File Ref.No.Ac.A3/Faculty of Technology/2023

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

(Abstract)

Faculty of Technology - Programmes offered at the Indian Navy Training Schools at Kochi- Resolution of the Academic Council - Communicated - Orders issued.

ACADEMIC A SECTION

No.CUSAT/AC(A).A3/4082/2024 Dated,KOCHI-22,26.09.2024

Read:-Item No. I (f) (7) of the minutes of the meeting of the Academic Council held on 30.04.2024

ORDER

The Academic Council considered along with the recommendations of it's standing committee, the Minutes of the Faculty of Technology held on 08.04.2024 and resolved to approve the following :

The revised curriculum framework (Regulations, Scheme of Examinations and Instructions and Syllabi) of the following three programmes conducted by the Indian Navy at the Naval training schools, with effect from May 2024:-

a) Programme 24-8203 – M.Sc (Naval Weapons); conducted by INS Dronacharya (Appendix I).

b) Programme 24-8603 – M.Sc (Telecom); conducted by Signal School (Appendix II).

c) Programme 24-8803 – M.Sc (Underwater Science and Technology); conducted by Anti – Submarine Warfare (ASW) School (Appendix III).

Orders are issued accordingly.

Dr. Arun A U *
Registrar

To:

1. The Dean, Faculty of Technology
2. Chairperson, BoS under Faculty of Technology
3. The Director, CTESS
4. All AR/DR Examination wing - with a request to forward to concerned sections
5. The Director, IQAC/ DoA
6. CIRM/Conference Sections
7. PS To VC/PVC;PA To Registrar/CE.

* This is a computer generated document. Hence no signature is required.

Appendix V (N)

Enclosure 1
(Refers to Para 3 of CTESS
Note 850/16 /CTESS
dated 09 Apr 24)

CURRICULUM FRAMEWORK AND COURSE CONTENT FOR OUTCOME BASED EDUCATION

IN

MSc (Naval Weapons)

(Programme No 24 - 8203)

INS DRONACHARYA

INS Dronacharya
Fort Kochi
Kochi- 682001
Phone 0484-2214046
E-Mail – sncdronacharya@navy.gov.in

REGULATIONS FOR MSc (NAVAL WEAPONS)

1.	**Programme No**	**:**	**24 - 8203**
2.	**Programme Name**	**:**	**MSc (Naval Weapons)**
3.	**Programme Name (Naval Equivalent)**	**:**	**Long G Course (Indian)**
4.	**Approving authority**	**:**	**IHQ MoD (Navy)**
5.	**Eligibility criteria for admission**	**:**	(a) Officers nominated by IHQ MoD (Navy) or HQICG. (b) A Bachelor's degree in Science or BE/BTech, in any discipline, from a recognised university.
6.	**Duration**	**:**	Phase 1 - Sem 1 & Sem 2- 48 weeks of Training and On-Job Training Phase 2 - Sem 3 & Sem 4 – 48 weeks specialisation training at INS Dronacharya.
7.	**Attendance requirement**	**:**	85% minimum
8.	**Nature**	**:**	Full Time contact programme
9.	**Approved intake capacity**	**:**	As approved by IHQ MoD (Navy)
10.	**Examination Pattern**	:	Combination of Theory and Practical Exam paper is set by instructor and vetted by Training Co-ordinator and Training Captain Written and Practical - 1760 Marks Dissertation - 100 Marks Oral - 140 Marks Total - 2000 Marks
11.	**Minimum Qualifying marks**	**:**	Theory - 55% Practical - 55%

12. **Grading.**

(a) **Grades**. The following are the grades for performance in individual subject.

Ser No	Range of Marks*	Grades	Weightage
1	90 % and above	S - Outstanding	10
2	80 - 90%	A - Excellent	9
3	70 - 80%	B - Very Good	8
4	60 - 70%	C - Good	7
5	55 - 60%	D - Satisfactory	6
6	Below 55%	F - Failed	0

* Note: Upper limit is not included in the class interval.

(b) **Cumulative Grade Point Average**. Overall performance on completion of all phases of training will be indicated by Cumulative Grade Point Average (CGPA) calculated as follows: -

$$CGPA = \frac{G1C1 + G2C2 + G3C3 + \ldots\ldots\ldots\ldots + GnCn}{C1 + C2 + C3 + \ldots\ldots\ldots\ldots Cn}$$

Where, G = Grade weightage.
C = Credit value corresponding to the course undergone by the student.

(c) The classification on degree would be as follows: -

Ser No	Classification	CGPA
1	First Class with distinction	8 and above
2	First Class	7 < 8
3	Second class	6< 7

13. **Failure in Examinations**.

(a) Failure in one subject will result in warning by Training Coordinator and Training Captain and re-examination.

(b) Failure in two subjects or in one subject more than once will result in warning by Training Captain and Commanding Officer followed by re-examination.

(c) Failure in three or more subjects or in re-examination will be considered as failure in the whole course and trainee will be withdrawn from the course.

14. **Synopsis of Subjects and Credit Points**.

Semester III			
Code	**Subject**	**Credits**	**Marks**
24-8203-0101	Principles of Naval Drill	2	100
24-8203-0102	Basic Gunnery	4	200
24-8203-0103	Principals of Ordnance, Armament & Explosive Chemistry	2	100
24-8203-0104	Maritime Law	2	100
24-8203-0105	Guided Weapon Technology	2	100

23-8203-0106	Electronics & Communication	2	100
23-8203-0107	Gunnery Foundation	1	50
24-8203-0108	Design, concept and operation of Super Rapid Gun Mount (SRGM) System	2	100
24-8203-0109	Design, concept and operation of Close-In- Weapon System - AK630	2	100
	Sub-Total	**19**	**950**
	Semester IV		
24-8203-0110	Design, concept and operation of Stabilised Remote Control Gun (SRCG) System	2	100
24-8203-0111	Design, concept and operation of Surface To Surface Missile System –P21/22	1	50
24-8203-0112	Design, concept and operation of Surface To Surface Missile System – BRAHMOS	4	200
24-8203-0113	Design, concept and operation of Surface To Air Missile System – BARAK	4	200
24-8203-0114	Design, concept and operation of Surface To Air Missile System – IGLA	1	50
24-8203-0115	Gunnery Sensor & Fire Control Radars (LYNX U2 & SSR)	2	100
24-8203-0116	Surveillance & Fire Control Systems (AMDR 2D&3D)	1	50
24-8203-0117	Gunnery Tactics	3	150
24-8203-0118	Project Work	1	50
24-8203-0119	Gunnery Board	2	100
	Sub-Total	**21**	**1050**
	Total	**40**	**2000**

SCHEME OF INSTRUCTIONS (SOI) AND SCHEME OF EXAMINATIONS (SOE)

Code	Subject	Hrs/week			Credit	Marks
		L	P	Total		
Semester III						
24-8203-0101	Principles of Naval Drill	1	1	2	2	100
24-8203-0102	Basic Gunnery	1	2	3	4	200
24-8203-0103	Principals of Ordnance, Armament & Explosive Chemistry	4	-	4	2	100
24-8203-0104	Maritime Law	3	1	4	2	100
24-8203-0105	Guided Weapon Technology	4	-	4	2	100
24-8203-0106	Electronics & Communication	3	-	3	2	100
24-8203-0107	Gunnery Foundation	2	-	2	1	50
24-8203-0108	Design, concept of Super Rapid Gun Mount (SRGM) System	2	3	5	2	100
24-8203-0109	Design, concept of CIWS - AK630	1	2	3	2	100
	Sub Total (A)			**30**	**19**	**950**

Semester IV						
24-8203-0110	Design, concept and operation of Stabilised Remote Control Gun (SRCG) System	2	2	4	2	100
24-8203-0111	Design, concept and operation of Surface To Surface Missile System – P21/22	2	2	4	2	100
24-8203-0112	Design, concept and operation of Surface To Surface Missile System – BRAHMOS	3	2	5	4	200
24-8203-0113	Design, concept and operation of Surface To Air Missile System – BARAK	3	2	5	4	200
24-8203-0114	Design, concept and operation of Surface To Air Missile System – IGLA	1	1	2	1	50
24-8203-0115	Gunnery Sensor & Fire Control Radars (LYNX U2 & SSR)	2	2	4	2	100
24-8203-0116	Surveillance & Fire Control Systems (AMDR 2D&3D)	2	1	3	1	50
24-8203-0117	Gunnery Tactics	3	0	3	2	100

24-8203-0118	Project Work	0	0	0	1	50
24-8203-0119	Gunnery Board	0	0	0	2	100
	Sub Total (B)			**30**	**21**	**1050**
Total (A+B)				**34**	**40**	**2000**

Total Credits : **40**

Total Exam Marks : **2000**

SYLLABI FOR PROGRAMME 24-8209 - MSC (NAVAL WEAPONS) REGULAR

VISION

To meet global standards as a centre of excellence across the spectrum of naval surface warfare and impart robust combat oriented training in all aspects of tactics and weapon employment in order to arm officers and sailors to win the war at sea.

MISSION

As the premier establishment of the Indian Navy for Gunnery and Missile training, INS Dronacharya seeks to continuously evolve to keep pace with developing technologies in the field of Gunnery and Missile warfare, thus emerging as a Centre of Excellence for the same. This unit strives to impart robust, practical oriented Gunnery and Missile training, with an aim to arm trainees with in-depth professional knowledge and thorough job competence, so as to be fully capable of effectively discharging assigned gunnery duties.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1. The trainees will be provided with scholastic atmosphere to acquire advance level knowledge to carry out duties of Explosive Accounting Officer wherein the officer will be able to account and maintain the requisite standards and amount of ammunition as required.

PEO 2. The trainees will be able to effectively implement the Fire Control Systems which will enable them to effectively exploit the guns and missiles onboard ships to maximize the effects on targets.

PEO 3. To trainees will be provided with a thorough understanding on maintenance and repair of ships' gunnery equipment which will enable them to carry out O level maintenance as per OEM specifications.

PEO 4. The trainees will be proficient in analysing the operational and tactical implementation of Surface to Air Missile and Surface to Surface Missile for pre and post firing analysis of the missile systems enabling them to generate CAASP for effective employment of weapon systems.

PROGRAMME OUTCOME (PO)

PO 1. The trainees will be able to impart training to officers and sailors posted on their ships and establishments for gunnery duties and in particular for the drill, discipline and smartness at gunnery quarters.

PO 2. The trainee will be able to effectively supervise juniors under his leadership for custody, maintenance, examination, embarkation, disembarkation, handling, fuzing and preparation for service of all explosives and missiles in ships and naval establishments.

PO 3. The trainee will be able to undertake handling of small arms, organise Landing Party and perform Range Officer Duties.

PO 4. The trainee will be educated on maritime laws and regulation and will be provided with practical training to organise, conduct and command a VBSS (Visit, Board, Search & Seizure) team.

PO 5. The trainee will be able to implement the best adjustments to Fire Control Systems for the mutual alignment of gunnery direction radar, gunnery control radar, director sight, gun sight and gun bore systems and guided missile radar and systems.

PO 6. The trainee will be able to functionally and tactically exploit the gunnery weapons, missiles and sensors for effective combat operations during operational exercises and war.

