puri (text Book)
2. Practice charts for English Channel, Bristol Channel and other areas 2675, 5047, 5056, 5072.
3. NP5011 (Text Book)
4. NP294- Admiralty "How to keep chart updated"
5. Modern Chartwork- W.H.squair
6. Chartwork by- Capt.SSChaudri
7. Principles of Navigation by Capt.T.K.Josep/Rewari (text Book)
8. Practical Navigation- Capt.H.Subramaniam(Text Book)
9. Nories Tables (text Book)
10. Chartwork – Nichols Concise Guide Volumes 1&2
11. Chart work by D.A.Moore-
12. Chartwork by Sharma
13. Admiralty Manual of Navigation
14. IMO publications on Bridge Watchkeeping Procedure
15. Weekly Notices to Mariners - samples
16. Annual NTM- atleast for previous 6 years
17. Cumulative NTMs- atlewast for previous 6 years-
18. NP131- Atleast
19. All 7 volumes of ALRS- one full set
20. NP100-
21. Admiralty Sailing Directions
22. Ocean Passages to the World
23. Marine Observer's Handbook
24. Complete World Charts as per NP131, including Planning and roueting charts or atleast one full set of charts covering Two Ports across two oceans.
25. Atleast all Gnomonic charts covering either Arctic or Antartic
26. IMO Rules of the Road- Bhandarkar(Text Book)
27. A Mariner's Guide to Colregs-Capt.Y.Chaabra
28. Sample Loran charts.
29. Magnetic variation charts-
30. Bathymetric charts. All volumes of List of Lights

Document Prepared in " Board of Studies" held on Date: 09.06.2023	**Document Approved in " Academic Council"**

Professional Elective Course - I

<table>
<tr><td>Program</td><td colspan="6">B.Sc., (Nautical Science)</td></tr>
<tr><td rowspan="2">Course Code</td><td colspan="3" rowspan="2">Course Name
Shipboard Communications and Procedures-I</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Year and Semester</td><td colspan="3">II Year (IV Semester)</td><td colspan="4" rowspan="2">Contact hours per week
2 Hrs.</td></tr>
<tr><td>Prerequisite course</td><td colspan="3"></td></tr>
<tr><td rowspan="4">Course category</td><td colspan="2">Humanities and Social Sciences</td><td>Management courses</td><td colspan="2">Professional Core</td><td colspan="2">Professional Elective</td></tr>
<tr><td colspan="2"></td><td></td><td colspan="2"></td><td colspan="2">✓</td></tr>
<tr><td colspan="2">Basic Science</td><td>Engineering Science</td><td colspan="2">Open Elective</td><td colspan="2">Mandatory</td></tr>
<tr><td colspan="2"></td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td rowspan="3">Course Objective</td><td>1</td><td colspan="6">Know the importance of shipboard communications & procedures</td></tr>
<tr><td>2</td><td colspan="6">Understand the primary communications responsibility during Distress, Urgency, Safety and Routine incidents</td></tr>
<tr><td>3</td><td colspan="6">Learn the basic technical aspects of terrestrial communication</td></tr>
<tr><td rowspan="6">Course Outcome</td><td>CO1</td><td colspan="6">Infer GMDSS and it’s advantages</td></tr>
<tr><td>CO2</td><td colspan="6">Interpret Radio regulations, distress and alerting systems</td></tr>
<tr><td>CO3</td><td colspan="6">Identify radio stations and list service publications</td></tr>
<tr><td>CO4</td><td colspan="6">Comprehend the use of terrestrial communications</td></tr>
<tr><td>CO5</td><td colspan="6">Identify sources of alternative power, batteries, antennas and their maintenance.</td></tr>
<tr><td>CO6</td><td colspan="6">Infer the importance and procedures of communication</td></tr>
</table>

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
Average	2.33	3	-	2.33	2.33	3	2.33	-	-	-	-	-	2.33	2.33	2.33

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT- 1: Statutory framework of the Maritime Mobile Service

INTRODUCTION : Old Communication systems prior GMDSS – Use of Radio telegraphy – Radiotelephony - Frequencies and their limitations – watch-keeping - Training required for operators
New Communication systems - Introduction of GMDSS –Implementation- Terrestrial and Satellite communications- Comparison of New system and old system - International Convention for the safety of life at sea – GMDSS overview
Functional Requirements - Sea Areas, Definition of Sea Areas - Carriage Requirements - Details of equipment specifications A1, A2, A3 & A4 - Details of carriage requirement - Means of Ensuring availability of ship station equipments- Primary and Secondary means of alerting. - Requirement of Safety Radio Certificate - Requirement of Ship Station License and it's contents. – Watch-keeping – Watch-keeping Procedures as given in Radio Regulations - Source of Power, reserve source of power, capacity and duration as defined in radio regulations

UNIT – 2: Radio Regulations

Authority of the Master -Secrecy of correspondence - Ship Station Licenses -Certificate of Personnel - Interference -Test Transmissions -Control of working -General calling procedure -Making Routine call -Difficulty with communication -DSC Routine alerting -Accounting Authority Identification Code -Public Correspondence Channels -Port operation and Pilot Channels -Transmission in harbours - On-board communication Procedure -Inspection of ship stations-Inspection Reports-Frequencies for Distress, Urgency and Safety communications- Important Frequencies-Distress communications-Urgency communications-Safety communications

UNIT – 3 :IDENTIFICATION OF RADIO STATIONS / SERVICE PUBLICATIONS

Identification of Ship stations -Ship's Name -Call sign-Maritime mobile service identity- Group calling number - Identification of coast stations -Identification of Search and Rescue stations- Identification of VTS stations- Identification of Aids to Navigation - Identification of Aircraft stations -Identification of associated craft with parent ship- Identification of SES

SERVICE PUBLICATIONS

List of Coast Stations and Special Services stations- List of Ship Stations and maritime mobile service identity
-Manual for use by maritime mobile and maritime mobile – satellite services- Admirality List of Radio Signals-Test Certificates-Radio Log Book-Shore based Maintenance contract

UNIT – 4 : TECHNICAL – 1

RADIO WAVE PROPOGATION
Basics-Main frequency band -Line of Sight Propagation- Ground waves and sky waves-Ionosphere structure-MF propagation-HF propagation- VHF propagation-Skip distance-Dead zone-Fading-OTF-MUF-LUF-Duct Propagation
MODULATION BASISCS
Frequency Modulation- Amplitude Modulation-Bandwidth of different types of modulations-Carrier and assigned frequencies
-Official designations of emissions- classes of emission-radition
TRANSMITTER AND RECEIVER BASICS
Basic Radio-Transmitter structure-Receiver structure

UNIT-5 : TECHNICAL – 2

BATTERIES
Basics-Different kinds of batteries – Lead Acid battery-UPS system-Characteristic of different types of batteries-Primary Batteries-Secondary batteries-Charging batteries, charging methods-Maintenance and monitoring of batteries

ANTENNAS
VHF antennas-Whip antennas-Long wire antennas-MF/HF antennas-Satellite antennas-ATU-Antenna Maintenance

DSC BASICS-Components of the DSC alert/call

RADIO TELEX BASICS
Automatic Request for Repeat (ARQ)-Forward Error Correction (FEC)-Selective FEC-Command codes used in NBDP

Text Book:

1. GMDSS HANDOUT

Reference Books:

1) Basic Radio – Marvin Tepper
2) ITU Manual for use by the Maritime Mobile and Maritime Mobile Satellite services
3) ITU List of coast stations and special services stations
4) INMARSAT maritime communications handbook
5) Admirality List of Radio Signals, Volume 1,3,5 & 6

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code	Course Name **Polar Navigation**		L	T	P	C
			2	0	0	2
Year and Semester	II Year (IV Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
				✓		
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To introduce the regulations regarding navigating in polar waters.
	2	To acquaint with the constructional requirements, qualifications, dangers of navigating in ice.
	3	To understand the procedure to seek assistance to save ship and , environment.
Course Outcome	CO1	Interpret the fundamentals of ice Physics and Ice Regime
	CO2	Infer the Regulations for transiting polar regions
	CO3	Identify the Vessel characteristics for navigating in Ice
	CO4	Prepare the ship for Navigation and operation in Ice
	CO5	Infer procedure for Arctic Navigation
	CO6	Apply the procedures for Passage Planning, Ice breaker and convoy operations.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
Average	2.50	3	0.50	2.50	2.50	3	2.50	-	-	-	-	-	2.50	2.50	2.50

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit 1 ICE REGIME

1.1 Ice physics, formation, growth, ageing and stages of melt 1.2 Ice types and concentrations 1.3 Ice reporting, coding and terminology 1.4 Ice advisories and forecasts 1.5 Signs of ice in the vicinity

Unit 2REGULATIONS AND PUBLICATIONS

2.1 Polar Code as adopted 2.2 Contents of Polar water Operational Manual 2.3 Hull designs 2.4 Ice strengthening requirements 2.5Three categories and seven types of polar class vessels

Unit 3EFFECTS OF EXTREME LOW TEMPERATURES

3.1 Brittleness of ships components 3.2 Freezing of equipment 3.3 Methods and precautions in de-icing
3.4 Safety procedures during ice transit. 3.5 Ice imagery

Unit 4MANOEUVRING IN ICE

4.1 Approaching, entering, and transiting ice 4.2 Backing in ice 4.3 Avoidance and freeing vessel beset 4.4 Turning in ice 4.5 Berthing in ice

Unit 5ICEBREAKER OPERATIONS

5.1 Icebreaker communication 5.2 Icebreaker operating methods 5.3 Convoy operations 5.4 Navigation in the Arctic 5.5Passage Planning

Text Book: SOLAS edition 2009
2.IMO POLAR CODE

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	B.Sc., (Nautical Science)					
Course Code **231NS1A54TA**	Course Name **Navigation – IV**		L	T	P	C
			3	0	0	3
Year and Semester	III Year (V Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To become proficient with main methods of position fixing with observation of celestial bodies including practical celestial sights (Sun, Planet, Stars and Moon)
	2	To impart adequate knowledge on the Celestial Navigation as required for Ship's Officers function at Sea.
	3	To appreciate the importance fixing ships positions manually in the absence of navigational aids
Course Outcome	CO1	Distinguish between all the methods of position fixing with observation of celestial bodies
	CO2	Formulate lower meridian passage and celestial bodies
	CO3	Formulate Long by Chron, Intercept, Ex Meridian, Polaris methods
	CO4	Infer fully how staggered positions are obtained daily at sea
	CO5	Categorize Visually how two or more position lines are plotted and cocked hat resolved
	CO6	Perform the task of fixing ships position using all celestial objects

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO6	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
Average	2.50	3	2.20	2.50	2.50	3	2.50	-	-	-	-	-	2.50	2.50	2.50

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit 1 –Observations of Celestial Bodies – Off the Meridian - Intercept Method (Sun & Star)

- Principles involved in obtaining an Intercept (True ZD - Calculated ZD) and Azimuth of a Celestial Body (calculation using ABC Table with DR Position). Relation between GP (Centre of a position circle) and Zenith Distance (its radius) & finding the Intercept Towards / Away from the GP.
- Plotting of Position Line based on obtained Intercept and Azimuth with respect to DR position.
- Calculations to obtain GHA & Dec of a CB at a particular instant; finding TZD based on Sextant Altitude &Calculated ZD with Cos ZD formulae to obtain Intercept; and finding the Azimuth using ABC Table (based on DR Lat, Dec & LHA of CB) to obtain Position Line by Intercept Method.

UNIT 2 –Observations of Celestial Bodies – Off the Meridian - Long by Chron Method (Sun)

- Principles involved in obtaining Observer's Longitude by chronometer calculation based on Ship's DR latitude. Calculations based on 'Cos P' formulae of this method (relation between True Altitude, Declination and DR Latitude) to find LHA of CB; GHA at that instant from Nautical Almanac to get Observers' Longitude. Further, calculations to find Azimuth of a Celestial Body (calculation using ABC Table with DR Position).
- Plotting of Position Line based on obtained Obs Long and Azimuth with respect to DR position.

UNIT 3 –MERPASS (SUN) - Latitude

- Principle in Meridian Passage of a Celestial Body. Figure drawing for Meridian Passage calculations for six different conditions between Latitude of Observer & Declination of Body.
- Relationship between the Meridian Altitude (Meralt) and the Latitude of the observer; MZD & Declination. Plotting of Position line obtained through Merpass observation.
- Calculations to find LMT of Meridian Passage of Sun, Planets and Star and Calculations to find Latitude from Sextant Altitude obtained during the Merpass of the Celestial Bodies.
- **Circumpolar Body** – Explain what is a Circumpolar Body and conditions necessary based on observer's Latitude and Declination of Celestial Body.
- Elementary introduction into the concept of Lower Meridian Passage of a Circumpolar Body.