PO 7. The trainee will be able to advice the Command on the tactics to employ to obtain the best results from the ship's gunnery weapons & missiles.

24-8203-0101 – PRINCIPLES OF NAVAL DRILL

1. **Course Description**. The curriculum of this course is designed to train the trainees for conduct of naval parade & ceremonials in naval ships and establishments at various occasions.

2. **Pre-Requisites**. Officers should have served onboard IN/ICG Ships and establishments.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0101	Principles of Naval Drill	1	1	2	2	100
	Total			**2**	**2**	**100**

4. C**ourse Outcome**. After completion of the course the trainees will be able to: -

CO 1	Supervise and conduct drill in naval ships and establishments at various occasions.
CO 2	Advise the command/seniors on ceremonials including commissioning, decommissioning, award of Colours, investiture ceremonies etc pertaining to Indian Navy.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), Medium (2) and High (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3						
CO 2	3						

6. **Course Content**.

(a) **Module I**. Standing drill, Squad drill, sword drill, Parade Commander drill, Platoon commander drill, conduct of divisions, conduct of presidents colours, conduct of Republic Day/ Independence Day parade.

(b) **Module II**. Power of Command- Duties of Parade commander, OOGI, Platoon Commander, Conduct Ceremonial parades ashore, Conduct of ceremonial parade division at afloat, Guard of honor, Colour guard, entering/leaving, Conduct of Naval ceremonials – Man and cheer ship, pulling out ceremony, wreath laying

(c) **Module III**. Conduct and ceremonial parade & divisions – Nishan Guard, Conduct of Naval ceremonial – Call on and return call, Conduct of funeral – Afloat and ashore, Commissioning/Decommissioning of warships.

7. **Reference**. INBR (Indian Naval Book of Reference) 1834 on Indian Naval drills, parades and ceremonials approved by Naval Headquarters, New Delhi in 2001

24-8203-0102 - BASIC GUNNERY

1. **Course Description**. The curriculum of this course is designed to provide trainees understanding on general gunnery aspects, duties of the armament responsible officer and the basic working principles of the weapon systems deployed on naval ships & submarines.

2. **Pre-Requisites**. Officers should have served onboard IN/ICG Ships and establishments.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0102	Small Arms	.5	1.5	2	2	100
	Landing Party	-	.5	.5	1	50
	Range Officer Duties	.5	-	.5	1	50
	Total			**3**	**4**	**200**

4. **Course Outcome**: After completion of the course the trainees will be able to: -

CO 1	Perform, supervise and train officers and sailors on assembling, disassembling, maintenance and firing of the small arms onboard ships and establishment. The trainee will also be familiar with safety procedures regarding handling and stowage of the small arms.
CO 2	Organise, train and command ship's sentries and Landing Party.
CO 3	Perform range officer duties to ensure safety of men & arms on firing range.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), Medium (2) and High (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			**3**				
CO 2			**3**				
CO 3			**3**				

6. **Course Content**.

(a) **Module I**. Rifle 5.56mm INSAS, Rifle 9mm Carbine, Rifle 7.62mm LMG, Rifle 12.7mm HMG operation, safety and maintenance actions for handling small arms. Duties of Range Officer, identifications of targets, practical firings at classification range/short range.

(b) **Module II**. Field Craft. Camouflage, concealment, field movement, formation and signal, Organisation and composition of Landing Party up to company level, Arms, ammunition and equipment carried by each individual, Aid to civil power, concept and responsibilities document, aid and equipment required, Function of Landing Party and order of dress.

(c) **Module III**. Ranges, Targets and safety precautions at range. Types and construction of range, Classification, short, Pistol, and miniature range, Types and characteristics, marking of Snap, CQB, Fig 11, Fig 12, Fig 11 Combat, A, B and C type targets, Ammunition warning to all personnel, live/empty cases mixing, ear

defenders, loading of weapons, danger flags, night firing lamp and inspection of targets

(d) **Module IV**. Sentries. Rig, items to be carried, safety precautions and Rules of engagement, Quick Reaction Team. Organisation, composition and procedure, challenging procedure, factors effecting challenging, Action on failure to obey the challenge, Positioning of sentries and Personal protection measures for sentries.

(e) **Module V**. Practical firing of 5.56 mm INSAS/9mm Pistol/5.56 mm LMG and HMG at Classification range/Short range.

7. **Reference**. Technical manual of Small arms (Rifle 5.56mm INSAS, Rifle 9mm Carbine, Rifle 7.62mm LMG, Rifle 12.7mm HMG)

24-8203-0103 – PRINCIPALS OF ORDNANCE, ARMAMENT AND EXPLOSIVE CHEMISTRY

1. **Course Description**. This course specifically covers modules pertaining to Ordnance and ammunition which will enable a trainee to facilitate safe stowage, handling and exploitation of the ammunition.

2. **Pre-Requisites**. Officers should have knowledge about basic concepts of chemistry to understand reactions.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0103	Explosive Chemistry	2	-	2	1	50
	Ordnance & Ammunition	2	-	2	1	50
	Total			**4**	**2**	**100**

4. **Course Outcome**: After completion of the course the trainees will be able to: -

CO 1	Explain types of explosives, various HE fillings in use, Pyrotechnic and its compositions and train including the characteristics of military explosives.
CO 2	Apply knowledge of composition of explosives for exploitation onboard.
CO 3	Facilitate safe stowage of Ordnance & ammunition onboard Ships.
CO 4	Conversant with principles of naval weapon systems and NAD organisation.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), Medium (2) and High (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3						
CO 2		3					
CO 3		2					
CO 4		2					

6. **Course Content**:

(a) **Module I**. Ballistics: Definitions, Internal Ballistics: and External Ballistics of projectile motion, Summary of Events inside and outside the barrel, Various Forces and Factors involved. Stability criteria.

(b) **Module II**. Introduction to Gun Design and Construction, Various types of Ordnance / Delivery systems. General description of gun mounts. Barrel and breech mechanism and other assemblies. Various methods of barrel construction, barrel wear.

(c) **Module III**. Introduction to Types of ammunition. Classification of Gun Ammunition, Complete round/Cartridge, Brief description of cartridge case system,

manufacture and types, Various Charges in Service, Components of In-Service cartridges.

(d) **Module IV**. Projectile: Introduction, Definitions, Basics of projectile / shell design, Stability Forces acting, Functions of Bourrelet, Types of Projectile, Filling of HE Shell, Driving Band: Introduction, Material, Design and Types.

(e) **Module V**. Identification of In-service Ammunition (30 mm and above) Fuzes: Functions, Design Principles, Classifications, Components, Arming Mechanisms/ Safety and Arming devices, Mechanical and Electronic Fuzes, Working of In-service Fuzes (AK 630, 40/60, 76.2 mm, 76/62 mm, 100 mm, Kavach, 127 mm, 140 mm)

(f) **Module VI**. Introduction to primer/ detonators. Constructional detail, various types. Percussion, electric combinations and conducting compositions type.

(g) **Module VII**. Proof of Ammunitions: Propellant, Primer, Fuze, Cartridge Case, shell and complete round proof. Various types of failures / defects encountered. Assessment of charge Mass. Ammunition Preparation, Marking and Storage, Safety Class Division: Magazines traverses, Safety class divisions and groups

(h) **Module VIII**. Concept of Rail Gun, Coil Guns and other hyper velocity projectile delivery systems. Extended range guided munitions and precision guided munitions, Latest trends in munitions.

(i) **Module IX**. Introduction to explosives and military explosives, classifications, functional performance parameters like sensitivity, power, FOI, brisance, stability, density. Introduction to explosion, detonation, deflagration, oxygen balance, relative strength, heat of explosion, group of explosives, primers and their classification, construction and action.

(j) **Module X**. Low explosives, Pt/Tt curves, propellant performance parameters of burn time, thrust, impulse, Isp etc, gun propellant in use with naval ammunition, high explosives: intermediaries and HE compositions in use, comparison performance parameters of low, intermediary and high explosives, exudation of TNT, Pyrotechnic and its compositions

7. **References**.

(a) INBR 1862/2019 Indian Naval Magazine explosive regulation Part 1 approved by Naval Headquarters, New Delhi in 2019.

(b) INBR 1977, Handbook of Conventional ammunition, Part I and II approved by Naval Headquarters, New Delhi in 2015

(c) INBR 1978, Naval armament technology A perspective, approved by Naval Headquarters, New Delhi in 2010

(d) Principles of Naval weapon system by Craige Payne, second edition published by Naval Institute Press, 2010

24-8203-0104 – MARITIME LAW

1. **Course Description**. This course is designed to introduce the aspects pertaining to International Maritime Laws and VBSS (Visit Board, Search & Seizure) procedure.

2. **Pre-Requisites**. Officers should be aware of the fundamentals of international maritime law.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0104	Maritime Law	1	0	1	.5	25
	VBSS (Visit Board, Search & Seizure)	1	1	2	1	50
	FPM	1	0	1	.5	25
	Total			**4**	**2**	**100**

4. **Course Outcome**. After completion of the course the trainees will be: -

CO 1	Conversant with the legal aspects of MIO (Maritime Interception Operations) and LEO (Let Export Order) with reference to UNCLOS (United Nations Convention on the Law of the sea) and laws of armed conflict.
CO 2	Able to organise, conduct and command the ships VBSS team and supervise a VBSS operation independently.
CO 3	To be conversant with basics of asymmetric attack and actions to counter the same

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), Medium (2) and High (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1				3			
CO 2			3	3			
CO 3			2	3			

6. **Course Content**.

(a) **Module I**. Legal aspects of MIO, LEO, MZI act, UNCLOS and law of armed conflict. Basic introduction of the laws of armed conflict and UNCLOS and their relevance in real time Ops.

(b) **Module II**. Composition of VBSS team as per class of ship. Role and duties of each component of the team. Guidelines for Evidence collection, Tagging & documentation.

(c) **Module III**. Introduction of general organisation onboard a merchant vessel. Classification of merchant vessels as per role and tonnage. Standard layout of compartments onboard various type of merchant vessels. Various documents

and certificates used onboard merchant vessels. Procedure for interrogation of suspect vessels on MMB. Sequence of action in each phase. Introduction to salient aspects to be included as part of briefing to command and boarding team on the conduct of VBSS Operations.

(d) **Module IV**. Types of asymmetric attack, Countermeasures against asymmetric threats, Organisation and Command & Control for FPM, Rules of Engagement, INEXREM exercises for FPM.

7. **References**.

(a) INBR 1700, Indian Navy *VBSS guidebook approved by Naval Headquarters, New Delhi in 2021

(b) United Nation Convention on Law of the Sea, an International agreement. Depositary- Secretary-General of the United Nations signed on and adopted in 1982.

(c) INBR 1651, Indian Navy “Defence Against Asymmetric Warfare”, 2010

24-8203-0105 - GUIDED WEAPON TECHNOLOGY

1. **Course Description**. This course will cover the aspects of missile guidance and control systems in the weapon and missile installed on naval platforms.