UNIT 4 –Pole Star Observation - Latitude

- **Pole Star Observation–** Identification of Polaris, a_0, a_1, a_2 correction and calculation of Latitude, Azimuth and Position Line and the Position through which it passes. Also explain significance of Pole Star for Gyro error while in Northern Hemisphere. Simple calculation based on Pole Star observation to find the Observer's Latitude and Position Line plotting.

UNIT 5 –Position Fixing – Celestial Observation Other Methods

- **Ex-Meridian Method (SUN)** Principles involved in obtaining MZD for an observation of Sun near the Meridian Passage & Observer's Latitude. Calculations to find Latitude based on this method including Azimuth of a Celestial Body (calculation using ABC Table with DR Position).
- Plotting of Position Line based on obtained Obs Latitude and Azimuth with respect to DR Longitude.
- **Staggered / Simultaneous Observation** – Principles involved in position finding by Simultaneous & Staggered Observations of Celestial bodies and simple calculations / plotting thereof.

Star Identification – Principles involved in identifying the unknown Star whose sextant altitude could be measured at a particular instant. Calculations involved in getting the Declination & SHA of the unknown star and using these values to obtain position line based on Intercept / Long by Chron method, on which ship may lie. Also explain the stellar constellations and stellar magnitudes.

Text Book:

1. Principles of Navigation by Capt. S.S.S Rewari& Capt. T.K.Joseph
2. Practical Navigation by Capt. H.Subramanium
3. Nichol's Concise Guide Volume-1 and 2

Reference Books:

1. The Admiralty Manual of Navigation
2. Principles of Navigation: Vol. 1- Nautical Institute
3. Navigation Guide Vol. 1: Near Coastal Navigation- Alexander Simpson
4. Practical Navigation for Officers of the Watch- Frost, A
5. The Marine sextant booklet by Capt. H.Subramaniam
6. Spherical Trigonometry by CaptH.Subramanium
7. Introduction to Spherical Trigonometry by J.H.Clough –Smith

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council**

Program	B.Sc., (Nautical Science)					
Course Code **231NS1A54TB**	Course Name **Bridge Equipment & Bridge Resource Mgt-IV**		L	T	P	C
			2	0	0	2
Year and Semester	III Year (V Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To learn and understand the different features of ECDIS for effective navigation
	2	To interpret data from navigational aids and decide effective actions.
	3	To acquire rapidity and accuracy in methods of radar plotting
Course Outcome	CO1	Become proficient in operating and comprehending ECDIS
	CO2	Relate Gyro and Magnetic compass and their interdependence on board.
	CO3	Categorize the Integrated Bridge Systems
	CO4	Reorganize the Bridge watch with proper Bridge Resource Management to the prevailing conditions of the navigational watch
	CO5	Co-relate the compliance with COLREGs and all other watch keeping regulations and applicable conventions.
	CO6	Comprehend the fundamental principles which govern the working of navigational aids.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.40	3	0.67	2.40	2.40	3	2.40	-	-	-	-	-	2.40	2.40	2.40

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT-1 Electronic chart display and information system(ECDIS)

This includes:

- describes principal types of electronic chart system
- describes the differences between Vector and Raster charts
- describes the terms and definitions used in the context of ECDIS
- explains the major characteristics of ECDIS data such as data term and definition; data contents; data structure; attribute; data quality and its accuracy
- describes the position reference system
- describes ECDIS display characteristics
- explains the scope and selection of chart data display categories
- explains the safety value available in ECDIS
- explains various sensors, its accuracy requirement and states proper action to take in case of malfunction
- describes the production and distribution of updates–manual, semi-automatic and automatic updating
- describes the route planning and route monitoring in ECDIs
- describes the route planning information; route planning calculation; calculation of the voyage schedule; construction of a route; planned route checking for navigator safety; alternative route; optimization of route planning and ultimate route selection
- explains route and voyage monitoring; checks route measurement and calculations ; navigation in open sea, coastal and confined waters using ECDIs; current and wind effects
- demonstrates the uses of all specific functions and obtains all relevant information for route planning and

monitoring for navigating and for the ship's safety:

- Sea area selection.
- Route planning information
- construction of a route
- adjustment of a planned route
- curve track planning
- planning notes
- safety values
- check for navigational safety
- ultimate route, monitored area
- vector time
- check measurements
- alarms
- current and wind

- explains the meaning of status Indications, Indicators & Alarm relating to ECDIS
- explains the typical errors of interpretation &takes action to avoid these errors
- explains the meaning of voyage recording, operates the corresponding functions and the reconstruction of past track

describes the possible risk of over-reliance and complacency on ECDIS

UNIT-2 Magnetism Theory

- Explains the theory of magnetism as applied to Ferro magnetic materials
- Describes a simple magnet, its poles and the law of attraction and repulsion, the magnetic field around a magnet, flux density and field strength
- describes magnetic induction and differentiates between 'hard' and 'soft' iron ,explains the meaning of the terms:
  - intensity of magnetization,permeability,magnetic susceptibility
- describes the magnetic field of the earth
- defines 'magnetic poles' and 'magnetic equator','angle of dip'
- explains how the earth's total field can be split into horizontal and vertical components , states that the direction and strength of a magnetic field maybe represented by a vector, uses a vector diagram to find the field at a point resulting from two given fields, states that a compass needle will align itself with the resultant field
- defines 'magnetic variation' and explains why it is as slowly changing quantity

-State the various co-efficients which affect accuracy of magnetic compass and its

- basic idea, correctors such as Soft-Iron spheres / Flinder's bar etc.

- Magnetic compass corrections: Precautions to be observed when swinging the vessel, Occasions when a full correction is necessary and when an adjustment is necessary

3. **Unit 3 Integrated Systems**

Integrated Navigation System(INS):- Introduction, Types(A,B,C), Main Features, Modules forming part of INS – Navigation - Anti-collision – Steering, Block Diagram of INS

Integrated Bridge System(IBS):-Introduction, Parts of IBS, Difference between INS and IBS, Advantages and Disadvantages of IBS

4. **Bridge resource management**

Knowledge of bridge resource management Principles:-

- describes the basic principles of bridge resource management
- explains how responsibility for the safety is clearly defined at all times, including periods when the master is on the bridge and while under pilot age
- demonstrates clear, concise communications and acknowledgements (at all times) in a seaman-like manner
- demonstrates the allocation, assignment and prioritization of resources
- demonstrates the importance of ensuring the effectiveness of communication between bridge team members
- explains the importance of ensuring the effectiveness of information exchange with pilot
- demonstrates effective information exchange
- defines "situational leadership"
- explains the relationship between assertiveness and leadership
- explains the importance of challenge and response
- explains the importance of obtaining and maintaining situational awareness
- demonstrates appropriate challenges and responses
- Demonstrates the ability to maintain situational awareness in complex situations.

5. **Watch keeping and performance standards**
    - Navigation in restricted visibility -Importance of using Parallel index techniques in restricted visibility
    - -Performance standards of ECDIS
    - -Performance standards of RADAR/ARPA
    - -Performance standards of Gyro compass
    - Performance standards of Echo sounder
    - Performance standards of Magnetic compass

Text Book:

1. Bridge Watch Keeping – Capt. H. Subramaniam
2. Bridge Procedure Guide - ICS
3. Bridge Team work - Nautical Institute
4. Mariners Handbook – HMSO Publication

Reference Books:

1. Bridge Equipment &Watch Keeping Notes – E. Fernandes.
2. STCW Convention / CODE with latest Amendments- Extracts on Bridge Watch Keeping-duties, functions and procedures.
3. Electronic Navigational Aid—Sonnenberg
4. Modern Electronic Aids—Bhatia and SinhaK
5. Electronic Navigational System --- L. Tetley & D. Calcutt
6. Admiralty Manual of Navigation – HMSO
7. Ship Magnetism and Magnetic Compass – F.G. Merrifield
8. Compass Work – Kemp & Young
9. Magnetic Compass Deviation correction – W. Denne
10. Collisions and their causes- Cahill, Richard
11. Marine Electronic Navigation – S.F.Appleyard

Ship Magnetism- Capt. T.K.Joseph& Capt. S.S.S.Rewari

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Program	B.Sc., (Nautical Science)					
Course Code **231NS1A54TC**	Course Name **Ship Stability – III**		L	T	P	C
			3	0	0	3
Year and Semester	III Year (V Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To introduce the concepts of Trim, Trim calculations using Hydrostatic Data.
	2	To assessing Compliance of a Ship's Loaded Condition with IMO Criteria
	3	To use of Wall Sided Formula and the stability compliance required by International Grain Code
Course Outcome	CO1	Perform Trim calculations using LOA, LBP, FP, AP, MCTC, LCF, LCB, LCG, Hydrostatic particulars
	CO2	Assess the Compliance of a Ship's Loaded Condition with IMO Criteria
	CO3	Deduce Wall Sided Formula
	CO4	Interpret International Grain Code
	CO5	Interpret intact stability criteria for cargo ships
	CO6	Evaluate that a ship's loaded condition complies with required minimum criteria.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.33	3	1.17	2.33	2.33	3	2.33	-	-	-	-	-	2.33	2.33	2.33

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit 1: Introduction to Trim

• Understand the terms Forward Perpendicular (FP), After Perpendicular (AP), Length between Perpendicular (LBP). Length Overall (LOA) and Amidships.

• Understand the terms Trim, Change of trim, Centre of Flotation, Longitudinal Centre of Floatation (LCF), Longitudinal Centre of Buoyancy (LCB), GML, and KML.

• Understand the terms Trimming moment and Moment to Change trim by one centimetre (MCTC). Derive a formula for the calculation of MCTC. Calculate the change of trim due to shifting of weights.

• Understand the Role of Centre of Flotation in change of trim. Calculate the final draughts when a weight is shifted, loaded and discharged by consideration of position of the LCF.

• Calculate the final drafts when multiple weights are shifted, loaded and discharged by consideration of position of the LCF.

• Knowledge of Ship and Hydrostatic particulars of M.V.Hindship.

Unit 2: Trim using Hydrostatic Data

• Understand the terms Arithmetic Mean Draught (AMD) and True Mean Draught (TMD) and recognize the importance of using the true mean draught for obtaining the ship's actual displacement when trimmed.

• Calculate the true mean draught.

• Calculate the final draughts for a ship when loading and/or discharging weights by taking moments about the mean LCF using hydrostatic data.

• Calculating the final drafts for ship initially on an even keel; calculating the final drafts for ship initially trimmed.

• Calculate the final drafts when multiple weights are shifted, loaded and discharged.

• Calculate the change of draught and trim due to change in water density; calculate the final drafts.

• Practice the above using Hydrostatic particulars of M.V. Hindship

Unit 3: Assessing Compliance of a Ship's Loaded Condition with IMO Criteria

• Understand Simpson's First, Second and third rules;

• Calculate areas, volumes, TPC, load displacement, centroids for areas and volumes using Simpson's rules;

• Area under GZ curves using Simpson's rule.

• Understand the term Dynamical Stability and its relevance to the area under the curve of Statical stability.
• Understand the IMO intact stability criteria for cargo ships. Verifying that a ship's loaded condition complies with required minimum criteria.
• Understand the relationship between GZ and GM at small angles of heel.

Unit 4: Wall Sided Formula

• Understand the distinction between stability at small and large angles of heel by considerations of the wall-sided formula;
• Derive the wall-sided formula for calculating GZ at moderate or large angles of heel.
• Calculate the Angle of loll using the Wall-sided formula.
• Calculation of the angle of loll and the effective GM at the angle of loll for ship that is unstable;
• Calculate the angle of list caused by a transverse shift of weight when the GM is zero.

Unit 5: The International Grain Code

• Define Grain, Angle of Repose, and Volumetric heeling moment.
• Explain the Hazards associated with respect to ship stability during carriage of bulk grain; Describe Document of Authorization;
• Understand the effect on the curve of Statical stability of a shift of a solid bulk cargo in general; know the Grain Code assumptions with respect to an anticipated shift of a bulk grain;
• Know the grain loading information to be supplied; Sketch and describe the intact stability criteria for a ship with a Document of Authorization carrying bulk grain.
• Construct GZ curve for grain laden vessel using KN values for various angles of heel; Construct Heeling arm curve by obtaining Heeling arm at 0^{o} and 40^{o}. Understand the procedure to check compliance with the intact stability requirements of the code.

Text Book:

1. Ship Stability for Masters and Mates- DA Derett
2. Ship Stability at the Operational Level-Capt H. Subramaniam
3. Problems on MV Hindship-Capt TK Joseph and Capt SSS Rewari

Reference Books:

1. Ship Stability Booklet of MV Hindship
2. Grain Code-IMO
3. Ship Stability for Masters and Mates-Martin A Rhodes
4. Ship Stability by Kemp and Young

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Program	B.Sc., (Nautical Science)					
Course Code **231NS1A54TD**	Course Name **Maritime Commerce**		L	T	P	C
			2	0	0	2
Year and Semester	III Year (V Semester)		Contact hours per week 2Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To familiarize the students about Past and present patterns of trading through ships
	2	To identify Major port of the world.
	3	To acquaint with stevedoring operations
Course Outcome	CO1	Describe History of Maritime Trade in India and the world
	CO2	Infer Organization of shipping companies, stevedores, suppliers, brokers
	CO3	Identify Sea ports and their location, major and minor ports of India.
	CO4	Classify Types of shipping-Liner, Tramp, Cruise and multi-modal transport,
	CO5	Interpret COGSA and identify types of Charter Party
	CO6	Correlate the implications of charter party with voyage planning.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.20	3	0.50	2.20	2.20	3	2.20	-	-	-	-	-	2.20	2.20	2.20

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT1HISTORY OF MARITIME TRADE IN THE WORLD AND IN INDIA.

Developments- current seaborne trade of the world:- composition and direction of cargoes – different types of ships which carry them Indian shipping development: India's merchant fleet – role of shipping on national economic development---role of government – India's shipping policy manning – business and cargo management; statutory regulations affecting shipping companies doing business in India.

UNIT 2 ORGANIZATION OF SHIPPING COMPANIES

Role of shipping companies; types of shipping companies - role of intermediaries in shipping business; customs freight brokers, clearing and forwarding agents-stevedores- shipbrokers, bunker and stores suppliers etc, shipping agencies.

UNIT 3 SEA PORTS AND SIGNIFICANCE, INCO TERMS

Ports locations- functions and range of services- financial aspects of utilization and cargo handling. India ports, their organization and administration. Modernization and development of ports.INCO terms with their inter-relation to bills of lading.

UNIT 4 TYPES OF SHIPPING SERVICES

Liner and tramp conference– definition, routes, schedules, obligations to trade. Different methods of commercial employment in tramp shipping and basic salient features, apportionment of expenses.

UNIT 5 TYPES OF CHARTER

COA, Timecharter, Voyage Charter, Trip Charter, Demise Charter, Bareboat Charter, Pooling etc Carriage of Goods By Sea Act, 1925 And Amendments – General Aspects With Specific Reference to A) Application (B) Carrier's Responsibilities, Liabilities, Rights and Immunities. The Hague Visby Rules, Hamburg Rules, Rotterdam Rules – Overview and Comparison with COGSA.

A detailed study of COGSA with case studies

Text Book: Elements of Shipping Alan Edward Branch **Reference Books:** **Reference web site:**

Document Prepared in " Board of Studies" held on **Date:09.06.2023**	**Document Approved in " Academic Council"**

<table>
<tr><td>Program</td><td colspan="5">B.Sc., (Nautical Science)</td></tr>
<tr><td rowspan="2">Course Code
231NS1A54TE</td><td colspan="2" rowspan="2">Course Name
Meteorology – II</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Year and Semester</td><td colspan="2">III Year (V Semester)</td><td colspan="3" rowspan="2">Contact hours per week
3 Hrs.</td></tr>
<tr><td>Prerequisite course</td><td colspan="2">Nil</td></tr>
<tr><td rowspan="4">Course category</td><td>Humanities and Social Sciences</td><td>Management courses</td><td>Professional Core</td><td colspan="2">Professional Elective</td></tr>
<tr><td></td><td></td><td>✓</td><td colspan="2"></td></tr>
<tr><td>Basic Science</td><td>Engineering Science</td><td>Open Elective</td><td colspan="2">Mandatory</td></tr>
<tr><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td rowspan="3">Course Objective</td><td>1</td><td colspan="5">To impart advanced knowledge of MarineMeteorology.</td></tr>
<tr><td>2</td><td colspan="5">To familiarize about Climatology, Weather systems, Weather reports.</td></tr>
<tr><td>3</td><td colspan="5">To comprehend Weather forecasting& reporting systems, Ice on the sea, weather routeing, and approaching Tropical Revolving Storms (TRS) actions to take.</td></tr>
<tr><td rowspan="6">Course Outcome</td><td>CO1</td><td colspan="5">Comprehend climatology-wind and pressure systems over the ocean</td></tr>
<tr><td>CO2</td><td colspan="5">Prepare weather systems, weather reports, weather forecasting and ice at sea</td></tr>
<tr><td>CO3</td><td colspan="5">Predict Tropical Revolving Storms(TRS)</td></tr>
<tr><td>CO4</td><td colspan="5">Prepare weather routeing and weather reports</td></tr>
<tr><td>CO5</td><td colspan="5">Make use of weather forecasting and reporting systems</td></tr>
<tr><td>CO6</td><td colspan="5">Prepare and support action taken to avoid adverse weather conditions with evidence</td></tr>
</table>

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.80	3	1.80	2.80	2.80	3	2.80	-	-	-	-	-	2.80	2.80	2.80

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT – 1 Climatology

Climatology : Wind and Pressure systems over the oceans (Draw the mean surface wind and pressure distribution over the earth's surface in January and July) ; Mean Surface Pressure and Wind distribution; Anabatic and Katabatic winds; Land and sea breezes; Local winds; Westerlies, Polar Easterlies, Doldrums and Inter- tropical Convergence Zones(ITCZ);General distribution of surface temperature, surface current; Monsoons, Dynamics of Indian monsoon; Seasonal weather & climatic characteristics inIndia. Monsoon in Indian Ocean, China sea, North coast of Australia, West coast of Africa and North East of Brazil.

UNIT – 2 Weather System(Anti Cyclone and Other Pressure system) &Ice on the sea

Anti Cyclone& Other Pressure Systems : Air Masses; Factors governing development; Classification and properties of air masses; Convergence and Divergence; Formation, Source region and movement of water masses. Types of fronts and associated weather ; Warm Front, Cold Front,Weather associated with Cyclone, Anticyclone, Ridge, Col, Trough and other pressure systems; Origin, life and movement of Frontal Depressions; Structure of Depressions.
Ice on the Sea: Different types of ice, icebergs, limits of icebergs, accumulation of ice on ships**.**

UNIT - 3 Tropical Revolving Storms (TRS) -

TRS: Local names, seasons and areas affected; Origin, structure, movement and lifespan of TRS; Weather associated with TRS; Definitions and nomenclature; Warning signs of an approaching TRS; Characteristics of TRS; Forecasting techniques; Action to be taken when the presence of TRS is confirmed; Cyclone tracking and warning bulletins under international

conventions; Practical Rules for navigation for manoeuvring in the vicinity of TRS; Avoidance of storm centers and the dangerous quadrants; Ideal conditions for the formation of TRS; Comparison between a TRS and a temperate latitude depression; Avoiding TRS – 1-2-3 theory and sectortheory.

UNIT - 4 Weather Routeing& Weather Reports

Weather Routeing: Weather routing services available to shipping; Shore based weather routeing; Information of current, wind and ice to select an optimum route, use of wave charts to select the best route; Basic considerations in Voyage Planning, Selection and use of data.
Weather Reports : Types of weather services for shipping; Meteorological Offices; Weather Facsimile Receiver; Digital weather receivers; Ship's weather code for sending reports; Coding and Decoding of weather messages; Weather reporting and recording procedures; Weather observation reports

UNIT - 5 Weather Forecasting & Reporting Systems

Methods and techniques; Sources of meteorological data; Function and Objective of WMO and Indian Meteorological Department, Symbols on weather charts and associated weather; Cold and warm front, Occlusion on a synoptic chart; Codes on a synoptic chart and analysis of synoptic charts; Interpretation of symbols and isobaric patterns on weather charts and facsimile charts; Structure of weather bulletin; Voluntary observing fleet under I.M.D; Services provided for Storm Warning, Type and nature of information collected: ships weather code; weather reporting from ships and its significance in weather forecasting. International system of weather reporting. Use of reporting in accordance with the general principles for ship reporting systems and with VTS Procedure.

Reference Books:

. 1. Marine Meteorology – Capt. H.Subramaniam
2. Meteorology for Mariners-HMSO
3. Meteorology for Seafarers- Frampton,R.M
4. Meteorology Demystified: self teaching guide- GibiliscoStan
5. Dynamical Meteorology: an introductory selection – Atkinson, BW
6. Notes on Meteorology - Kemp
7. Meteorology at Sea- SandersonRay
8. Meteorology - Charles W. Roberts
9. Mariners Handbook (NP 100) -Admiralty
10. Cloud Types for Observers-HMSO
11. Ship's Code and Decode Book - The Met Office

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Program	B.Sc., (Nautical Science)					
Course Code **231NS1A54TF**	Course Name **Maritime Law-III**		L	T	P	C
			2	0	0	2
Year and Semester	III Year (V Semester)		Contact hours per week 2 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To create environmental awareness.
	2	To appreciate ecology and pollution by air and water, biodiversity.
	3	To understand conventions related to environmental protection
Course Outcome	CO1	Interpret ANNEX I: (Regulations for the Prevention of Pollution by Oil in bulk)
	CO2	Relate ANNEX II: (Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk)
	CO3	Infer ANNEX IV (Regulations for the Prevention of Pollution by Sewage from Ships
	CO4	Interpret (Regulations for the Prevention of Pollution by Garbage from Ships)
	CO5	Describe Ballast Water Management.
	CO6	Perform an antipollution task by integrating the requirement of all annexed to protect marine environment.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
Average	2.17	3	-	2.17	2.17	3	2.17	-	-	-	-	-	2.17	2.17	2.17

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT-1 CONVENTIONS

- The international convention for the prevention of pollution from ships, 1973, as modified by the protocol of 1978 relating thereto (MARPOL 73/78)- brief history of convention;
- MARPOL ANNEX I: (REGULATIONS FOR THE PREVENTION OF POLLUTION BY OIL)-
- GENERAL: Definitions- Application -Surveys - Issue of Endorsement of Certificate- Duration And Validity of Certificate – Port State Control on Operational Requirements;
- Requirements for machinery spaces of all ships – tanks for oil residues (sludge)- standard discharge connection - oil filtering equipment
- Control Of Operational Discharge Of Oil From Machinery Space – Discharge Outside Special Areas; Discharge In Special Areas; Requirements For Ship Of Less Than 400 Gross Tonnage In All Areas Except The Antarctic Area; General Requirements.
- Requirements For The Cargo Areas Of Oil Tankers – Segregated Ballast Tanks; Accidental Oil Outflow Performance; Slop Tanks ; Pumping, Piping And Discharge Arrangement
- Equipments - Oil Discharge Monitoring and Control System - Oil/Water Interface Detector; Crude Oil Washing Requirements;
- Control Of Operational Discharge of Oil From Cargo Area Of Oil Tanker– Control of Discharge of Oil – General Requirements; Crude Oil Washing Operations ; Oil Record Book, Part Ii- Cargo/Ballast Operations; Shipboard Oil Pollution Emergency Plan And Equipments.
- Reception Facilities – Outside Special Areas and within Special Areas.
- Forms -Form Of IOPP Certificate and Supplements; Form of Oil Record Book.
- PSSA – Vessel Response Plan (VRP)- Connection of Small Diameter Line to the Manifold Valve - Specification of a Part Flow System for Control of Overboard Discharges.

UNIT-2 MARPOL ANNEX II: (REGULATIONS FOR THE CONTROL OF POLLUTION BY NOXIOUS LIQUID SUBSTANCES IN BULK

- General - Definitions- Application - Exception – Survey and Certification of Chemical Tankers – Issue or Endorsement of Certificate – Duration and Validity of Certificate.

- Operational Discharges of Residues of Noxious Liquid Substances- Control of Discharges Of Residues of Noxious Liquid Substances; Procedures and Arrangements Manual; Cargo Record Book.

  MEASURES OF CONTROL BY PORT STATES

- Prevention of Pollution arising from an Incident Involving Noxious Liquid Substances – Shipboard Marine Pollution Emergency Plan for Noxious Liquid Substances and Equipments.
- Reception Facilities and Cargo Unloading Terminal Arrangements.