2. **Pre-Requisites**. Should have a clear understanding about the basic concepts in physics.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0105	Guided Weapon Information Capsule	2	0	2	1	**50**
	Missile Decoys	1	0	1	.5	**25**
	Introduction To Modern SSMS And SAMS	1	0	1	.5	**25**
	Total			**4**	**2**	**100**

4. **Course Outcome**. After completion of the course the students will be able to: -

CO 1	Apply basic knowledge on missile guidance techniques, missile control systems and missile kinematics so as to understand design and development concepts and various missile systems.
CO 2	Calculate and apply non-standard ballistic settings on Fire Control Computer.
CO 3	Apply basic knowledge on concept and working of various types of anti-ship missile decoys, apply thorough knowledge on components, Elevation and other mechanism, electrical equipment, firing circuit, stowage of ammunition, allowance of ammunition, and Exploitation of Chaff in different modes
CO 4	To check existing knowledge of class on the subject, To have basic knowledge of PN SSM/ AShMs, To have basic knowledge of PN surface to air missiles, To have basic knowledge of PLA (N) SSMs/AShMs, To have basic knowledge of PLA (N) surface to air missiles

5. **Mapping of Course Outcomes with Program Outcomes**. Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					3		
CO 2					3		
CO 3						3	
CO 4							2

6. **Course Content**.

(a) **Module I**. Missile Instruments Introduction, elementary theory of gyroscopes, frees gyro, rate gyro, accelerometers, resolvers and altimeter. Auto Pilot Introduction, parameters of auto pilot design, autopilot and changing environment, vertical launch autopilots. Introduction to Missile Kinematics. Missile Trajectories Constant bearing course, pure pursuit course, deviated pursuit course, proportional navigation course.

(b) **Module II**. Introduction, phases of guidance, types of guidance systems, principles of inertial guidance, beam rider guidance, fundamental and basic principles, typical beam rider receiver, laser range finders, laser designators and receiver, homing guidance, active/passive homing system, comparison of active and semi-active homing, homing heads and their stabilisation. IR detectors, Infra-red passive homing systems.

(c) **Module III**. Fundamentals of Jet propulsion. Thermodynamics of nozzle flow. Solid, liquid propellants and systems. Air breathing engines. Types of Sustainers engines including RAMJET, SCRAMJET, Cryogenic based sustainers and their applications in Naval system.

(d) **Module IV**. Introduction to concept of anti-ship missile decoys, Modern active/passive onboard and offboard missile decoys and their working principle, TTD, Purpose, Launcher Parts Fire control panel, Elevation and Training Mechanism, Electrical Equipment, Firing circuit, Block Diagram of Firing circuit, Firing Circuit checks, Ammunition, Type of Ammunition, Packing of Ammunition, Stowage capacity of magazine, Fuse setting operation, Annual practice allowance, Preparation for Sea & Action, Preparation for firing, Firing procedure, Procedure of loading/Unloading of projectile, trouble shooting, Misfire drill, Chaff exploitation as per Chaff Exploitation Doctrine.

(e) **Module V**. **Snap Test,** Conduct of snap test (objective) covering SSMs, SAMs, onboard ships of PN and PLA (N),

- Advantages/ Limitations over SSMs of IN

(i) **LY 80, FM 90, LY 60**

(ii) **Zarb, Harba, C802, Exocet, YJ-12, Atmaca,**

- Ships fitted on
- Technical data
- Propulsion
- Payload
- Guidance
- Basic flight trajectory
- Weapon/Fire Control System

- Ships fitted on
- Technical data
- Propulsion
- Payload
- Guidance
- Basic flight trajectory
- Weapon/Fire Control System
- Advantages/ Limitations over SAMs of IN

(iii) **C 701, HY 2, YJ 18, YJ 62**

- Ships fitted on
- Technical data
- Propulsion
- Payload
- Guidance
- Basic flight trajectory
- Weapon/Fire Control System
- Advantages/ Limitations over SSMs of IN

(iv) **HHQ, HHQ 7/7A, HHQ 9/9A, HHQ 16**

- Ships fitted on
- Technical data
- Propulsion
- Payload
- Guidance
- Basic flight trajectory
- Weapon/Fire Control System
- Advantages/ Limitations over SAMs of IN

7. **References**.

(a) Principles of Naval weapon system by Craige Payne, Second edition published by Naval Institute Press, 2010

(b) Guided weapons – Land warfare: Brassey's New battlefield weapon systems and technology series into 21st century by Ken Rouse J, Fourth edition published by Brassey's 2000

(c) Military Ballistics - Land warfare: Brassey's New battlefield weapon systems and technology series into 21st century by CL Farrar, Vol 13 published by Brassey's 1999

(d) Fundamentals of Guided Missiles by SR Mohan, First edition published by DRDO 2016

(e) Guided Weapons System Design by R Balakrishnan, First edition published by DRDO 1998

24-8203-0106 – ELECTRONICS & COMMUNICATION

1. **Course Description**. This course is designed to provide the trainees an overview on fiber optics and laser technology used in weapons, electronics and radar for weapons & sensors and networking fundamentals.

2. **Pre-Requisites**. Officers should have senior secondary level knowledge in Physics.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0106	Electronics And Radar	1	0	1	1	**50**
	Networking Fundamentals	1	0	1	.5	**25**
	Fiber Optics & Laser	1	0	1	.5	**25**
	Total			**3**	**2**	**100**

4. **Course Outcome**. After completion of the course the students will be able to: -

CO 1	Apply basic knowledge of electronics, laser, optics and radar so as to understand the functioning of various fire control, air/surface surveillance systems and professional tasking.
CO 2	Apply basic knowledge of network fundamentals to understand the concepts of Network Centric Equipment and operating Systems during network centric warfare.
CO 3	Understand the principles of Lasers, its military applications and be conversant with the principle of Thermal Imaging and its applications.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					3	2	
CO 2						2	3
CO3					2	2	

6. **Course Content**.

(a) **Module I.** MTI, external coherence, Doppler effect, factors effecting radar performance, duct propagation, types of gunnery radars, frequency selection surveillance tracking, TWS, fire control missile guidance radar, altimeter, AEW, pulses Doppler, CW radar, pulse compression technique, phase array multiplication radar, milimetric wave Radar, beam switching sequential lobbing, monopulse and LORO techniques, IR laser tracking methods. ESM range advantage, RX sensitivity/freq band. Consideration for jamming its effects, types of jamming noise swept, RGPO DECM VGPO main/slide lobe jamming its cancellation. Chaff and its characteristics bloom time, persistence time, ECCM.

(b) **Module II**. Introduction, Applications, Classifications Network Security, OSI Model, TCP/IT model, Practical on Installing, Configuring and Network Management. Information Security: Various IT and INFOSEC policies in force, Networking infrastructure in the *IN.*

(c) **Module III**. Introduction to Fibre Optics and working principle of Optical Fibres, Military applications of Optical Fibres, Principles of Laser, Directed Energy Weapons, Defensive Countermeasures, Target Designators, Disorientation, Guidance, Fire Arms (Laser Sight, Eye Targeted Lasers, Holographic Weapon Sight), Principles of Thermal Imaging, Military applications of Thermal Imaging – FLIR, Motion Detection.

7. **References**.

(a) Radar Handbook – Merrill I Skolnik, Third edition by McGraw-Hill Education, 2008.

(b) Data Communication and Networking by Behrouz A Forouzan, Fourth Edition published by Mc Graw Hill Education, 2017.

(c) Fibre optics and Laser Instruments by N Nagaraj, S Renuka published by Anuradha Publication, 2010

24-8203-0107 - GUNNERY FOUNDATION

1. **Course Description**. The course is designed to provide the trainees with an overview on gunnery concepts like stabilisation & probability for effective delivery of ordnance on target.

2. **Pre-Requisites**. Officers should have senior-secondary level knowledge of physics and maths.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0107	Gunnery Theory	1	0	1	.5	**25**
	Mathematical Ground Work	1	0	1	.5	**25**
	Total			**2**	**1**	**50**

4. **Course Outcome**. After completion of the course the trainee will be: -

CO 1	Conversant with Reference frame & Coordinate system, theory of stabilisation, theory of Tracking and theory of Prediction, this will enable them to apply the concept for effective delivery of ordnance on target.
CO 2	Conversant with mathematical concepts involved in Operational Research and System Analysis.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), Medium (2) and High (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					2	3	3
CO 2					2		

6. **Course Content**.

(a) **Module I**. Introduction to Weapon Station Reference Frames, Reference Frame Rotation and Reference Frame Translation along with its utilities in Navy, Introduction to Co-ordinate systems (Spherical, Polar, Cylindrical and Cartesian) and Conversion from one to another, Introduction to angles between lines and planes, spherical planes, Introduction to Angular Movement of Ship, Vertical Stabilisation – Roll, Pitch, Level, Cross Level and Slope Angles, Azimuth Stabilisation – Yaw, Normal Gimballed Gyro, Double Gimballed Gyro, Stabilisation problem with Two Axis, Three Axis and Four Axis Mountings, Line Stabilisation.

(b) **Module II**. Working principle of Weapon Gyro, Determination of Target Position and Movement, Measurement of Target Coordinates, Rate aided operations, Regenerative Operations, Second Derivative Operation, Radar Servo Tracking System and Range Tracking, Prediction Assumptions, Calculation of Time

of Flight and Tangent Elevation, Corrections for change in Muzzle Velocity, Ballistic Coefficient, Drift, Own Speed, Effect of Wind on Shell Motion.

(c) **Module III**. Introduction to Operational Research and System Analysis, Basics of Probability Theory for ORSA, Basic of Statistics for ORSA, Basics of Linear programming for ORSA.

7. **References**.

(a) Control System Engineering, Norman Nise,1992

(b) Schaum's Outline of Feedback & Control System, Joseph J.DiStefano,2013

(c) Essential Stability Theory, Cambridge Core

24-8203-0108 – DESIGN, CONCEPT AND OPERATION OF SUPER RAPID GUN MOUNT (SRGM) SYSTEM

1. **Course Description**. The course is designed to provide practical and theoretical knowledge on Anti-missile gun- Super Rapid Gun Mount (SRGM) installed on naval platforms.

2. **Pre-Requisites**. Officers should have undergone ab initio training.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0108	SRGM – Technical Details	.5	0	.5	.5	**25**
	SRGM – Gun Mount	.5	2	2.5	1	**100**
	SRGM – Tactical Exploitation	1	1	2	.5	**25**
	Total			**5**	**2**	**100**

4. **Course Outcome**: After completion of the course the trainee will be: -

CO 1	Able to understand capabilities, tactical utilisation and limitation of 72/62 SRGM.
CO 2	Conversant with the components, layout, mechanical construction and operational functional diagram.
CO 3	Undertake loading/unloading and misfire drills and to carry out pre firing and post firing checks.
CO 4	Understand proximity switches, their functions and interactions during gun mount operation and firing so as to be able to analyse stoppages and failures.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					2	3	2
CO 2					3	3	3
CO 3					2	3	2
CO 4					3	2	2

6. **Course Content**.

(a) **Module I**. Purpose, Technical data, capabilities and limitation, Type of ammunition, Layout of system and manning, Overall operation of the gun mount, Various methods of training fire control system and sight. Intercommunication between compartments of the system. Air-conditioning and ventilation arrangement in the barbette and Firefighting arrangement in barbette and magazine. Operation of ammunition hoist.