  APPENDICES TO ANNEX II

- Guidelines for The Categorization of Noxious Liquid Substances; Form of Cargo Record Book for Ships Carrying Noxious Liquid Substances in Bulk; Form of International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk; Standard Form for the Procedures and Arrangements Manual; Prewash Procedures; Ventilation Procedures.
- MARPOL ANNEX III: (REGULATIONS FOR THE PREVENTION OF POLLUTION BY HARMFUL SUBSTANCES CARRIED BY SEA IN PACKAGED FORM)
- General – Application; Packing ; Marking and Labelling; Documentation; Stowage; Quantity Limitations; Exceptions; Port State Control on Operational Requirements.

  APPENDIX TO ANNEX III

- Guidelines for the identification of harmful substances in packaged form

UNIT -3 MARPOL ANNEX IV (REGULATIONS FOR THE PREVENTION OF POLLUTION BY SEWAGE FROM SHIPS General - Definition- Application-Exceptions – Surveys - Issue or Endorsement of a Certificate - Issue or Endorsement of a Certificate by another Government - Form of Certificate – Duration and Validity of Certificate

- Equipment and Control Of Discharge – Sewage Systems - Standard Discharge Connections - Discharge of Sewage. RECEPTION FACILITIES
- Appendix to Annexure IV – Form of International Sewage Pollution Prevention Certificate

UNIT-4 MARPOL ANNEX V: (REGULATIONS FOR THE PREVENTION OF POLLUTION BY GARBAGE FROM SHIPS)

- General-Definitions - Application; Disposal of Garbage Outside Special Areas; Special Requirements for Disposal of Garbage; Disposal of Garbage within Special Areas; Exceptions; Reception Facilities; Port State Control on Operational Requirements; Placards, Garbage Management Plans and Garbage Record – Keeping
- Appendix To Annexure V- Form of Garbage Record Book

- MARPOL ANNEX VI:(REGULATIONS FOR THE PREVENTION OF AIR POLLUTION FROM SHIP)
- General – Application- Definitions General Exceptions – Surveys; Issue or Endorsement of Certificate; Issue or Endorsement of a Certificate by another Government; Form of Certificate; Duration and Validity of Certificate; Port State Control on Operational Requirements; Detection of Violations and Enforcement.
- Requirements for Control of Emission from Ship - Ozone Depleting Substances - Nitrogen Oxides (NOX) - Sulphur Oxides (SOX) - Volatile Organic Compounds - Shipboard Incineration - Reception Facilities - Fuel Oil Quality
- Appendices To Annexure Vi – Form Of IAPP Certificate; Test Cycle and weighting factors; Criteria and Procedure for Designation of SOX Emission Control Areas; Type Approval and Operating Limits for Shipboard Incinerators; Information to be Included in the Bunker Delivery Note.

UNIT-5 BALLAST WATER MANAGEMENT

- Introduction; Brief History; Imo Resolutions Regarding BWM; BWM Systems –Ballast Water Exchange System and Ballast Water Treatment System; Safety Procedure for Ship and Crew During BWM; Procedure for Disposal of Ballast Water Residue; Crew Training and Familiarization as Per BWM Convention; Records to be maintained. ANTI FOULING PAINT POLLUTION:

- Introduction; Brief History; Antifouling, Effects and Zones: Antifouling purpose and Types; Environmental Impact ; IMO Regulation for Anti Fouling Paints; Alternate Antifouling System; Futures of Antifouling Paints.
- ANTI POLLUTION EQUIPMENT (INTRODUCTION):
- Operating procedures and precautions of anti-pollution equipments: sewage plant, incinerator, comminutor, ballast water treatment plant;

Reference Books:

R1: MARPOL 73/ 78 as Amended (Latest Edition)

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Program	B.Sc., (Nautical Science)					
Course Code **231NS1A54PG**	Course Name **Chart Work and Voyage Planning - II**		L	T	P	C
			0	0	3	2
Year and Semester	III Year (V Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To resolve problems related to effects of wind and current in fixing a ship, and monitoring progress of passage as planned.
	2	To keep nautical charts and publications updated by way of incorporating Notices promulgated by UKHO and Indian Hydrographic Department through weekly Notices.
	3	To plan a complete berth-to-berth Passage in accordance with IMO Guidelines for a given sample set of passages across the world, each involving at least two oceans, a narrow strait or canal or River passage.
Course Outcome	CO1	Comprehend the volumnous data availble in the mandatory Navigational Publications and be able to sift out and prioritise those data that have an immediate impact on the safety of planned passage.
	CO2	Demonstrate the ability to carry out full-scale passage plan on various sea routes using the prioritised data – involving appraisal, planning priorities, executing and montioring
	CO3	Validate all theories of Terrestrial Navigation through advanced problems solving and Navigational watch.
	CO4	Compare the advantages and limitations of position fixing by navigational aids and determine the most appropriate DOP of position fixing amongst those that are at his disposal.
	CO5	Fully familiarise oneself with various Publications periodically promulgated through Hydrographic offices worldwide and be able to carry out chart correction and maintain
	CO6	Maintain a proper record of T&P corrections to various Publications, maintain chart folios updated and prepare for vetting and State Control inspections.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	1	3	3		3	-	-	-	-	-	3	3	3
CO5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.50	3	1.33	2.50	2.50	3	2.50	-	-	-	-	-	2.50	2.50	2.50

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1Chart Work: Counteracting with Leeway

1. Vector resolution- counteracting, finding out TRUE course to steer to maintain intended track.
2. Finding out true course to steer and Speed to order to reach ETA points at stipulated times.
3. Action to take in case of reduction in Engine speed whilst counteracting.
4. Finding Set, rate, drift and leeway.
5. Course to ensure passing a lighthouse at a given distance.
6. Determining distance off when abeam and CPA distance from offlying dangers whilst counteracting / allowing.
7. Practical exercises on above

UNIT 2Chart Work: Additional position plotting methods – with current and leeway

1. Converting True / Magnetic / Compass courses- applying Deviation, variation
2. Exercises to appreciate change of deviation due to change in Ship's head. (eg. Find compass course to steer from A to B and thence from B to C – no current or leeway- using deviation tables and variation from compass roses)
3. Exercises on Position fixing by VSA including height correction, HSA ($>90^0$, $<90^0$, $=90^0$).
4. Exercises based on above (both allowing and counteracting and combinations), (Only true courses, no variation or deviation aspects) and estimating amended ETA at waypoint/s.
5. Astronomical PLs, value of a single position line.

UNIT 3: **Chart Work: Publications / Chart Correction**

1. Detailed study of NP 131, NTM (Annual, Quarterly etc) – both Admiralty, Indian publications. Brief about other local charts –especially AUS, NZ and the need to consult and use local charts wherever available.
2. Preliminary study of all Nautical Publications, their layout and list of contents.
3. Chart correction:- NTM , Weekly, Quarterly, Annual- tracings etc- their layout and contents. Procedures for correction of charts and publications including T&P notices, using information from Notices to Mariners and corrections using tracings; Use of Admiralty publication NP 294; Checking newly received chart for last correction; Chart correction using digital notices; Finding the date when chart was last brought up to date, Entries in Chart Correction Log.
4. Chart Folio system, arranging carts, indexing
5. Practical exercises on chart corrections**.**

6. Video : UKHO video on chart correction

UNIT 4 :-Chart Work: Passage Planning

1. More detailed study of various Publication- Roueting chart, planning chart, OPW, Sailing directions, meterological charts, Wind and current roses etc – their layout, how to readily obtain required data there from etcetra.
2. Plan a passage between two ports from berth to berth using the procedures for passage planning (taking into consideration important factors such as ship type, draft and displacement of ship, depth of water, distance off dangers, current, TSS, navigations aids available, Ocean Passages of the World, Sailing Directions, Routeing Charts, List of Lights and Fog Signals, List of Radio Signals, Guide to Port Entry etc.); Landfall in thick and clear weather; Selection of a suitable anchorage.
3. Impact of Loadline Zones in Passage Planning, Tidal Windows, Traffic reporting and position reporting VTMS- where to obtain information regarding special instruction / local regulations (eg Tanker / DW route etc),
4. Appraisal – ascertain the charts and publication required for the voyage and whether they are corrected and up-to-date, numbering and sequencing the charts in properorder, importance of keeping adjoining medium / large scale charts as ready-reference charts, Extract all relevant information from the publications and obtain weather prognosis.
5. Planning – Plot courses on the charts, both small and large scale, way points, no-go areas, contingency anchorages, alerts, abort points and other relevant marks; Select a suitable anchorage; Selection of ocean routes; Prepare a Passage Plan document.
6. 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.
7. Monitoring – Monitor frequently the traffic, position, weather, visibility and maintain a situational awareness at all times. Check the proper functioning of navigational instruments and fills up logs periodically during watch.

UNIT 5 Passage planning actual exercises – berth to berth and invloving one buker port enroute.

- Cadets divided into group and given actual passage planning exercises covering atleast one ocean, one narrow straits with reporting points, preferably a canal or river passage with ship particulars , departure drafts, TPC , fuel consumtion ,required UKC, and similar information furnished.

A total of 16 such passages distributed to different groups and access to all nautcal publications provided

Text Book:

1. Chartwork by S.K.Puri
2. Practice charts for English Channel, Bristol Channel and other areas 2675, 5047, 5056, 5072.
3. NP5011 , NP 5012 – Chart Sumbols Paper and ECDIS-ENC
4. Chartwork by- Capt.S.S.Chaudri
5. Extracts of Admiralty Tide Tables 1992 or later.

Reference Books:

1. Principles of Navigation by Capt.T.K.Joseph/Rewari
2. Nories Tables
3. Nichols Concise Guide – Vol 1
4. Chartwork by- Capt.SSChaudri
5. Practical Navigation- Capt.H.Subramaniam
6. Chartwork – Nichols Concise Guide Volumes 1&2
7. Chart work by D.A.Moore-
8. Chartwork by Sharma
9. Admiralty Manual of Navigation
10. INTERCO Signals
11. Fog Signals.
12. Compass error Book-
13. Deck Log Book (Bridge Log Book)
14. Bell Book (Movements Book)-
15. Nautical Almanac-.
16. VHF Log
17. Radar Log
18. Deviation chart
19. Guide to Port Entry-
20. Admiralty Distance Tables-
21. Brown's Almanac-
22. Echo Sounder Log
23. Radar Plotting Sheets
24. Tidal Atlasses for English Channel and Malacca Straits.
25. IALA – NP735.
26. Admiralty Tide Tables- All volumes current year
27. Admiralty Tide Tables, abridged for 1992, all volumes
28. Indian Notices to Mariners, Annual etc – One full set IMO Publication on Routeing
29. NP294- Admiralty "How to keep chart updated"
30. Modern Chartwork- W.H.squair
31. IMO publications on Bridge Watchkeeping Procedure
32. Weekly Notices to Mariners - samples
33. Annual NTM- atleast for previous 6 years
34. Cumulative NTMs- atleast for previous 6 years (e-versions)
35. NP131- Atleast
36. All 7 volumes of ALRS- one full set
37. NP100
38. Admiralty Sailing Directions- Full set
39. Ocean Passages to the World
40. Marine Observer's Handbook
41. Complete World Charts as per NP131, including Planning and roueting charts or atleast one full set of charts covering Two Ports across two oceans.
42. Atleast all Gnomonic charts covering either Arctic or Antartic
43. IMO Rules of the Road- Bhandarkar(Text Book)
44. A Mariner's Guide to Colregs-Capt.Y.Chaabra
45. Sample Loran charts.
46. Magnetic variation charts-
47. Bathymetric charts.
48. All volumes of List of Lights

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Professional Elective course - II

<table>
<tr><td>Program</td><td colspan="6">BSc-Nautical Science</td></tr>
<tr><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">Course Name
SHIPBOARD COMMUNICATION& PROCEDURES-II</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Year and Semester</td><td colspan="2">III Year (V Semester)</td><td colspan="3" rowspan="2">Contact hours per week
2 Hrs.</td></tr>
<tr><td>Prerequisite course</td><td colspan="2">Nil</td></tr>
<tr><td rowspan="4">Course category</td><td>Humanities and Social Sciences</td><td>Management courses</td><td>Professional Core</td><td colspan="3">Professional Elective</td></tr>
<tr><td></td><td></td><td></td><td colspan="3">✓</td></tr>
<tr><td>Basic Science</td><td>Engineering Science</td><td>Open Elective</td><td colspan="3">Mandatory</td></tr>
<tr><td></td><td></td><td></td><td colspan="3"></td></tr>
<tr><td rowspan="3">Course Objective</td><td>1</td><td colspan="5">Knowledge about the STANDARD MARINE COMMUNICATION PHRASES (SMCP)</td></tr>
<tr><td>2</td><td colspan="5">Understand the various GMDSS equipment available onboard</td></tr>
<tr><td>3</td><td colspan="5">Learn the procedures to communicate from a ship</td></tr>
<tr><td rowspan="6">Course Outcome</td><td>CO1</td><td colspan="5">Acquire knowledge about STANDARD MARINE COMMUNICATION PHRASES (SMCP)</td></tr>
<tr><td>CO2</td><td colspan="5">Understand the practical aspects and operation of EPIRB and SART</td></tr>
<tr><td>CO3</td><td colspan="5">Basic concept ,principle features and practical aspects of NAVTEX</td></tr>
<tr><td>CO4</td><td colspan="5">Understanding practical aspects of VHF TxRx and MF/HF TxRx</td></tr>
<tr><td>CO5</td><td colspan="5">Practical understanding and operation of the SATCOM-C equipment</td></tr>
<tr><td>CO6</td><td colspan="5">Knowledge about GMDSS batteries and basics of antenna onboard</td></tr>
</table>

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	-	3	2	2	3	-	-	-	-	-	3	3	2
CO2	-	2	-	-	3	3	-	-	-	-	-	-	-	-	3
CO3	3	1	-	2	1	1	2	-	-	-	-	-	2	2	1
CO4	-	1	-	3	2	2	3	-	-	-	-	-	3	3	2
CO5	-	2	-	-	3	3	-	-	-	-	-	-	-	-	3
CO6	-	1	-	3	2	2	3	-	-	-	-	-	3	3	2
Average	1	2	-	2	3	3	2	-	-	-	-	-	2	2	3

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT-1 - STANDARDMARINE COMMUNICATION PHRASES (SMCP)

Introduction to SMCP- Position of SMCP in maritime practice- Organization of SMCP- Basic Communicative features of SMCP- Typographical Conventions - Introduction to message markers - Types of message markers – **Instruction** – **Advice – Warning – Information** - **Question** - **Answer** - **Request – Intention** - Application of message markers - General procedures - Standard organizational phrases - Importance of SMCP - External communication phrases - Onboard communication phrases part(a) - Onboard communication phrases part(b)

UNIT-2 PRACTICAL ASPECTS OF EPIRB AND SART

Introduction to EPIRB - Introduction to SART - Understanding parts of EPIRB equipment - Understanding parts of SART equipment - Procedure to switch on EPIRB - Procedure to switch on SART - Practical uses of SART - Testing of SART - Activation of SART - Working of SART -Importance of SART onboard- Operational aspects of SART - Carriage requirement of SART - Importance of EPIRB - How EPIRB works- Carriage requirements of EPIRB - Activation of EPIRB - Technical understanding of EPIRB -Introduction to EPIRB HRU - Working of HRU - Technical factors of HRU -Process to replace HRU

UNIT-3 NAVTEX

Introduction - Basic concept of NAVTEX - Principle features of NAVTEX
Message priorities - Vital - Important - Routine
Alphabet type of message - Performance standards for NAVTEX receiver- Activation of the alarm system -Navtex receiver - Transmitter identification character (B1) -Subject indicator character (B2) -Message numbering (B3, B4)-NAVTEXreceiver checklist - Standard format of NAVTEX messages- Operator selection NAVTEX receiver onboard -Audible alarm in NAVTEX-Revised performance standards for NAVTEX receiver- Definitions
Practical aspects of NAVTEX basics - Frequencies in which NAVTEX works - Range - Basic operation - Service area -Type of message - NAVTEX station - International NAVTEX - National NAVTEX - NAV AREAS - Limits of NAV AREAS - Coverage area Warnings - Information provided by NAVTEX stations - Transmitter identification character - Transmission start times (UTC) - Procedure to read a NAVTEX message

UNIT-4 PRACTICAL ASPECTS OF VHF TRANSCIEVER, MF/HF TRANSCEIVER AND SATCOM-C

Introduction to VHF equipment- Understanding of VHF equipment -Frequency and range of VHF equipment-Transmitting message on VHF -Testing of VHF-Understanding MF/HF equipment-Working of MF/HF DSC-Sources of sending MF/HF DSC alert -Frequencies and range of MF/HF -Introduction to MF/HF transceiver control panel- Introduction to INMARSAT system Understanding INMARSAT satellites -Communication through INMARSAT system - Facilities provided by INMARSAT-Equipments under INMARSAT -Introduction to INMARSAT SATCOM-C - Understanding of SATCOM-C equipment-Working of SATCOM-C equipment-Process to send distress alert in SATCOM-C -Facilities provided by SATCOM-C equipment -Importance of SATCOM-C

UNIT-5 POWER SUPPLY IN GMDSS AND ANTENNA

Introduction- GMDSS batteries -Battery -Primary battery-Secondary battery -Lead acid battery-Lithium battery -Advantages of lithium battery -Construction of lead acid battery- GMDSS batteries: reserve source of energy
Tests done on GMDSS batteries- Daily on load / off load test - Capacity test - Process of daily on load / off load test - Process of capacity test
Maintenance of batteries -Points to be followed pertaining to maintenance - Precautions taken while entering battery room - Introduction to antenna - Polarisation -Whip antenna -Long wire antenna -Active antenna -Parabolic antenna -Maintenance of aerials- Radio workstation

Text Book:
BSc., Nautical Science Students Hand Book for GMDSS - by Mr. Mohandas G.

Reference Books:
1. International Maritime Organization (IMO)-GMDSS manual
2.International Telecommunication Union (ITU) - GMDSS manual
3.Admiralty List of Radio Signals (ALRS) –Volumes – I, III, and V
4.IMO MODEL COURSE – 1.25

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	BSc-Nautical Science					
Course Code	Course Name **PUMP OPERATION AND MAINTENANCE**		L	T	P	C
			2	0	0	2
Year and Semester	III Year (V Semester)		Contact hours per week 2 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
				✓		
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To study the construction and working principle of different types of pumps installed onboard
	2	To learn about construction and working principle of different types of valves such as gate valve, butterfly valve etc.
	3	To understand the basics of selection of types of pumps for cargo operations.
Course Outcome	CO1	Operate and carryout maintenance of different types of pumps onboard the ship.
	CO2	Design and choose appropriate valves for different systems onboard the ship.
	CO3	Design and choose the correct prime movers for different systems onboard ship.
	CO4	Sketch the structural arrangement of various types of pumps
	CO5	Compare the advantages and limitations of various types of pumps
	CO6	Describe the procedure for efficient use of pumps.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.67	3	1.25	2.67	2.67	3	2.67	-	-	-	-	-	2.67	2.67	2.67

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit I: Pumps and Application

Introduction, general principle of pumps, characteristics of suction and discharge conditions, frictional losses, definition of various heads, classification of pumps, types of pumps used on ship, working principle of positive displacement and dynamic pumps

Unit II: Positive displacement pumps

Working sequence of single and double acting reciprocating pumps, construction of reciprocating pumps, valve chest and valves, applications, material used, maintenance,construction and working principle of Gear Pumps, Screw Pumps and Rotary Displacement
Pumps, their applications, operation and maintenance

Unit III Dynamic Pumps

Centrifugal pump theory, characteristic curve, relation between head and throughput, parameters needed for selection of centrifugal pumps for specific duty, construction of centrifugal pumps, different types of centrifugal pumps, impellers and casing, arrangements for balancing, axial flow pump theory, characteristic curve and construction, operation and maintenance,

Unit IV Types of valves

Construction and working principle of globe valve, gate valve, butterfly valve, reducing valve, relief valve and quick closing valve, inspection and maintenance

Unit V Prime movers

Basis of selection of prime movers for cargo pumps, types of pumps used for cargo operation i.e. centrifugal and screw type, arrangements for deep well pumps and submergible pumps, stripping systems

Text Book:

Marine Auxiliary Machinery - H.D. Mc. George

2. REED'S MARINE ENGINEERING SERIES VOL 8 – General Engineering Knowledge

Reference Books:

The Running & Maintenance of Marine Machinery - J.Cowley

Document Prepared in " Board of Studies" held on **Date:09.06.2023**	**Document Approved in " Academic Council"**

Program	BSc-Nautical Science					
Course Code	Course Name Satellite Communication		L	T	P	C
			2	0	0	2
Year and Semester	III Year (V Semester)		Contact hours per week 2 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
	Basic Science	Engineering Science	Open Elective		Mandatory	
			✓			
Course Objective	1	To introduce the students to satellites used for communication such as GPS and the segments such as satellite, control and user				
Course Outcome	CO1	Satellite orbits				
	CO2	Space segment and satellite link design				
	CO3	Satellite Modulation and Multiplexing				
	CO4	Satellite Applications				
	CO5	Direct Broadcast satellites(DBS), (DTH), (DAB)				

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
Average	2.33	3	1.17	2.33	2.33	3	2.33	-	-	-	-	-	2.33	2.33	2.33

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT I SATELLITE ORBITS

Introduction to satellites and their applications- History of evolution of satellites-Orbit and trajectory-Orbital elements- satellite launch-Injection velocity-acquiring desired orbit-launch sequence-launch vehicles-orbital perturbations-stabilizations-station keeping-Orbital effects on satellite performance-Eclipse-Look angles of satellite

UNIT II SATELLITE HARDWARE

Satellite subsystem-Mechanical Structure-Propulsion Subsystem-Thermal control subsystem-power supply-Attitude and orbit control-Telemetry-Tracking-Command Subsystem-Payload-Antenna subsystem-Space qualification-Reliability-SAtelite link design-Transmission equation-Link parameters-Frequency consideration-Propagation consideration-Noise consideration-Interference Related problems-Link design-Link budget

UNIT III COMMUNICATION TECHNIQUES

Information signals-Amplitude modulation-Frequency spectrum of AM signal-Power-Noise in AM Signals - Frequency modulation-frequency spectrum of FM signal-Noise-Generation and Detection of FM signal- pulse communication techniques-Analog and digital pulse communication systems- Adaptive delta modulator- sampling theorem-Shannon Hartley theorem-Digital modulation techniques-Amplitude shift keying-frequency shift keying-phase shift keying-Multiplexing techniques-Frequency division multiplexing and Time division multiplexing.

UNIT IV COMMUNICATION SATELLITES

Introduction-Geostationary and Non-geostationary satellites-Satellite communication systems-Frequency bands-Payloads-Transponders-

Types of transponders- Advantages and disadvantages of satellites over terrestrial networks-Satellite telephony-Satellite television-Satellite radio-Satellite data broadcasting-VSAT-Important satellite missions-INMARSAT-INTELSAT-Iridium satellite constellation-INSAT

UNIT V APPLICATIONS

Remote sensing satellites-classification-orbits-payloads-types of images-weather forcasting satellites-orbits-payload-applications-GOES and METEOSAT-Navigation satellites-GPS system-GLONASS-Applications of navigation satellites-Scientific satellites-Payloads-applications-Military satellites-communication satellites-reconnaissance satellites-military weather forecasting-military navigation systems.