(b) **Module II**. Gun mount assembly, COT console, Cooling system, Local stabilization unit, Hydraulic system, Manual operation of GM, Description of the gun mount, Training (Upper shank, lower shank, Reduction gear box, Tr bearing and Trg lock), Elevation Cradle, Balancer, upper compensation cylinder, lower compensation cylinder, Reduction gear box, Elevating arc, hydraulic limit stop buffer, elevating lock

(c) **Module III**. Feeding, loading and case ejection system, revolving mechanism, hand crank, interlocks, round retainer and supports screw feeder hoist, rocking arms, Hydraulic system, Loading/unloading, misfire drill, preparation for firing, post firing routines and securing of mounting post firing, maintenance schedule.

(d) **Module IV**. Proximity switches, their functions and interactions during gun mount operation , analyse of stoppages and failures

7. **Reference.** Technical Documents Operating Instructions SRGM approved by Naval Headquarters, New Delhi

24-8203-0109 – DESIGN, CONCEPT AND OPERATION OF CLOSE-IN- WEAPON SYSTEM - AK630

1. **Course Description**. The course is designed to provide practical and theoretical knowledge on Close-in- Weapon System AK630 installed on naval platforms.

2. **Pre-Requisites**. Officers should have undergone ab initio training.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0109	AK630 – Technical Details & Tactical Exploitation	.5	1	1.5	.5	**50**
	AK630 – Gun Mount	.5	1	1.5	1	**50**
	Total			**3**	**2**	**100**

4. **Course Outcome**: After completion of the course the trainee will be able to: -

CO 1	Functionally and tactically exploit AK630 for combat operations.
CO 2	Conversant with the components, layout, mechanical construction and operational functional diagram.
CO 3	Undertake loading/unloading and misfire drills and to carry out pre firing and post firing checks.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					2	2	3
CO 2					3	2	2
CO 3					2	3	2

6. **Course Content**.

(a) **Module I**. Introduction to System including Technical Data, Barbette & Mounting Layout, AO 18, Breech Block, Cradle & Cooling System, Electrical & Hydraulic Systems of AK 630 GM

(b) **Module II**. Pneumatic Systems of AK 630 and Charging of Air Bottles, Firing operation of the gun, Modes of Fire, Command & Control orders, MAINTOPS Routines, Gun trials & Series Inspection, Incident Study and Analysis related to AK 630GM, Live Firing of AK 630.

(c) **Module III**. Introduction, Technical Description, Main functions, System Component, Below Deck and above deck components, Pedestal Architecture, Weapon Overview and common terms, Pedestal Movement, Auxiliary Operation, Drift Cancellation Process, Human Machine Interface (HMI), Screen Key Controls,

(d) FCS/ Battle Screen including various indications and action buttons, Setting tab of Battle, Ammunition, Camera, Environment, utility and sight, Operation of SCP, switches logic, Main assemblies/ groups, internal parts of gun and their functions.

(e) **Module IV**. Stripping/ Assembling of gun, loading and firing mechanism of gun, mounting of gun on the cradle, Loading/ unloading of ammunition, identification of types of ammunition, Preventive maintenance schedules including pre and post firing routines, Corrective maintenance schedule, Functionality test, Nitrogen purging procedure, Boresight camera calibration procedure and Gun jump calibration during weapon alignment, Stripping/ Assembling of gun, belting/ unbolting, Safe practices during operation or maintenance of the system including misfire drill and stoppages.

7. **Reference.** Technical Documents Operating Instructions AK 630 approved by Naval Headquarters, New Delhi

24-8203-0110 – DESIGN, CONCEPT AND OPERATION OF STABILISED REMOTE CONTROL GUN (SRCG) SYSTEM

1. **Course Description**. The course is designed to provide practical and theoretical knowledge on Stabilised Remote Control Gun (SRCG) installed on naval platforms.

2. **Pre-Requisites**. Officers should be well versed with the operation of small arms.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0110	SRCG – Technical & Exploitation Details	1	0	1	1	**50**
	SRCG – Practical & Firing	1	2	3	1	**50**
	Total			**4**	**2**	**100**

4. **Course Outcome**: After completion of the course the trainee will be able to: -

CO 1	Functionally and tactically exploit SRCG for combat operations.
CO 2	Exploit capabilities of the system and understand maintenance concept of the entire system for safe operation and evaluate the trainees.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					3	3	3
CO 2					3	2	2

6. **Course Content**.

(a) **Module I**. Introduction, Technical Description, Main functions, System Component, Below Deck and above deck components, Pedestal Architecture, Weapon Overview and common terms, Pedestal Movement, Auxiliary Operation

(b) **Module II**. Drift Cancellation Process, Human Machine Interface (HMI), Screen Key Controls, FCS/ Battle Screen including various indications and action buttons, Setting tab of Battle, Ammunition, Camera, Environment, utility and sight

(c) **Module III**. Operation of SCP, switches logic, Main assemblies/ groups, internal parts of gun and their functions. Stripping/ Assembling of gun, loading and firing mechanism of gun, mounting of gun on the cradle

(d) **Module IV**. Loading/ unloading of ammunition, identification of types of ammunition, Preventive maintenance schedules including pre and post firing routines, Corrective maintenance schedule, Functionality test, Nitrogen purging procedure

(e) **Module V**. Boresight camera calibration procedure and Gun jump calibration during weapon alignment, Stripping/ Assembling of gun, belting/ unbolting, Safe practices during operation or maintenance of the system including misfire drill and stoppages, Examination

7. **Reference**. Technical Documents Operating Instructions of SRCG approved by Naval Headquarters, New Delhi

24-8203-0111 – DESIGN, CONCEPT AND OPERATION OF SURFACE TO SURFACE MISSILE SYSTEM –P21/22

1. **Course Description**. The course is designed to provide practical and theoretical knowledge on P21/22 SSM installed on naval platforms.

2. **Pre-Requisites**. Officers should have an understanding of explosive chemistry and physics.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0111	P21/22 – Technical Details & Circuit Diagram	.5	0	.5	.5	**25**
	P21/22 – Simulator & Firing Practicals	.5	1	1.5	.5	**25**
	Total			**2**	**1**	**50**

4. **Course Outcome**: After completion of the course the trainee will be: -

CO 1	Conversant with P21/22 complex, trajectory and sub-systems and functional knowledge of missile propulsion system.
CO 2	Able to understand SSM loader and will be conversant with Embarkation/ Disembarkation procedure of the missile.
CO 3	Functionally and tactically exploit missile P 21-22 (Surface to Surface Missile) for combat operations.
CO 4	Able to prepare system and crew for CIT checks, undertake Practice missile firing as per firing order, have knowledge to undertake basic analysis and prepare WAU report.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					2	2	3
CO 2					3	3	2
CO 3					2	3	2
CO 4					3	2	2

6. **Course Content**.

(a) **Module I**. Introduction, Booster, Propellant and Air System, Sustainer Engine, Electric Equipment, Warhead and Fuze Assembly, Radar Homing Head (DCM-AE), IR Homing Head (FAD Module), Container, Electrical Connectors, Sprinkling System (KARAT-M), Loader (KT-97BE), Loading/Unloading, Modes of Operations, Fire Control System (Korall-NKE), Computer (IK, Data entry device (83K), Missile Officer's Panel (101), Firing Circuit Diagrams, Modes of firing Harbour drills, CIT preparation, Practice missile firing, Maintenance.

(b) **Module II**. General Information-Missile- Introduction, Technical Specifications, Configuration of missile, Flight Trajectory, Brief Description of hardware components, Design of Missile Hardware Structure- Hardware structure,

Transportation cum Launch Canister (TLC), Nose Cap, Internal Nose Cap ,airframe, F1 section body, F2 section body, Instrument frame of F1/F2 section, Wing, Fin Assembly, Sustainer- Function and area of application, Structure of supersonic Ramjet, Fuel system of Ramjet, Starting system, turbo hydraulic pump set, electrical equipment of sustainer, Telemetry sensor, Combined Pneumatic and Hydraulic System (CPHS)- Function and structure

(c) **Module III**. Basic parameters and technical descriptions, serviceability, structure, operation of CPHS, control surface unfolding system, Booster- function and structure, Technical characteristics of booster stage, Docking of booster stage to sustainer, operation of booster stage, Front Docking Unit(FDU), Instrument bay pressurisation system, Pyro Device- Types and function, design and operation, Launch Gas Generator, solid propellant motor system of nose cap, initiation system.

(d) **Module IV**. Electrical equipment- function and structure, Power and command distribution unit, Pyro control unit, Onboard power supply source, Armament- Structure and function, Warhead CK 317, Action of Warhead, Fuze CK 318, Impact sensor system CK319, Onboard Control system Equipment-Function, Basic technical data, Composition of Onboard Control system equipment, seeker K-312, Angular Velocity sensor K 314-47, Information Convertor CK 314-43, servo Amplifier CK 314-42, Radio Altimeter K-313, Inertial Navigation system, Onboard Digital computer, Detection and homing system-seeker-Function

7. **Reference**. Technical Documents Operating Instructions of P21 approved by Naval Headquarters, New Delhi

24-8203-0112 – DESIGN, CONCEPT AND OPERATION OF SURFACE TO SURFACE MISSILE SYSTEM – BRAHMOS

1. **Course Description**. The course is designed to provide practical and theoretical knowledge on BRAHMOS SSM installed on naval platforms.

2. **Pre-Requisites**. Officers should have an understanding of explosive chemistry and physics.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0112	BRAHMOS – Technical Details	1	0	1	1	**50**
	BRAHMOS – Simulator & Firing Practical	1	1	2	1	**50**
	BRAHMOS – Tactical Exploitation	1	1	2	2	**100**
	Total			**5**	**4**	**200**

4. **Course Outcome**. After completion of the course the trainee will be able to: -

CO 1	Understand the basic structure of BrahMos missile and will be conversant with the technical data & components of BrahMos missile.
CO 2	Understand the BrahMos missile Flight and target detection components and will possess functional and operational knowledge of BrahMos FCS.
CO 3	Undertake combat & tactical exploration of missile system.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					2	2	3
CO 2					3	3	2
CO 3					2	3	3

6. **Course Content**.

(a) **Module I**. General Information-Missile- Introduction, Technical Specifications, Configuration of missile, Flight Trajectory, Brief Description of hardware components, Design of Missile Hardware Structure- Hardware structure, Transportation cum Launch Canister (TLC), Nose Cap, Internal Nose Cap, airframe, F1 section body, F2 section body, Instrument frame of F1/F2 section, Wing.

(b) **Module II**. Fin Assembly, Sustainer- Function and area of application, Structure of supersonic Ramjet, Fuel system of Ramjet, Starting system, turbo hydraulic pump set, electrical equipment of sustainer, Telemetry sensor, Combined Pneumatic and Hydraulic System (CPHS)- Function and structure, Basic parameters and technical descriptions, serviceability, structure, operation of CPHS, control surface unfolding system, Booster- function and structure.