Reference Books:

Satellite Technology: Principles and Applications, 2nd Edition
Anil K. Maini, Varsha Agrawal

Document Prepared in " Board of Studies" held on Date:09.06.2023	**Document Approved in " Academic Council"**

Program	BSc-Nautical Science					
Course Code **231NS1A64TA**	Course Name **Maritime Management**		L	T	P	C
			2	0	0	2
Year and Semester	III Year (VI Semester)		Contact hours per week 2 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	
Course Objective	1	To become aware of various documents used in Merchant Shipping				
	2	To understand the consequences of cargo claims and maritime fraud.				
	3	To familiarize with voyage estimations				
Course Outcome	CO1	Identify Cargo Documents used in Merchant Shipping				
	CO2	Evaluate cargo claims, maritime frauds, salvage, mutual and liability insurance				
	CO3	Conceptualize Multi modal transport and e-documentation to facilitate the same.				
	CO4	Calculate Cargo quantity, Lay-time, Demurrage and Dead freight claims				
	CO5	Prepare Voyage estimates and revise charter party dispute case studies				
	CO6	Assess the degree of loss due cargo claims and maritime frauds and its impact on stake holders				

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Average	3	-	2	3	3	-	3	-	-	-	-	-	3	3	3

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1: CARGO DOCUMENTAITION

Letters Of Credit. Basic definition of a B/L and its Three functions Mates' Receipts and B/Ls: - Role of Mates' Receipts, Types of Bills of Lading – Negotiable and Non – Negotiable, (limited to Clean, Foul, Received for Shipment, Shipped B/L, Order B/L, Through or Multimodal B/L and a general description of a liner B/L) - Clauses in a B/L, Precautions whilst signing B/L, Role of Letters of Indemnity and their legal position. Liens, Force Majore, War and Ice Clause, NAABSA, Always Afloat, Both-to-Blame Collision, Jason and similar terms calling for efficient Cargo Operations from the carrier)
Time Charter Party : Important Clauses of C/P and Their Interpretation. – Vessel/ Owners/ Disponent Owners/ Period/ Delivery Redelivery- ROBs/ Voyage Notices and reporting/ Cancellation/ Charter Hire Rate, Periodicity/ Off-Hire Clause / Performance – Speed, Consumption, Weather Log-Books and Access / Hold Cleaning responsibility / On-Hire and Off-Hire Surveys, Wear and Tear / Deviations

UNIT 2 CLAIMS, P&I CLUBS

Insurance Claims. Maritime Frauds, Flags Of Convenience. Safeguards to be taken to prevent frauds with special reference to shipping industry, by the operators and seafaring personnel. Risks Covered by P&I Clubs. Role of P&I Clubs, Calls, Assistance to Master in Claims ,Defence.

UNIT 3: MULTIMODAL, E-DOCUMENTATION

Multimodal Transport In detail, EDP, Signing of B/L's other than by Master, E-Documentation SCAC CODE.

UNIT 4 COMMERCIAL CALCULATIONS

Dead Freight, Notice of Readiness etc. Common Fixture Terms, Common Charter Party Terms - Conditions, Warranties, Exceptions & Exclusions, SOF, Calculation of Lay Time-Examples of Lay Time Problems. Calculation of Demurrage or Dispatch in simple Lay Time problems.

UNIT 5 LOADLINE CALCULATIONS

Loadline Zone Calculations & Loadline Calculations, Voyage Estimates, Charter Parties Case Studies

Text Book:

Business and Law for the Ship Master by Capt PJ Hopkins

Shipping and Law by Capt.S.Pullat and Capt. Venkat

Reference Books:

Ship Master's business Companion by Malcom Machachlam

Document Prepared in " Board of Studies" held on **Date:09.06.2023**	**Document Approved in " Academic Council"**

Program	BSc-Nautical Science					
Course Code **231NS1A64TB**	Course Name **Ship Operation Technology – IV**		L	T	P	C
			2	0	0	2
Year and Semester	III Year (VI Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To introduce the students to watchkeeping
	2	To participate in emergencies and Anchor watch.
	3	To acquire the confidence to handle international code of signals
Course Outcome	CO1	Plan and organize a navigational watch with safety concerns.
	CO2	Prioritize action following collision and grounding of vessel
	CO3	Identify Procedure for anchoring
	CO4	Apply Code of Safe Working Practices for Merchant Seamen
	CO5	Distinguish International Code flags and pennants with their meaning and usage
	CO6	Perceive safe watch-keeping and actions in emergency situations.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2.8	3	1.4	2.8	2.8	3	2.8	-	-	-	-	-	2.8	2.8	2.8

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

WATCHKEEPING, EMERGENCIES AND SIGNALING

Unit 1: Principles in keeping a Safe Navigational Watch

Safe watch in – port, navigational watch, deck watch in port, deck watch while carrying hazardous cargo. Precautions for the protection and safety of passengers in emergency situations.Duties of a deck cadet during Navigational watch (order of checking equipments, monitoring vessel action, taking over and handing over procedures), etc.

Unit 2: Initial Action following Collision or Grounding

Precautions and actions to be taken – when beaching, following a collision, following a grounding. Initial damage control and Assessment, Procedures to be followed – while rescuing persons from sea or distress vessel or wreck, during port emergencies, while assisting a ship in distress. Case studies of recent major collision and groundings.

Unit 3:Proper Procedure for anchoring

- Procedures - Securing anchor for sea, preparation to let go Anchor, Preparation to heave up Anchor. Safety Precautions to be taken during Anchor Work. Anchor watch communications.
- Action to be taken in case of dragging Anchor oranother vessel dragging towards your ship. Duties during Anchor watch.
- General Anchoring terms - Heave away, commence weighing, Anchor wash, Engage/disengage gear, Open brake, slacken brake, Anchor Aweigh, cable up and down, Anchor cockbill position, brought up, Long stay, short stay,

scope, walk back anchor, veer cable, etc.

Unit 4: Code of Safe Working Procedures for Merchant Seamen.

- Contents of Code of Safe Working practices for Merchant Seamen (COSWP) Basic Risk Assessment procedures. Role of - Safety Officer, safety representative on board, Safety committee.
- Methods for improving and maintaining the safety awareness of crew. Safety precautions - handling batteries, prior bunkering, during Berthing/Unberthing Operations, working aloft/over side. Permit to work system–
- Types of work permit and Checklists. Safety checks to be carried when using SCBA.
- Musters and drill procedures conducted onboard. Muster list. Emergency teams. Procedures for Abandon ship action. Safety signs onboard (with different colors). Procedure to lift weights and manual handling of weights.

Unit 5: International Code of Signals

International Code flags and pennants with their meaning and usage. More code signals and phonetics. Arrangement of Flag codes signals into single letter, 2 – letter, three letter and sentence structure. Medical signals with beginning letter 'M'. Procedures to send Morse Code signals. Forming and Deciphering of Morse Code. Distress signalling appliances. Procedures for usage of various distress signalling appliances (SART, Pyro techniques, EPIRB, Aldis Lamps, Fog Horn, X-band Radar, VHF, etc.)

Text Book:

1. Seamanship Notes by Kemp and Young
2. Theory and practice of seamanship by Danton G
3. Seamanship practice by Capt Dinger
4. Nautical Watchkeeping by H. Subramanian

Reference Books:

1. Code of Safe Working Practices for Mrechant Seamen
2. International Code of Signals
3. Seamanship and Nautical Knowledge – Nicholls

Document Prepared in " Board of Studies" held on **Date: 09.06.2023**	**Document Approved in " Academic Council"**

Program	BSc-Nautical Science					
Course Code **231NS1A64TC**	Course Name **CARGO HANDLING AND STOWAGE- IV**		L	T	P	C
			3	0	0	3
Year and Semester	III Year (VI Semester)		Contact hours per week 3 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To familiarize the students with all statutory regulations regarding carriage of grain,
	2	To understand the requirement for carrying imdg cargoes,
	3	To describe the procedure for carrying liquid and gases in bulkgas, chemicals and roro
Course Outcome	CO1	Classify Chemical and Gas tankers and the relevant regulations
	CO2	Plan Oil tankers Cargo Loading , Cargo Heating Cooling and Ventilation:
	CO3	Prepare and assess reported defects and damage to cargo spaces, hatch covers and ballast tanks and take appropriate action
	CO4	Prepare the car decks on RORO vessels for the loading of trailers and vehicles and related Securing arrangements and methods.
	CO5	Identify Dangerous goods in packaged form and plan their segregation for safe carriage by sea
	CO6	Make working models/preparing power point presentation on Cargo work topics covered in Sem-I to Sem-V

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	3	-	1.60	3	3	-	3	-	-	-	-	-	3	3	3

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1 - Chemical Tankers (SOLAS Ch. VII, MARPOL Annex II, IBC Code)

Type 1, Type2 and Type 3 chemical tankers. Various categories (X, Y, Z, OS) of cargoes.

Hazards associated with chemical cargoes and control measures.

Purpose and use of IBC Code. Discharge criteria. Changing grades of cargoes. P & A Manual.

Gas Tankers: (Ch. VII of SOLAS, SIGTTO and IGC Code)

- LNG, LPG, LEG and chemical gases in bulk. Type A, Type B and Type C tanks; each tank is fitted with high level alarm and auto-shut off.
- Purpose and objectives of the IGC Code. Hazards of gas cargoes and control measures adopted.

UNIT-2 Oil Tankers: Cargo Loading

- Preparing to load one grade and more than one grade
- Dirty and clean oil, Segregation of different grades, Mixed cargoes and dirty oil, Lubricating oil.
- Preparation for loading lubricating oil, Loading overall.
- Safety Procedure during cargo operation, Ballasting
- Precaution to be taken when loading multi grade
- Procedure for discharging oil tankers.
- Ship/Shore check list.

Cargo Heating Cooling and Ventilation:

- Cargo Heating system, Cargo cooling system
- Tanker ventilation system, Independent Venting system, Common Venting system, Grouped Type venting system, Ventilation while loading and discharging.

- Tank and Line Cleaning Procedures: Supervision, Tank cleaning and gas freeing concurrently with cargo handling, Gas measuring equipment, Tank atmosphere, Washing in an inert atmosphere, l Washing in a too lean atmosphere, Control of washing in an undefined atmosphere, Washing in an over rich atmosphere, Portable tank washing machines and hoses, Effect of sediments, Tank washing with water.
- Cargo Measurements: Gauging Equipments, Sampling, Temperature Measurements, Water Dips, Flexi Dip Closed Trimode Gauging Tape, MMC Oil Water Interface Probe(Portable type), Electronic Gauges, Float Gauges, Tank Radar System and Problem involving cargo calculation and different temperatures.

UNIT-3 - Inspection Report; Assess reported defects and damage to cargo spaces, hatch covers and ballast tanks and take appropriate action

- Knowledge of the limitations on strength of the vital constructional parts of a standard bulk carrier and ability to interpret given figures for bending moments and shear forces.
- 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 tanktop in bulk carriers having combination cargo/ballast holds.
- Ability to explain how to avoid the detrimental effects on bulk carriers of corrosion, fatigue and inadequate cargo handling.,,,,
- Actions to be taken to avoid the detrimental effects on bulk carriers of corrosion, fatigue and inadequate cargo handling
- Causes of corrosion in cargo spaces and ballast tanks and how they could be identified and prevented.
- Understanding the purpose of the "Enhanced Survey Programme ".

Damage report

- lists the items that need to be taken into account when preparing a damage report
- lists the evidence that needs to be collected in assisting the preparation of a damage report

UNIT-4 - Ro- Ro Vehicles

- Preparation of the car decks for the loading of trailers and vehicles.
- Securing arrangements and methods.
- Use of work Equipments.
- Ro-Ro check list, Handling and stowage of heavy vehicles.
- Floating decks.
- Procedures for opening, closing, securing of bow, stern and side doors and ramps.
- Care and maintain the systems.
- Maintaining water-tight integrity of the cargo decks.
- Inspection of Vehicles for fire safety.

UNIT 5 Dangerous goods in packaged form (SOLAS Ch. VII, IMDG Code and MARPOL Annex III)

- Classification of IMDG cargo with distinctive labels and examples.
- Use of IMDG Code, UN No., General Index.
- MFAG.
- EmS.
- Compatibility & Segregation , Use Of Segregation Table.
- Precautions when handling dangerous goods.
- Dangerous cargo manifest.
- Inspections before loading dangerous goods.
- Construction of magazine for carriage of explosives.
- Limitations on carriage of explosives.

- Precautions during stowage, handling, loading and carriage of explosives.

PROJECT:

Making working models/preparing power point presentation on Cargo work topics covered in Sem-I to Sem-IV

Text Book:

Safe Cargo Handling Vol-I & II by PJ Samson

Reference Books:

1) Cargo Work for Ship officer – Capt Errol Fernandes
2) Cargo Work – Kemp and Young
3) Cargo Works – Taylor
4) Cargo Works – D.J. House
5) Cargo Notes- DhananjaySwadi
6. Chemical Tankers – Capt. K.S.D. Mistree
7) Safe Gas Tanker Operation – Capt. K.S.D. Mistree& B.K. Sharma
8) Liquefied Petroleum Gas Tanker Practice – T.W.V. Woolco..

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Program	BSc-Nautical Science					
Course Code **231NS1A64TD**	Course Name **Ship Stability-IV**		L	T	P	C
			2	0	0	2
Year and Semester	III Year (VI Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To introduce students to Angle of heel when turning and Wind heeling.
	2	To understand the purpose of inclining experiment.
	3	To assess stability while Dry-docking and Grounding, Bilging.
	4	To learn about Shearing forces and bending moment on ships
Course Outcome	CO1	Interpret Angle of heel when turning, Heeling due to Wind and apply methods to minimize ship's rolling motions at sea.
	CO2	Infer the Inclining Experiment and how and why it is performed.
	CO3	Comprehend Dry-docking and Grounding and compute up-thrust and loss of stability due to these.
	CO4	Compute changes and effects on full and empty compartments due to Bilging and Permeability
	CO5	Identify Shearing Force and Bending Moments of how they arise.
	CO6	Produce simple shear force and bending moment diagrams for box-shaped vessels.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.80	3	1.17	2.80	2.80	3	2.80	-	-	-	-	-	2.80	2.80	2.80

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit 1: Angle of heel when turning, Wind heeling

• Understand the terms relating to a ship to turning circle;
• Understand the forces that cause the ship to heel when turning; calculate the angle of heel when turning;
• Calculate the increase in draft due to list or heel when turning.
• Methods adopted to minimize a ship's rolling motions at sea.

Unit 2: Inclining experiment

• Know the stability information that must be provided for the Master.
• Understand the Objective and correct procedures for conducting an inclining experiment.
• Understand the precautions to be observed while conducting the inclining experiment.
• Compute the Lightship KG.

Unit 3: Dry-docking

• Understanding the sequence of events that takes place whilst a ship being dry-docked and the terms 'Critical Period' and 'Critical Instant'.
• Calculate the upthrust at the blocks (P force) at any stage during dry-docking of the ship;
• Understand the loss of stability during dry-docking and calculate the loss of stability as either a rise of the ship's centre of gravity (increase in KG) or as a fall of the metacenter (reduction in KM); conduct typical dry-docking calculations;
• Understand the practical considerations during the dry-docking of a ship; Explain the importance of trim during Dry-docking.
• Practice the above using Hydrostatic particulars of M.V. Hindship.

Unit 4: Bilging

• Sketch, Define and Describe bilging of a box-shaped vessel; Explain the effects of bilging of a compartment with/ without permeability.
• Calculate the change in draught and stability of a box-shaped vessel when an empty amidships compartments is/ are bilged.
• Calculate the effects of bilging an amidships compartment of a box-shaped vessel when permeability is less than 100%.
• Understand the Second moment of area of a rectangle about an axis passing through the centroid and about one of its

sides; Understand the theorem of Parallel Axis.
• Calculate the draughts (forward and aft) when an empty end compartment of a box-shaped vessel is bilged.
• Calculate the draughts (forward and aft) when an end compartment of a box-shaped vessel with permeability less than 100% is bilged.

Unit 5: Shear Forces and Bending Moments in ships

• Understand how shear forces and bending moments arise in a vessel floating in still water.
• Producing simple shear force and bending moment diagrams for box-shaped vessels floating on an even keel in still water.
• Understand how stress data may be represented on modem stress loading programs.
• Introduction to Loadicator; Requirements for a Loadicator as per SOLAS, Class requirements;
• Describe the testing procedure and importance of maintaining records.
• Uses of a Loadicator as decision support system on board ships.

Text Book:

Ship Stability "M.V. Hindship" by Capt. Joseph and Capt. SSS Rewari
2. Ships Stability Vol. 1 and Vol.2 by Capt. H. Subramaniam.

Reference Books:

Ship Stability for Masters and Mates by C.B. Barrass & .D.R. Derrett
2. Ships Stability Mates / Masters by Martin A. Rhodes.

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Program	BSc-Nautical Science					
Course Code	Course Name **Environmental Studies**		L	T	P	C
			2	0	0	2
Year and Semester	III Year (VI Semester)		Contact hours per week 2 Hrs.			
Prerequisite course						
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
	✓					
	Basic Science	Engineering Science	Open Elective		Mandatory	
Course Objective	1	To provide fundamental knowledge and understanding about the Natural Resources, Environment and Ecosystem.				
	2	To apply Knowledge in everyone's professional life on biodiversity, pollution, environment and society.				
Course Outcome	CO1	Infer the status and need for conservation of natural resources				
	CO2	Interpret conservation of ecosystem and environment and apply in their respective professional fields				
	CO3	Infer environmental pollution and its effects				
	CO4	Interpret the environmental awareness and relate to the social life				
	CO5	Infer the Environment and Social Issues				
	CO6	Interpret knowledge on Human Population and its effect on the Environment				

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO4	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
Average	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit 1: Natural Resources

Environmental studies-terminologies, need for public awareness. Natural resources-Renewable and non-renewable resources; Characteristics, uses and conservation of natural resources-Forest resources, Water resources, Mineral resources, Food resources, Energy resources and Land resources. Role of an individual in conservation of natural resources; equitable use of resources for sustainable lifestyles.

Unit 2: Ecosystems

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of the different ecosystems- Forest. ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 3: Biodiversity and its conservation

Introduction – Definition : genetic, species and ecosystem diversity; Biogeographical classification of India; Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, National and local levels; Inida as a mega-diversity nation; Hot-sports of biodiversity; Threats to biodiversity; Endangered and endemic species of India; Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Unit 4: Environment and Social Issues

Environmental Pollution; Cause, effects and control measures of different types of pollution; Solid waste Management; Role of an individual in prevention of pollution; Disaster management. Social Issues and the

Environment, From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics, Climate change, global warming, nuclear hazards, ill-effects of fireworks. Wasteland reclamation. Laws and acts in India for environment protection, Public awareness.

Unit 5: Human Population and the Environment

Population growth, variation among nations. Population explosion – Family Welfare Programme. Environment and human health- Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health. Field work and Field Visit.

Text Book:

Environmental Science by Dr. V. Balasubramanian, Dr. S. Sreedevi, Dr. G. Ramachandran-CARS Publishers.

Reference Books:

1. De.A.K. Environmental Chemistry, Wiley Eastern Ltd.,
2. Miller T.G.Jr. Environmental Science, Wadsworth Publishing Co., (TB)

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Program	BSc-Nautical Science					
Course Code	Course Name **Marine Engr.Auto. Control Systems – II**		L	T	P	C
			2	0	0	2
Year and Semester	III Year (VI Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective		
			✓			
	Basic Science	Engineering Science	Open Elective	Mandatory		

Course Objective	1	To understand basic marine engineering systems, Automation and control systems
	2	To acquire knowledge of IC engines, steering gear, Deck machinery.
	3	To maintain Marine auxiliary machineries and Electrical power systems,
Course Outcome	CO1	Interpret Basic marine engineering systems
	CO2	Infer Automation and control systems
	CO3	Acquire Knowledge of IC engines
	CO4	Compare Auxiliary Engines and Electrical Engineering,
	CO5	Classify Main Generator and Emergency Generator, Emergency Fire Pump
	CO6	Discuss the measures to be adopted to maximize the efficiency of marine engines.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO2	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO6	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.50	3	1.17	2.50	2.50	3	2.50	-	-	-	-	-	2.50	2.50	2.50

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

Unit 1. MARINE ENGINEERING PRACTICE

General introduction and scope. Classification of ship as per propulsion plants , Engine room Layout & supporting systems. Introduction about ship‘s Main and Auxiliary Systems. Types of Fuel oils and properties. Fuel storage and supply on board the ship. Treatment and purification of fuel oils. Types of lubricating oils for different duties. Tesing and purification. Propellers and main shafting, Stern tube arrangements, Types of propeller, fixed pitched and variable pitch propellers. Types of Rudders, The watch keeping system,, UMS operation, periodic safety routines, heavy weather precautions for main propulsion plant, steering, etc.

Unit 2 INTERNAL COMBUSTION ENGINES

Working principles: Classification of various types of engines, various types of modern diesel engines. Basic principles of cycles, P-V diagrams. Main components and working of two and four stroke engines. Process of exhausting, scavenging and supercharging. Scavenge fire, Starting air line explosion and Crankcase explosion. Lubricating oil system, cylinder cooling water system, Piston cooling system, Sea water primary cooling systems.. Reasons and method of chemical treatment of CW system. Operations of IC engine as main propulsion engine. Warning up, starting maneuvering, reversing and full power running of the main engine. Limitations and care required on IC engine during maneuvering and at full power. Purpose of turbocharger and Governor.

Unit 3. MARINE ENGINEERING AUXILIARIES

Effect of condition of hull, fuel consumption and propeller efficiency. Pollution control, Sewage disposal and regulations. Bilge oil water separator, regulations. Control of pollution from machinery spaces, Incinerator operation. Methods of generation of freshwater from seawater. Principle, construction & operation of freshwater generator,Treatment of water for obtaining portable water. Storage and supply of fresh water in ships, Hydrophore systems. Heat exchangers, Purifiers, Air compressor, uses of compressed air. Storage anddistribution of compressed air. Types of marine steam boilers. Construction and operation of water tube and smoke tube boiler. Boiler mountings and safety features. Waste heat recovery boilers. Boilers maintenance. Importance of boiler, feed water chemical treatment. Principle of refrigeration, compression refrigeration cycle, components & operation., Common types of steering gear, electro hydraulic steering gears, 2 & 4 Ram

systems, Rotary vane steering gear, Variable delivery pump, Telemotor and control systems. Emergency arrangements. Operations and maintenance. Hydraulic systems; Bow thrusters , Deck machinery Windlass, Capstan, Automatic, Mooring winch, Winches and Cranes for cargo handling, Lifeboat winch. Hydraulic and pneumatic systems. Safety features.

Unit 4. ELECTRICAL ENGINEERING SCIENCE

Parallel running & load sharing of alternators. Prime movers, High and Low voltage transformers. Step up/step down Transformers. Main switch boards, power distribution boards. Circuit breakers, Circuit protection, Measuring instruments. High voltage systems Services to be supplied from emergency generator. Procedure for starting emergency generator. Procedure of maintenance of batteries, Navigation light circuit with indicators / alarms & alternative power supply.

Unit 5AUTOMATION & CONTROL ENGINEERING

Growth in shipboard automation, understanding terminology. transmitter and actuators. Open loop, closed loop control system, general principles. Controllers and proportional controller. Pneumatic, hydraulic, electric, electronic control systems. Applications in various shipboard operations. Bridge control on main propulsion. Maneuvering aids – CP. Propeller, bow thruster. Care and precautions. Arrangements necessary for appropriate and effective engineering watches to be maintained for the purpose of safety under normal circumstances and UMS operations. Trim indicator, heel indicator, draft gauge, load and stress indicators. . Liquid cargo loading, storage and discharge operations. Monitoring. Remote level gauges. Types of remote control valves used on board ships. Remote control operation of hatch covers. Remote operation for loading, discharging and ballasting operations. Information display, data logging, alarm systems. Testing and maintenance.

Text Book:

1) Motor Engineering Knowledge for Marine Engineers – Reeds Vol. 12

Reference Books:

2) Basic Marine Engineering – J.K. Dhar
3) General Engineering Knowledge for Engineers – Reeds Vol. 8
4) Engineering Drawing – Reeds
5) Basic Electro technology – Reeds Vol. 6
6) Marine Electrical Equipment & Practice – McGeorge
7) Marine Engineering Practice Vol. 2 Part 17 Slow Speed Diesel Engines by Institute of Marine Engineers (England)
8) Marine Auxiliary Machinery – McGeorge
9) Marine Machinery – Operation and maintenance- T.B.Srinivasan
11) Diesel Engines Q and A – A.J. Wharton Kandy Series
12) Marine Engineering Practice Vol. 1 Part 3 Marine Medium Speed Diesel Engines by Institute of Marine Engineers (England)
13) Internal Combustion Engine Fundamentals – J.B. Heywood
14) Marine Auxiliary Machinery – Taylor
15) Instrumentation & Control for Engineers –Reeds Vol. 10

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Program	BSc-Nautical Science					
Course Code **231NS1A64PE**	Course Name **Chart Work and Voyage Planning –III**		L	T	P	C
			0	0	3	2
Year and Semester	III Year (VI Semester)		Contact hours per week 3 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	

Course Objective	1	To become proficient in advanced non-determinant methods of position fixing and their practical use on board with full appreciation of the DOP parameters.
	2	To acquire the ability to perform tidal calculations and factor in tidal windows rapidly and accurately.
	3	To relate theoretical determinations with respect to case studies, near-misses reported by various Investigating Organizations
Course Outcome	CO1	Execute advanced aspects of Passage Planning and modify the planned passage as required considering abort-point determination, impact of MARPOL areas, Loadline Zones and Navarea warnings received over NAVTEZ on planned passage and ECDIS Chart updation
	CO2	Make use of data from Admiralty Tide Tables and Tidal Charts to make tidal calculations, under keel clearances and over head clearances and determine the Tidal-Windows that impact didderent stage of planned passage.
	CO3	Validate all theories of Terrestrial Navigation through advanced problems solving and Navigational watch.
	CO4	Demonstrate through role-plays the key princiles of Bridge Watch Keeping and Bridge Team management.
	CO5	Comprehend by analysing the contributory factors iro various accidents, near-misses that have happened in recent past for which investigations are either underway or completed.
	CO6	Obtain a basic level appreciation of a generic ECDIS system sufficient to apprecaite the precautions against over reliance on alarms, safety contour and multile layers setting.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Average	3	-	2.17	3	3	-	3	-	-	-	-	-	3	3	3