(c) **Module II**. Technical characteristics of booster stage, Docking of booster stage to sustainer, operation of booster stage, Front Docking Unit(FDU), Instrument bay pressurisation system, Pyro Device- Types and function, design and operation, Launch Gas Generator, solid propellant motor system of nose cap, initiation system, Electrical equipment- function and structure, Power and command distribution unit, Pyro control unit, Onboard power supply source, Armament- Structure and function, Warhead CK 317, Action of Warhead, Fuze CK 318, Impact sensor system CK319, Onboard Control system Equipment-Function, Basic technical data.

(d) **Module III**. Composition of Onboard Control system equipment, seeker K-312, Angular Velocity Sensor K 314-47, Information Convertor CK 314-43, servo Amplifier CK 314-42, Radio Altimeter K-313, Inertial Navigation system, Onboard Digital computer, Detection and homing System-Seeker-Function

(e) **Module IV**. Technical specification, functional configuration, operational modes, structure of seeker, system checks of the seeker, Interface with control and guidance system, Radio Altimeter- Function and structure, Technical specification, functional configuration, operational modes, structure of seeker, system checks of the seeker, interface with control and guidance system, Inertial Navigation System-function, output parameter , characteristics, Flight sequence- flight sequence, Pre-Launch Preparation, Brahmos FCS.

7. **Reference**. Technical Documents and Operating Instructions of P21 approved by Naval Headquarters, New Delhi.

24-8203-0113 – DESIGN, CONCEPT AND OPERATION OF SURFACE TO AIR MISSILE SYSTEM – BARAK

1. **Course Description**. The course is designed to provide practical and theoretical knowledge on SAM system BARAK installed on naval platforms.

2. **Pre-Requisites**. Officers should have an understanding of explosive chemistry and physics.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0113	BARAK – Technical Details	1	0	1	1	**50**
	BARAK – Simulator & Firing Practical	1	1	2	2	**100**
	BARAK – Tactical Exploitation	1	1	2	1	**50**
	Total			**5**	**4**	**200**

4. **Course Outcome**: After completion of the course the trainee will be: -

CO 1	Conversant with the technical data & composition of system for tactical exploitation.
CO 2	Able to exploit BWCS Operational Process for threat evaluation and resource allocation.
CO 3	Able to practically exploit BWCS operating functions, transmitter channel and receiver channel.
CO 4	Able to perform system drills and analysis of previous firings.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					2	2	3
CO 2					3	3	3
CO 3					2	3	3
CO 4					3	3	3

6. **Course Content**.

(a) **Module I**. System Overview, BWCS Layout Description, FCS & INS - Technical Overview Units and Performances Description- FCS Interfaces, Major Block Level System description, Units and Sub Units Description, System Configurations, FCR, Technical Overview, units and performance description, FCR Interface with FCS, FCR main tasks.

(b) **Module II**. Main features, specification, System Op Modes, Missilery Engagement Modes, Simulation Mode, Maintenance Mode, TERA Functions, TERA parameters, TERA modes, FCR – Logic Modes, BLCU – Logic, Modes, FCC-controls and indications, MU controls and indications, BLCU controls and indications, BARAK canister –controls and indications, FCC means of operation, FCC –upper monitor display, lower monitor display, Display forms, General

description, System activation/ shutdown, control functions, engagement management, FCR Operating parameters, tactical functions graphic tools, simulation modes, maintenance mode FCR frequency setting, Recording Unit (RECU).

(c) **Module III**. Technical overview, Operating Procedure, Recording procedures, Data Format for firing analysis as per AMBAR, FCR main Task, Main Features, Specifications, Interfaces, Pictorial Diagram Antenna System, Transmitter and Processor rack(TPR), TWT Transmitter, Anti condensation Unit, Servo Unit Rack, Man aloft switch, Block Diagram of X band Tx channel, Block Diagram of Ka band Tx channel, Rx channel general Block Diagram, RSPU interconnections, Rx channel signal processing, Antenna assembly General View of AE, Block Diagram, Main Antenna, Feed, Reflectors, Narrow capture AE, Wide Capture AE, Side Lobe AE, IMU, TTD of BCM, Parts of BCM and their functions

(d) **Module IV**. General safety regulations for Missile Handling activities, Safety regulations for BCM loading/ unloading onboard ship, Incidents/Accidents, Safety regulations for BCM unloading after launch failure, Safety regulations, unloading after Hang fire, Emergency procedures in case of fire, Safety regulations for handling a dropped BCM, Humidity Check, Visual inspection and corrections, pressure check and Nitrogen filling, Pressure check, Nitrogen filling procedure using portable filling Device, built-in –test using FCS, PLCC-BCM-FCR communication checkout procedure using PCCA.

(e) **Module V**. Preparation/selection of articles for firing, 1General Description of VLU, MSU connection to VLU, Functional and Physical Description of VLU, Upper Plate Assembly-Location and Function, Central Structure –Location and function, Hangfire Funnel –Location and function, Hangfire Chamber-Location and function, VLU –Physical Characteristics, Safety Precautions to be followed for maintenance of VLU, Periodic Maintenance Activities, Pre and Post sailing Inspections, Canister handling after Missile launch, After docking service, Quarterly service, Funnel Cover Replacement and installation, Undertake firing drills/ PMF in TERA On and Off Mode on emulator.

7. **Reference.** Technical Documents and Operating Instructions of BARAK approved by Naval Headquarters, New Delhi.

24-8203-0114 – DESIGN, CONCEPT AND OPERATION OF SURFACE TO AIR MISSILE SYSTEM – IGLA

1. **Course Description**. The course is designed to provide practical and theoretical knowledge on IGLA system installed on naval platforms.

2. **Pre-Requisites**. Officers should have an understanding of explosive chemistry and physics.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0114	IGLA – Technical Details & Exploitation	1	0	1	.5	**25**
	IGLA – Simulator Training	0	1	1	.5	**25**
	Total			**2**	**1**	**50**

4. **Course Outcome**: After completion of the course the trainee will be: -

CO 1	Conversant with capabilities, limitations, technical utilisation and stowage conditions of IGLA SAM for implementation onboard Ships.
CO 2	Conversant with the launching conditions, acceptance, stowage, care and maintenance of IGLA SAM.
CO 3	Conversant with the Tactical exploitation of IGLA SAM.

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					2	3	3
CO 2					3	3	
CO 3					2	3	3

6. **Course Content**.

(a) **Module I**. Introduction to IGLA SAM, Purpose, Composition, Technical data, Stowage conditions on board.

(b) **Module II**. Parts of SAM, SAM, launching tube, Launching mechanism, Combat employment & operation, Launching conditions & procedure, Misfire drill, Acceptance of missile, Care and maintenance of the SAM/ magazine stowage.

7. **Reference**. Technical Documents and Operating Instructions of IGLA approved by Naval Headquarters, New Delhi.

24-8203-0115 – GUNNERY SENSOR & FIRE CONTROL RADARS (LYNX U2 & SSR)

1. **Course Description**. The course is designed to provide practical and theoretical knowledge on Fire Control Radars installed on naval platforms.

2. **Pre-Requisites**. Officers should have adequate knowledge about the operation of radars.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0115	LYNX U2	1	1	2	1	**50**
	SSR	1	1	2	1	**50**
	Total			**4**	**2**	**100**

4. **Course Outcome**: After completion of the course the trainee will be able to: -

CO 1	Optimally utilize the LYNX fire control radar for combat exploitations.
CO 2	Conversant with the basics data and components of active channel of the system, radar devices, understand tactical exploitation

5. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					3	3	
CO 2					2	3	3

6. **Course Content**.

(a) **Module I**. Basic components of LYNX FCR, Technical Specifications, Switching on/off procedures, Controls and Indicators, Operational Functions, Secondary and ancillary functions, Visual sight operation, TDS operation. Practical for target detection, passing of target information, final hit data, projectile information.

(b) **Module II**. Various Functions and Operation/Exploitation of DRES including Mobile Operator Panel, Various Functions and Operation/Exploitation of TDS: Kolanka Sight, TDS Graticule for AK 630, TDS Graticule for SRGM, Gun Casualty Panel, Primary Operational Functions: Alert, Surveillance, Designation and Acquisition of Target, Tracking of Target, Engagement of Target, Assessment of Battle Damage

(c) **Module III**. Secondary Operational Functions (PAC Firings and Corrections, Shot Corrections) and Ancillary Functions (BITE, Alignment, Simulation), Controls, indications and Operations for SRGM firing, Controls, indications and Operations for AK 176 firing, Controls, indications and Operations for AK 630 firing

(d) **Module IV**. Basic data and Components of Active Channel, Introduction, Functions, Modes of Operation, TTD, MFC and RSAP, Combat Exploitation.

7. **References**.

(a) Technical Documents and Operating Instructions of SSR approved by Naval Headquarters, New Delhi.

(b) Technical Documents and Operating Instructions LYNX approved by Naval Headquarters, New Delhi.

24-8203-0116 – SURVEILLANCE & FIRE CONTROL SYSTEMS (AMDR 2D&3D)

1. **Course Description**. The course is designed to provide practical and theoretical knowledge on major gunnery sensors systems installed on naval platforms.

2. **Pre-Requisites**. Officers should have adequate knowledge about the functioning of radars.

3. **Distribution of Marks**.

Code	Subject	Hrs/week			Credits	Marks
		L	P	Total		
24-8203-0116	AMDR 2D&3D	2	1	3	1	50
	Total			**3**	**1**	**50**

4. **Course Outcome**: After completion of the course the trainee will be: -

CO 1	Conversant with the AMDR general description, the basic system specifications.
CO 2	AMDR system block diagram, AMDR modes of operation, power supply requirement of AMDR system, AMDR System performance.

5. **Mapping of Course Outcomes with Program Outcomes**:
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					3	3	
CO 2					2	3	2

6. **Course Content**.

(a) **Module I**. System main features, Antenna main features, ECCM features, basic parameters (System), basic parameters (Antenna), basic parameters (Transmitter), Receiver specifications, Signal Processing specifications, Basic block Diagram, Cooling Unit.

(b) **Module II**. TX Block Diagram, Receiver Processor Block Diagram, Antenna Control Box, Remote Control Unit, Antenna, Operational Mode, Maintenance Mode, LRS Mode, TA Mode, TAWS Mode, Power supplies required for the system, PDD, Conversion machinery, Operational Performance, Exploitation onboard ships.

7. **Reference**. Technical Documents and Operating Instructions LYNX approved by Naval Headquarters, New Delhi.

24-8203-0117 - GUNNERY TACTICS

Course Description. The course is designed to provide knowledge of Gunnery Tactics for operational exploitation for operational exploitation of naval platforms..

1. **Pre-Requisites**. Officers should have served onboard Indian Naval ships and establishments.