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1Chart Work: Tidal Calculations with UKC / Overhead clearances- Secondary ports and standard ports(ONLYPRACTICALexercises)

1. Tidal curves, Admiralty Tide Tables for the World and the regions, Indian Tide Tables / local Tide Tables- the importance of using local tables wherever available.
2. Calculating predicted time and height of high and low water at standard ports (including intermediate times and heights)
3. Tidal Calculations incorporating UKCs or airdraft restrition
    a. Standard Port and secondary ports tidal calculation including intermediate heights
    b. Precautions on reliability of tidal predictions – Introduction pages of all Volumes
    c. Basic outline of "harmonic method" of tidal predictions and when to use the same in preference to standard method.
4. TIDAL WINDOWS and calculations thereof (Primary and secondary ports
5. On-line tidal calculations and their limitation and advantages
6. Precautions on reliability of tidal predictions – Introduction pages of all Volumes
7. Basic outline of "harmonic method" of tidal predictions and when to use the same in preference to standard methodTidal stream atlas; Tidal information given on a chart;
8. Brief introduction to co-tidal atlasses

UNIT 2Chart Work: Additional Position Plotting methods- combined with current and leeway

1. Detailed study of List of Lights- Geographical, luminous and nominal ranges various ranges used in various charts /countries, Introductory notes of List of Lights volumes.
2. Position fixing by Dipping and Raising of lights, cautions whilst using this method of position finding
3. Astronomical PLs, value of a single position line
4. Recap of allowing and counteracting problems – ensuring that CMG (Ground track) passes a Light house / Danger

with required distance off under current and leeway conditions.

5. Factors determining frequency of position fixing, cross verifying electronic position fixes with visual fixing and importance of visual means in comparison with electronic means- case studies
6. Choice of optimally separated Lighthouses to achieve least DOP whilst coasting and whilst "homing:
7. Use of NMT / NLT techniques wrt ranges as well as bearings- precautions to be observed.
8. Use of clearing bearing and marks

UNIT 3 Chart Work: Running fix, 3 point beraing exercises

1. Running fix with current and leeway and combinations thereof - Assumptions made and limitations
2. Running fix with transferred Position Circle- both HSA and VSA or radr bearing with a transferred bearing- ambiguity resolution
3. Three-point bearing, assumptions made, its usefulness for further track-keeping and coasting on straight coastlines with no headlands
4. Combining Running fix with 3 point bearing exercises
5. Doubling the angle on the bow- the assumptions and limitations and advantage
6. Practical exercises from all semesters.

UNIT 4 ECDIS – basics and layers and Radar overlay on ECDIS – reliability decisions

1. With use of videos explain the following:-
    - General outline on navigating with ECDIS.
    - Passage Planning on ECDIS.
    - Types of information overlays on ECDIS
    - Brief outline on Electronic charts and their corrections and the limitations / advantages
    - CADZOC and its significance on reliability of soundngs and radar versus electronic fixes.
    - Datum shift and radar overlay on ECDIS, ECDIS overlay on radar – videos showing same
    - Safety contour and Depth contour – precautions
    - M.V. OTIS Case study and studen's presentation.

UNIT 5 Chart Work: Navigational watch and CW practical exercises

- **Navigational watch**
    - Key aspects of Bridge Watch-Keeping Procedure:-
    - Workstation concept
    - Pilot Exchange card, information and key details to provide
    - Use of Bridge resources
    - Manning level, open sea, Coastal, restricted waters
    - Calling Master
    - Duties of OOW on Bridge, significance of "LOOK-OUT".
    - Handing over / Taking Over procedure
    - Other related aspects
    - East and West bound passage through Singapore straits- video
- **CW practical exercises covering all previous semesters**

Text Book:

1. Chartwork by S.K.Puri
2. Practice charts for English Channel, Bristol Channel and other areas 2675, 5047, 5056, 5072.
3. NP5011 , NP 5012 – Chart Sumbols Paper and ECDIS-ENC
4. Chartwork by- Capt.S.S.Chaudri
5. Extracts of Admiralty Tide Tables 1992 or later

Reference Books:

1. Principles of Navigation by Capt.T.K.Joseph/Rewari
2. Nories Tables
3. Nichols Concise Guide – Vol 1
4. Chartwork by- Capt.SSChaudri
5. Practical Navigation- Capt.H.Subramaniam
6. Chartwork – Nichols Concise Guide Volumes 1&2
7. Chart work by D.A.Moore-
8. Chartwork by Sharma
9. Admiralty Manual of Navigation
10. INTERCO Signals
11. Fog Signals.
12. Compass error Book-
13. Deck Log Book (Bridge Log Book)
14. Bell Book (Movements Book)-
15. Nautical Almanac-.
16. VHF Log
17. Radar Log
18. Deviation chart
19. Guide to Port Entry-
20. Admiralty Distance Tables-
21. Brown's Almanac-
22. Echo Sounder Log
23. Radar Plotting Sheets
24. Tidal Atlasses for English Channel and Malacca Straits.
25. IALA – NP735.
26. Admiralty Tide Tables- All volumes current year
27. Admiralty Tide Tables, abridged for 1992, all volumes
28. Indian Notices to Mariners, Annual etc – One full set IMO Publication on Routeing
29. NP294- Admiralty "How to keep chart updated"
30. Modern Chartwork- W.H.squair
31. IMO publications on Bridge Watchkeeping Procedure
32. Weekly Notices to Mariners - samples
33. Annual NTM- atleast for previous 6 years
34. Cumulative NTMs- atleast for previous 6 years (e-versions)
35. NP131- Atleast
36. All 7 volumes of ALRS- one full set
37. NP100
38. Admiralty Sailing Directions- Full set
39. Ocean Passages to the World
40. Marine Observer's Handbook
41. Complete World Charts as per NP131, including Planning and roueting charts or atleast one full set of charts covering Two Ports across two oceans.
42. Atleast all Gnomonic charts covering either Arctic or Antartic
43. IMO Rules of the Road- Bhandarkar(Text Book)
44. A Mariner's Guide to Colregs-Capt.Y.Chaabra
45. Sample Loran charts.
46. Magnetic variation charts-
47. Bathymetric charts.

48. All volumes of List of Lights

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Program	BSc-Nautical Science				
Course Code	Course Name PDP-2 (Personality Development Program)	L	T	P	C
		0	0	2	1
Year and Semester	III Year (VI Semester)	Contact hours per week 2Hrs.			
Prerequisite course					

Course category	Humanities and Social Sciences	Management courses	Professional Core	Professional Elective
	Basic Science	Engineering Science	Open Elective	Mandatory

Course Objective	1	This chapter is imparted to augment the morale in students, to fewer negative emotions.
	2	Assertiveness is imparted to enhance the attitude and reach win-win solutions.
	3	Accountability is taught to establish the feeling of responsibility in the mind of students and discourage harassment
	4	Stress management is imparted to create awareness of mental and physical wellbeing of seafaring
	5	Soft skills at work place is emphasized to students to focus their attention to competitive corporate world
Course Outcome	CO1	Continue working towards their goals even in the face of challenges and setbacks and ultimately be successful.
	CO2	Understand the basic principles of assertive behavior, rights and respect of rights of others and deal with fear and criticism.
	CO3	To train the students to understand the importance and value of work in life.
	CO4	To make the students develop proactive responses and coping tips to stressful situations.
	CO5	To familiarize the students with the skills that is essential in every sphere of life.

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	-	2	2	-	-	-	-	-	2	2	2
CO2	2	2	2	-	-	2	2	-	-	-	-	-	2	2	2
CO3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	3	2	2	-	-	-	-	-	2	2	2
CO5	2	2	-	3	-	2	2	-	-	-	-	-	2	2	2
CO6	-	2	2	-	-	2	2	-	-	-	-	-	2	2	2
Average	2	2	2	3	3	2	2	-	-	-	-	-	2	2	2

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

UNIT 1: 1 Optimism / Positivity

DIFFERENCES BETWEEN OPTIMISM AND POSITIVE THINKING
Impact of Optimism
What Is Optimism? How to Practice Optimism

UNIT II: **Assertiveness**

What Is Assertiveness?
The Benefits of Being Assertive
How to Become More Assertive
Use Assertive Communication Techniqueseness

UNIT III: Accountability

What is accountability in the workplace?
Without accountability at work, what happens?
How do you promote accountability in the workplace?
Use the 5Cs framework to build accountability...

UNIT IV: Stress Management

Overview of Stress Management
What Is Stress?
Causes of stress
Effects of stress
Tips to Manage Stress

UNIT V: Soft Skills in the Workplace
Important Soft Skills for Workplace Success
Top Soft Skills Employers Want
How to Let Employers Know the Skills You Have

6. Procrastination
What is Procrastination?
How to stop procrastinating

Reference Books:
Web resources

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Program	BSc-Nautical Science					
Course Code **231NS1A64PF**	Course Name **Ship Operation Technology Laboratory-IV**		L	T	P	C
			0	0	2	1
Year and Semester	III Year (VI Semester)		Contact hours per week 2 Hrs.			
Prerequisite course	Nil					
Course category	Humanities and Social Sciences	Management courses	Professional Core		Professional Elective	
			✓			
	Basic Science	Engineering Science	Open Elective		Mandatory	
Course Objective	1	To train the students on practical handling of deck equipments and seamanship				
Course Outcome	CO1	Make use Emergency equipment like SCBA, Immersion suits, Thermal Protective Aid i				
	CO2	Plan and Demonstrate Handling of heavy cargoes, securing Heavy Lifts				
	CO3	Organize and Demonstrate use of Chipping tools-Manual and Pneumatic				
	CO4	Make use of Heaving line, head line, stern line, breast lines and springs in Mooring stations				
	CO5	Demonstrate Mooring the ship to a buoy using anchor chains				

CO-PO ATTAINMENT

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO2	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO3	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO4	3	-	1	3	3	-	3	-	-	-	-	-	3	3	3
CO5	2	3	-	2	2	3	2	-	-	-	-	-	2	2	2
CO6	2.80	3	0.80	2.80	2.80	3	2.80	-	-	-	-	-	2.80	2.80	2.80
Average	3	-	1	3	3	-	3	-	-	-	-	-			

CORRELATION LEVELS	1. SLIGHT (LOW)	2. MODERATE (MEDIUM)	3. SUBSTANTIAL (HIGH)

S.No	TASK	TYPE	DESCRIPTION
1	LSA /FFA	Donning	Practical Muster Station & Assigning Duties
2	LSA /FFA	Drill	Conducting Fire Drill
3	LSA /FFA	Drill	Conducting Boat Drill
4	LSA /FFA	Types	Various Types Of Extinguishers
5	LSA /FFA	Procedure	Swinging Out /Lowering/ Hoisting Lifeboat
6	EMERGENCY	Grounding	Action To Be Taken Following A Grounding
7	OOW	Hand Steering	Steering Procedure, Repeating Orders & Report After Exceuting Order
8	OOW	Lashing Gear	Preparing Union Purchase For Cargo Operation
9	EMERGENCY	Stow Away	Stow Away Search Procedure
10	EMERGENCY	Bomb Search	Initial & Subsequent Action To Be Taken For Bomb Search
11	EMERGENCY	Piracy	Initial & Subsequent Action To Be Taken In Piracy Zone
12	MAINTENANCE	Draft Mark	Different Types Of Grease
13	EMERGENCY	Enclosed Space	Enclosed Space Entry Checklist.
14	EMERGENCY	Pickingup Unconscious Person	Procedure For Picking Up A Unconscious Person From Hold.
15	OOW	Sounding	Hand Lead Line
16	LSA/FFA	Familiarization	All LSA/FFA Equipments In SS Lab
17	EMERGENCY	Emergency Towing Arrangement	Procedure To Payout And Secure Towing Wire To Towing Ship
18	Cargo work	Hatches	Hatch cleaning procedure

Text Book:

1. Seamanship Notes by Kemp and Young
2. Theory and practice of seamanship by Danton G
3. Seamanship practice by Capt Dinger

Reference Books:

Life Boat and Life Raft – Capt Puri SK

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