Code	Subject	Hrs/week			Credit	Marks
		L	P	Total		Total
24-8203-0117	Operational Efficiency	1.25	0	1.25	.5	20
	Fighting Efficiency	1.5	0	1.5	1	50
	Equipment Efficiency	.25	0	.25	.25	10
	MWC Tactics phase. (ND School, ASW School, Signal School, NODPAC, Seamanship school, NIAT	2	0	2	1.25	70
	Total			**5**	**3**	**150**

2. **Course Outcome**. After completion of the course the trainee will be able to: -

CO 1	Administer functioning of Gunnery department, to analyse various gunnery shoots as per extant policies and have thorough knowledge of targets used in IN for missile and gun shoot.
CO 2	Tactically exploit laid down principles of General, surface tactics.
CO 3	Ensure optimum efficiency of gunnery weapons and sensors.
CO 4	Apply the basic knowledge of Navigation Direction, Communication networks, Electronic warfare, ASW aspects for conduct of effective Gunnery warfare at sea.

3. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					2	3	
CO 2					3	2	3
CO 3					3	3	
CO 4							3

4. **Course Content**.

(a) **Module I**. Training principles, pre-commission, working up and communication of training for user skills, preparation before practice gunnery firings. Safety rules: AA and NGS practices, NGS: Classification of target, firing procedures. The standard format and salient points for the preparation of firing order including distribution (home assignment). Procedure for conducting various AA/SU/FPX/VBX non firing exercise. Drafting of FAAWC and SAG CDR policy and conduct of drills. Safety precautions, safety rules to be observed during various gunnery practices.

The standard format of salient points for the preparation of a firing order including its distribution.

(b) **Module II**. Principles of war, sea control/ denial, blockade, territorial waters, EEZ and continental shelf. Surface gunnery fighting range and bearing of targets, formation and ship handling effect of weather. Ammunition expenditure and type of SU action., Amphibious warfare, Over the Horizon targeting, AMD employment of soft kill and hard kill measures.

(c) **Module III**. To coordinate care and maintenance, testing and tuning, weapon alignment and HATS and SATS of sensor and weapons. **T**o be conversant with various organisations responsible for testing and tuning and confirming the proper functioning of equipment and gun. To be conversant with the organisations for ensuring constant checks and maintenance of gunnery equipment

(d) **Module IV**. Electronic warfare, Radio Organisation, RT communication, Under water acoustics, Mines, UW sensors, basics of ASW tactics, Introduction to air weapons, Targeting philosophy, GPS, Coastal Navigation, Action Information Organisation. Basics of Helo control.

5. **References**.

(a) INBR 45 (1 & 2), Admiralty manual of navigation, Lords commissioners of Admiralty, approved by Naval Headquarters, New Delhi in1967

(b) Joint Services Communication Publication (JSCP) - II, Handbook on brevity code

(c) Principles of underwater sound by Robert J Urick published by Peninsula publishing, 1983

(d) Sonar for Practising Engineers by AD Waite, Third edition published by John Wiley& Sons inc 2002

24-8203-0118 - PROJECT WORK

1. **Course Description**. The course is designed to enable trainees to undertake thorough study/ research of gunnery related topics.

2. **Pre-Requisites**. Officers should have a very clear understanding about the concepts of naval gunnery.

Code	Subject	Hrs/week			Credit	Marks
		L	P	Total		Total
24-8203-0118	Project Work	0	0	0	1	50
	Total			**0**	**1**	**50**

3. **Course Outcome**. After completion of the course the trainee will be able to: -

CO 1	Appreciate developments in the field of naval gunnery and contribute to

	developments in the field of naval gunnery in Indian Navy.

4. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1					**2**	**2**	

5. **Course Content**. Trainees will be required to undertake research on gunnery related topics as decided by Training Captain.

6. **Reference**. NA

24-8203-0119 – GUNNERY BOARD

1. **Course Description**. The course is designed to assess the knowledge gained by trainees.

2. **Pre-Requisites**. Assimilation of all the courses covered during the curriculum.

Code	Subject	Hrs/week			Credit	Marks
		L	P	Total		Total
24-8203-0119	Gunnery Board	0	0	0	2	100
	Total			**0**	**2**	**100**

3. **Course Outcome**. After completion of the course the trainee will be able to: -

CO 1	Have a sound knowledge of the essentials of time tested naval gunnery practices, Weapon Systems on board ships and also ashore, and, gunnery tactics, to function effectively as the Gunnery Officer in a naval unit.

4. **Mapping of Course Outcomes with Program Outcomes**.
Level – Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	**3**	**3**	**3**	**3**	**3**	**3**	**3**

5. **Course Content**. The entire spectrum of topics covered during the curriculum of the specialist training.

6. **Reference**. NA

Appendix - V (O)

Enclosure 2
(Refers to Para 3 of CTESS
Note 850/16 /CTESS
dated 09 Apr 24)

CURRICULUM FRAME WORK AND COURSE CONTENT FOR OUTCOME BASED EDUCATION

IN

MSc (Telecom)
(Programme No 24 - 8603)

Conducted By

SIGNAL SCHOOL

Signal School
Naval Base PO
Kochi 682004
Phone 04842896550
E-Mail - sncsigsc@navy.gov.in

Regulations for MSC (Telecom)

1.	**Programme No**	**:**	24 - 8603
2.	**Programme Name**	:	MSc (Telecom)
3.	**Programme Name (Naval Equivalent)**	**:**	Long C Course(Indian)
4.	**Approving Authority**	:	IHQ MoD (Navy)
5.	**Eligibility Criteria for Admission**:		(a) Officer Nominated by IHQ MoD (Navy)/ HQ ICG. (b) A Bachelor's Degree in Science or BE/ BTech, in any discipline, from a recognized university.
6.	**Duration**	:	**Phase I (Semester I & Semester II)** 48 Weeks of Training and On-Job Training.
		:	**Phase II (Semester III & Semester IV)** 48 weeks specialisation training at Signal School.
7.	**Attendance Requirement**	:	85% minimum
8.	**Nature**	:	Full Time Contact Programme
9.	**Approved Intake Capacity**	:	As approved by IHQ MoD(N)
10.	**Examination Pattern**	:	Combination of Theory and Practical Exam paper setter and evaluator will be other than Subject instructor as nominated by Training Coordinator. Written Papers - 950 Marks Practical - 450 Marks Dissertation - 100 Marks Oral - 200 Marks Total - 1700 Marks
11.	**Minimum Qualifying Marks**:		(a) **Written Examination**. 60% for IW, Networking & IT, Small Arms & Safety; 65% for Communication Electronics and Radar Electronics; 75% for Fleet Work (Operations), Fleet Works (Tactics), Communication

Organisation, Communication Operations, Communication Cryptology, Communication Equipment (RF), Communication Equipment (SATCOM), Electronic Warfare (Principles), Electronic Warfare (Systems), Naval Network Framework, Dissertation.

(b) **Practica**l. 90% for Communication Cryptology; 75% for Fleet Work (Operations), Communication Equipment (RF), Naval Network Framework, Communication Equipment (SATCOM), Electronic Warfare (Systems), Oral Board; 60% for Information Warfare, Networking & IT, Small Arms & Safety.

12. **Grading**.

(a) For Information Warfare, Oral Exam, Networking & Information Technology, and Small Arms: -

Range of Marks	Grades	Weightage
90% and above	S - Outstanding	10
85 - 90	A - Excellent	09
80 - 85	B - Very Good	08
70 - 80	C - Good	07
60-70	D - Satisfactory	06
Below 60%	F – Failure	00

(b) For Communication Electronics and Radar Electronics: -

Range of Marks	Grades	Weightage
90% and above	S - Outstanding	10
80 - 90	A - Excellent	09
70 - 80	B - Very Good	08
65 - 70	C - Good	07
Below 65%	F – Failure	00

(c) For all other Subjects: -

Range of Marks	Grades	Weightage
90% and above	S - Outstanding	10
85 - 90	A - Excellent	09
80 - 85	B - Very Good	08
75 - 80	C - Good	07
Below 75%	F – Failure	00

(Where (X – Y) means X is included and Y is excluded)

(d) **Cumulative Grade Point Average (CGPA)**. Overall performance at the end of the course is indicated by CGPA calculated as follows for all subject: -

CGPA = (G1C1 + G2C2 + G3C3 + …… + GnCn) / (C1 + C2 + C3 +……Cn)

Where, G is Grade weightage and C is Credit value corresponding to the subject.

(e) **Classification**. Classification for the Degree will be given as follows: -

Ser No	Classification	CGPA
1	First Class with distinction	8 and above
2	First Class	7 to <8
3	Second Class	6 to <7

13. **Failure in Examinations**:

(a) Failure in one subject will result in warning by Chief Instructor and re-examination.

(b) Failure in two subjects or in one subject more than once will result in warning by Officer-in-Charge and re-examination.

(c) Failure in three or more subjects or in re-examination will be considered as failure in the whole course and trainee will be withdrawn from the course.

14. **Synopsis of the Course and Credit Points**.

Course Code	Course	C/E	Credit
Semester III			
24-8603-0101	Fleet Work (Operations)	C	3
24-8603-0102	Fleet Work (Tactics)	C	3
24-8603-0103	Communication Organisation	C	2
24-8603-0104	Communication Operations	C	2
24-8603-0105	Communication Electronics	C	2
24-8603-0106	Radar Electronics	C	2
24-8603-0107	Communication Cryptology	C	2
24-8603-0108	Communication Equipment (RF)	C	2
24-8603-0109	Communication Equipment (SATCOM)	C	2
Semester IV			
24-8603-0110	Information Warfare	C	3
24-8603-0111	Electronic Warfare (Principles)	C	2
24-8603-0112	Electronic Warfare (Systems)	C	3
24-8603-0113	Networking & Information Technology	C	4
24-8603-0114	Naval Network Framework	C	2
24-8603-0115	Small Arms and Safety	C	1
24-8603-0116	ORAL Board	C	3
24-8603-0117	Dissertation	C	4
C+E			**42**

SCHEME OF INSTRUCTIONS (SOI) AND SCHEME OF EXAMINATIONS (SOE)

Code	Course	Hours/ Week				Credit	Marks		
		L	T	P	Total		Th	Pr	Total
Semester III									
24-8603-0101	Fleet Work (Operations)	3	-	1	4	3	75	25	100
24-8603-0102	Fleet Work (Tactics)	4	-	-	4	3	100	-	100
24-8603-0103	Communication Organisation	4	-	-	4	2	100	-	100
24-8603-0104	Communication Operations	3	-	-	3	2	150	-	150
24-8603-0105	Communication Electronics	2	-	-	2	2	50	-	50
24-8603-0106	Radar Electronics	2	-	-	2	2	50	-	50
24-8603-0107	Communication Cryptology	2	-	1	3	2	50	50	100
24-8603-0108	Communication Equipment (RF)	3	-	1	4	2	50	50	100
24-8603-0109	Communication Eqp. (SATCOM)	3	-	1	4	2	50	100	150
Total		**26**	**-**	**4**	**30**	**20**	**675**	**225**	**900**
Semester IV									
24-8603-0110	Information Warfare	3	-	2	5	3	75	25	100
24-8603-0111	Electronic Warfare (Principles)	3	-	-	3	2	50	-	50
24-8603-0112	Electronic Warfare (Systems)	3	-	3	6	3	50	50	100
24-8603-0113	Networking & Information Technology	3	-	3	6	4	25	75	100
24-8603-0114	Naval Network Framework	3	-	2	5	2	50	50	100
24-8603-0115	Small Arms and Safety	2	-	-	2	1	25	25	50
24-8603-0116	ORAL Board	-	-	3	3	3	-	200	200
24-8603-0117	Dissertation	-	-	-	-	4	100	-	100
Total		**17**	-	**13**	**30**	**22**	**375**	**425**	**800**
Grand Total		**43**	**-**	**17**	**60**	**42**	**1050**	**650**	**1700**

SYLLABI FOR MSc (Telecom)

VISION

Our vision is to be a leading institution that empowers Naval Communicators with the knowledge and skills necessary to excel in the ever-evolving landscape of communication and warfare.

Signal School is committed to transforming the trainees into Communication professionals, equipped with the knowledge and skills in Telecommunications, Fleet Tactics, Electronic & Information Warfare, and, Network Centric Operations, necessary to thrive as Combat Communicators in the maritime domain.

We will strive to create exceptional Naval Communicators who are not only highly skilled and knowledgeable in their field, but also possess the leadership, adaptability and resilience to tackle the most pressing challenges during wartime.

We envision a world where our trainees are at the forefront of innovation and progress, driving positive change and making a lasting impact in their units, the Navy and beyond.

We believe that the key to success in Naval Communications is not just technical mastery, but also the ability to think creatively, communicate effectively and work collaboratively.

MISSION

To develop professional excellence amongst officers and sailors in the core competencies of Signal Communication, Electronic Warfare and Information Warfare through sound educational and skill based, flexible training processes and innovative research capabilities, adapted to the changing technological environment, to operate optimally across the full spectrum of maritime operations.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PE 01: Seek continuous educational opportunities to advance technical and professional skills within telecommunication and electronic warfare domain, all the while maintaining the utmost standards of professional ethics.

PE 02: Ingrain adept technical competence in analysing, operating, and managing telecommunication systems, aiming to provide effective solutions to encountered challenges.

PE 03: Strive to become an authentic, professional leader, actively embracing assigned responsibilities, and maintaining an attitude conducive to effectively achieving objectives.

PE 04: Foster a successful career as a professional in telecommunications, electronic warfare, and related fields. Utilise both formal and informal learning opportunities to sustain and enhance technical excellence, contributing to continuous professional growth.

PROGRAMME OUTCOMES (PO)

PO1: Carry out the duties of a Signal Communication Officer (SCO)/ Electronic Warfare Officer (EWO)/ Charge Book Officer (CBO).

PO2: Perform the duties of Officer-in-Charge of the Communication Centre and Staff Officer Communication in Headquarters.

PO3: Provide advice to the Command on Tactics, Procedures and Fleet Doctrines including Electronic Warfare Principles.

PO4: Ensure effective and optimum utilisation of Communication, Satellite Communication (SATCOM) and Electronic Warfare (EW) equipment including basic trouble shooting.

PO5: Supervise the organisation of radio and tactical communication including Electronic Warfare (EW) onboard and ashore.

PO6: Provide inputs/advice to the Command on Radio Hazards and Electronic Interference/ countermeasures.

24-8603 - 0101 FLEET WORK (OPERATIONS)

Course Description. This course is aimed at imparting knowledge on advanced fleet manoeuvres and procedures, planning and conduct of fleet tactical operations/ exercise including surface, air and sub-surface.

24-8603 - 0101	Fleet Work (Operations)	Category	L	T	P	Credit
		-	3	-	1	3

Pre-requisites. Basic knowledge of fleet work including manoeuvring, procedures, definitions.

Course Objectives. To have knowledge on all fleet manoeuvres, procedures and ability to plan and conduct various tactical operations and exercise at sea.

Course Outcome. After completion of the course, the student will be able to

CO 1	Interpret manoeuvring signals correctly.
CO 2	Plan and conduct manoeuvring of ships during tactical exercises/ operations
CO 3	Advice Command in correct fleet procedures at sea including entering and leaving harbour.

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	3	1	2	1
CO 2	3	1	3	1	1	3
CO 3	3	1	3	1	1	3

Distribution of Marks

Total Marks	ESE	ESE Duration
100	100	2 hours

End Semester Examination Pattern.
There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank, choose the correct answer, true or false or match the following). Part B will contain subjective questions.

MODULE 1

ANSB (Allied Naval Signal Book)

Complete general instructions purpose and scope, Layout, Encoding/Decoding from ANSB, Arrangements of signals in chapter 4 to 8, Basic groups, Suffixes, sequence of data Governing pennant, Governing groups Supplementing signals, Tables and list, substitute, Unit of reference, fractions Times and dates, positions, Bearing and distance,

course and speeds and standard sectors, Recognition and meaning of signal flags pennants from chapter 2 and 3, Cable and speed flags (ANSB art 202 and 230) Night RAS (Replenishment at Sea) signals (Art 205).

Organisation and Manoeuvring Definitions.

Fleet Organisation Definitions, Aircraft organisation Definitions, Manoeuvring Definitions.

MODULE 2

Organisation and Command

Fleet Organisation, System Employed, Task Organisation, Changes in Task Organisation Assignment, Type Organisation, Ships Sequence numbers, Changes in Ships Sequence Numbers, Command of Joint Forces, Command and Mission Relationships during Support Operations, Command Relationships, Relationship between Missions, Support operations, Situation A, Situation B, Situation C, Command Functions.

Entering and Leaving Harbour

Content in classified domain

MODULE 3

Position, Course and Speed

Method of Expressing Positions, Bearing and Distance in Miles, Station Occupied, Cartesian, Coordinate Grid (CCG) Art 410- Standard Positions, Standard Positions, Reference Position, Reporting & Exchanging Data on Position, Speed, Course, Course and Speed Made Good, Speed while Manoeuvring, Position and Intended Movement (PIM).

Principle Rules for Manoeuvring

Unit of Distance, Distance between Ships, Manoeuvring and extended manoeuvring interval, Tactical Diameter, Standard and Reduced Tactical, Designation of Guide, Pivot, Automatic Change of Guide, Individual Action to Avoid Danger, Special Rules of the Road, Sea Manners and Customs, Adjusting Station to Assist visual signalling, executing manoeuvre at prearranged time, Manoeuvring under hazardous Conditions at Night or at low visibility, Preparative for Signalling Intentions Hoisting Station No by day, Stationing, Methods of Stationing, Types of Bearing, Assigning Specific Duty to Stationed Unit, Formation used by stationed Unit, Exchanging Station when in Formation, Changing Station in a Formation, Units closing or Re-joining, Units temporarily detached, Units Joining, Man Overboard, Standard Procedure, Peacetime Recovery Manoeuvres.

Formations and Dispositions for a Combatant Force

Single and Multiple Line Formations, Assuming Formations, forming in Consecutive Numeral Order of Sequence Numbers, Variation to Single and Multiple Line Formations.

(Basic formations), Forming in Quickest Sequence, Reversing Order of Ships in Column. (Form F), Altering Line of Bearing, Loose Line of Bearing, (Form C), Loose Line Abreast (Form Y), Column Open Order (Form E), Diamond Formation (Form D), Circular Formations, Circular Stationing, Station Occupied by More than one Ship.

MODULE 4

Altering Course

Turn Together, Turn of Specified Amount, Turn of Unspecified Amount, Emergency Signals, Wheel, Ordering Wheel, Restriction on Wheeling, Wheeling in Single Column, Wheeling in Single Line Abreast, Wheeling in Multiple Line Formations, Adjusting Speed of Pivot, Special Methods of Alterations of Courses, Signal Flags, Line or Units Wheeling Simultaneously, Unit maintaining True Bearing from Guide, Each Unit Maintaining Relative bearing, Altering Course and Formation Axis Simultaneously in Circular Formations, Altering Course by Conforming method, Altering Course by Search Turn, Evasive Steering (Indian Naval Charge Book 38).

MODULE 5

Replenishment at Sea

Organisation and command, Definitions, Underway replenishment force, Composition of a typical replenishment force, Command during replenishment, Replenishment planning, requirement during replenishment, Selecting the replenishment area, Information required, Replenishment programme, Distribution service, Replenishment of escorts, VERTREP(Vertical Replenishment), Specific advantages of VERTREP, Limitation of VERTREP, Factors controlling VERTRERP, Principles for replenishment, Replenishment formations, Guide, Replenishment Course, Replenishment Speed, Ordering the replenishment formation, Movements during replenishments, Preliminary movements, Subsequent movements, Consolidation, Replenishment of aircraft and aircrew, Manoeuvring during replenishment, station keeping by replenishment units, Alteration of course, Alteration of speed, Air patrols, Need for expediting the operations, Going alongside other ships, Clearing other ships and Man over board.

Multinational Exercises

MTP 1 (D) Vol II, Supplementing signals, governing pennants, governing groups, Call signs, Sequence numbers and unit indicators, Description signals, Plain text, operating signals, International code of signals, Tables and lists, Drafting of TABORDS.

References

1. ANSB (Allied Naval Signal Book)
2. INMI (Indian Naval Manoeuvring Instructions)
3. MXP (Multinational Exercise Publication) 2 C and MXP 1 D
4. Fleet Standing Orders (WEFSO/ EFSO)
5. Indian Naval Exercise Manual (INEXREM)

24-8603 - 0102 FLEET WORK (TACTICS)

Course Description. This course is aimed at imparting knowledge on fleet tactical procedures and concepts employed in Surface Warfare, Anti- Submarine Warfare and Anti-Air Warfare, carrier operations and emission policies.

24-8603 - 0102	Fleet Work (Tactics)	Category	L	T	P	Credit
		-	4	-	-	3

Pre-requisites. Knowledge of basic tactical publications and exposure to sea.

Course Objectives. To impart knowledge on advanced fleet operations in Surface Warfare, Anti- Submarine Warfare and Anti-Air Warfare.

Course Outcome. After completion of the course, the student will be able to

CO 1	Plan and conduct tactical exercises in three domains, surface, subsurface and air.
CO 2	Advice command on positioning of units for a particular exercise
CO 3	Plan and control Electronic Emission Policy

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	3	1	2	1
CO 2	3	1	3	1	1	3
CO 3	3	2	3	3	3	3

Distribution of Marks

Total Marks	ESE	ESE Duration
100	100	2 hours

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

Surveillance, Reconnaissance and Shadowing

Introduction, Definitions, Selecting a Scout, Selecting a sensor, Factors in Scouting, Factors relative to sensors, Operational factors, Sweep rate, Spreading on an Arc, Stationing the Scouting Line, Maintaining Station on Scouting Line, Barrier line, Search, Ordering a search, Rectangular search, Rectangular search with non-parallel tracks,

Sector search, Expanding square search, Intercepting search, Random search, Patrol, Ordering a patrol, Fixed station patrol, Linear patrol, Cross over patrol, Advancing/Retiring crossover patrol, Area Patrol, Shadowing, Means of Shadowing, Reconnaissance, Type of Reconnaissance, Rules of engagement and Guide for planning a scouting mission.

Reporting Enemy Contact

Content in classified domain

MODULE 2

General ASW (Anti-Submarine Warfare) Instructions

Introduction, Tactical definitions, Environment and technical definitions, Duties and responsibilities, OTC, ASW Commander, ASW sector commander, Screen commander, Search and attack unit commander, Scene of action commander, Submarine contact classification, Purpose of classification, Classification procedure, Standards of contact classification, Datum, Establishing Datum, Guidelines for determination of datum error, Sonar Mutual Interference, Reduction of Sonar Mutual Interference (ROSI), Terminology Used, Implementation, ROSI plans, Mine counter measures, Classification of swept channels, Action while passing mined waters, Actions on detecting a mine, Types of air ASW operations, ASW air close support, ASW air distant support, ASW air area operation, Tactical control of ASW aircraft, ASW air control ship, ASW helicopter control ship, ASW helicopter sub control ship, Control of ASW helicopter operations, Safety precautions, Operating limitations, Responsibility for ASW aircraft safety, Helicopter safety, Use of lights and Vertical and lateral separation.

General ASW Operations

Content in classified domain

Coordinated ASW Operations

Introduction, Actions on gaining contact by units, Action by units, Actions by units in vicinity, Movements of carrier and screens, Command and control, Reporting contact, Responsibility of OTC, Responsibility of screens commander, Responsibility of ASW A/C control ship, Responsibility of helicopter control ship, responsibilities of SAU and ASAU Cdr, Sending reinforcement to the scene of action, Responsibility, Air Reinforcement, Sending surface reinforcement, Reporting contact position to SAU & ASAU, Changing scene of action commander, Action at the scene of action, Responsibility of scene of action Cdr, Plans red and black and Vectored attacks.(VECTAC).

Screens for Combatant Formation

Introduction, Use of screen, Function of screen, Principles of ASW screening, Primary consideration, Line efficiency, Effect of random patrol by screening units, Positioning of screening units, Screening with VDS ships, Relative positioning of screening units, Command and control of screen, Screen commander, Principal responsibilities of screen Cdr, Additional responsibilities, Types and selection of ASW screen, Types of screen, Supplementary definitions, Selection of screens, Screen plans. (Remaining content in classified domain).

MODULE 3

Carrier and Carrier Aircraft Ops

Introduction, Task group and Task force command, Tactical command while operating A/C, Carrier formations, operating carriers in company, Carriers dispositions, Ship movements during flight operations, Carrier task group PIM, Carrier signals while operating aircraft, Duties in a carrier task group, manoeuvring carriers for flight Ops, Definitions and uses of various methods, Method A, Method B, Method C, Manoeuvring for emergency landing, Anti-submarine precautions during delay while operating aircraft, Low visibility recovery operations, Course and relative wind, Offensive operations of aircraft, Avoiding mutual interference, Aircraft command, Employment of Aircraft, Air Defence Options, Types of Strikes, Aircraft Launch/ Departure, Procedure for Returning Aircraft, Night Aircraft operations, , Aircraft Emergency and Rescue, Pilot's Choices of Action, General Provisions, Procedure for Handling Aircraft in Distress, Conditions of emergency, Special provisions unusual circumstances, Communication during A/C emergencies, Pilot's Procedure During Emergency Landing, Rescue from Force Landing.

Defence Against Airborne Threat

Introductions, Airborne threat, Scope, Definitions, Meaning of force, Responsibilities of OTC, Force anti air warfare coordinator, Sector anti air warfare coordinator, Concept of layer defence, AAW surveillance, Means of surveillance, Surface born surveillance, Air borne surveillance, Watch and engagement zone, Air raid reporting control ship, Guard ships, Pickets, Surface pickets, Insufficient picket ships, Watchdog and Tomcat, Picket aircraft, Picket sectors, Air raid warning signals, Defence with aircraft, Safety of own aircraft, Procedures for friendly A/C joining force, Combat air patrol, Defence with hard kill weapons, Classification of missiles, AA weapons restriction signals, AA gunfire formations, Anti air gunfire coordination and control, Missile coordination and control, Fire distribution and doctrine, Special assignments and considerations for AA warfare, Formations and dispositions.

Readiness for Action

Principles and Degrees of Readiness, Definitions, Responsibilities, General degrees of Readiness, Particular degrees of readiness, Anti air warfare degrees of readiness, Anti-ship degrees of readiness, Anti-submarine degrees of readiness, Damage Control states and conditions of watertight integrity, DC states, Conditions of watertight integrity, Notice for Propulsion Machinery, Aircraft conditions of readiness, Fixed wing aircraft, Helicopter, Aircraft alert sates and Reporting inoperable equipment.

Surface Action

General, Introduction, Responsibilities of OTC, Information about the enemy, Organisation for surface action, Surface action group, Duties of SAG commander, Command and control of a SAG, Detaching the surface action group, Forming SAG from dispersed units, ASM warfare, Target location, Target identification, Phase of missile action, recommended methods of attack, Over the horizon targeting.

MODULE 4

Measures to Prevent Mutual Interference

Establishment of measures, Authority, responsibility, Type of measures, Compromise, Recognition and identification, Initiation and identification, Restricted areas, Safety zones, Joint zones, Air surface zones, Anti-Air warfare restricted areas, Air ways, Air corridors, shore bombardment lines, Bomb lines, Submarine and surface restricted areas, Submarine patrol zones, Safety lanes, Submarine safety lanes/zones, Surface ship safety lanes, Havens, Submarine moving haven, Fixed haven, Special haven, Signal format, Aircraft operating over SM patrol areas, S/M entering own bases during war, Disabled submarine procedure, Responsibility to assist disabled S/M

Electronic Emission Control (EMCON)

Policy, Criteria for selection, EMCON consideration, Emission control planning and signalling, Signalling EMCON, radiation status indicators, Adherence to EMCON, Electronic Emission control policies, Instructions to marine aircraft and Construction of EMCON plan.

References

1. INMI (Indian Naval Manoeuvring Instructions)

2. Other classified publications

24-8603-0103 COMMUNICATION ORGANISATION

Course Description. This course covers Communication Organisation (RF and satellite) in the Navy and Maritime domain.

24-8603-0103	Communication Organisation	Category	L	T	P	Credit
		-	4	-	-	2

Pre-requisites. Understanding of basic communication facilities and procedures in force (wired and wireless).

Course Objectives. To give complete understanding of communication organization so as to enable the student to ensure seamless and robust maritime communication setup upon assuming the duties of Signal Communication officer onboard Naval platforms.

Course Outcome. After completion of the course, the student will be able to

CO 1	Advise CO on functioning of communication organization and nuances of operational control/ tactical aspects
CO 2	Handle, supervise, control and optimally exploit various radio and satellite equipment
CO 3	Supervise submarine communication and related safety aspects
CO 4	Monitor and execute salient aspects of Air communication
CO 5	Optimal usage of Naval Broadcasts and its maintenance
CO 6	Implementation of communication organisation for merchant ships in times of war and Naval control of shipping.
CO 7	Establish reliable communication during multinational exercises

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	3	3	3	2	3	1
CO 2	3	2	3	3	3	1
CO 3	3	3	3	3	3	1
CO 4	3	2	3	3	3	1
CO 5	3	3	3	2	2	1
CO 6	3	2	3	3	2	1
CO 7	3	3	2	3	3	1

Distribution of Marks

Total Marks	**ESE**	**ESE Duration**
100	100	2 hours

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

International Telecommunication Union (ITU)

Brief introduction of ITU, frequency assignment, monitoring radio circuits, unauthorised radio transmission, reporting harmful wireless interference.

Broadcast

Types, advantages reliability of reception, shifting, general conduct of broadcast, Conduct of Very Low Frequency (VLF), Mobile Satellite System (MSS) (SV,SB) and digital broadcast. Area coverage, authority copying, special routines, failure and report on Printability.

MODULE 2

Submarine Communication

Content in classified domain

MODULE 3

Ship-Shore Organisation

Ship-shore organisation existing in the Navy today including various satellite based circuits available for passing signals ashore Harbour B/C, authorisation of telephone for ships, Harbour Intercommunication Circuit (HIC), Maritime Mobile Band (MMB) facility, restriction on HIC at Okha and Porbandar

Ship Distress Messages

Action on receipt by ship, aircraft and COMCEN, Search and Rescue Organisation (SAR) organization and its aim.

MODULE 4

Passage Communication

Sailing authorities, sailing order signals, alteration of Estimated Time of Departure (ETD)/ Estimated Time of Arrival (ETA) and Logistic requirement (LOGREQ).

Global Maritime Distress Safety System (GMDSS)

Concept, fundamental, implementation and working procedure of all GMDSS compliance equipment.

MODULE 5

Aircraft Communication

Briefing of air crews, carriage of publications by A/C and loss, communication instructions for A/C taking part in exercises, Ship NAS, primary circuit for strike forces, air move messages, Rainbow forms, callsign used, weather reports to NAS/Aircraft.

MODULE 6

Tactical Communication

Drafting of Communication Plan (COMPLAN) for task force proceeding for specific mission.

Weather Messages

Met Communication requirements, purpose, and weather reports from naval ships, and weather message to ships during wartime, codes & cipher to be used during war. Operations and functions of FBB 500, INMARSAT PCs and ISAT Phone.

Naval Control of Shipping

Escort forces, Instructions to merchant shipping during war/ emergencies.

References

1. NO'S' (Navy Order Signal Series) 1/17 and 7/15
2. NO'S' 4/16
3. NO (Navy Order) 14/03
4. NO 09/21
5. ALRS (Allied List of Radio Signal) Vol. 5
6. Radio Organisation Docket – Signal School
7. GMDSS Docket – Signal School
8. DIN (Detaining Officer War Instruction) 5 of Indian Navy

24-8603-0104 - COMMUNICATION OPERATIONS

Course Description. To understand the correct Communication Operations procedure, transmission and reception of Signals using various methods including visual signalling procedures and interpretation of communication books, handling of these messages and the concept and operating procedures of GMDSS and associated equipment.

24-8603-0104	Communication Operations	Category	L	T	P	Credit
		-	3	-	-	2

Pre-requisites. Knowledge of basic signal drafting, semaphore and flashing using Morse code, basics of message handling and familiarisation with GMDSS equipment.

Course Objectives. To give complete understanding of communication operations so as to enable the student to ensure seamless and robust signal organisation setup upon assuming the duties of Signal Communication officer onboard Naval platforms.

Course Outcome. After completion of the course, the student will be able to

CO 1	Draft signals as per authorised format and bring out discrepancies if any
CO 2	Transmit and Receive Signals using correct visual signalling procedure
CO 3	Advise Command on Naval ceremonials
CO 4	Understand GMDSS concept and it's functioning, actions in distress situation including operation of equipment

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	3	3	1	1	3	1
CO 2	3	1	1	1	2	1
CO 3	3	2	1	1	1	1
CO 4	3	3	1	2	1	3

Distribution of Marks

Total Marks	**ESE**	**ESE Duration**
150	150	03 Hrs

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

Rules/ Guidelines for Signal Drafting

Purpose of military communication, means of communication on method of dispatch, Restriction on visual signalling, Originator, Drafter, Releasing officer, Action officer, NOTAL(Not Addressed to All) & PASEP(Being Passed Separately), Acknowledgement, Code word, Nick name, Base gram, Intra and Joint, Combined, NOFIX procedure, Minimise, Clear, Reticence, Approved circuit, Types of messages, Message address, Rear link procedure, Use of commercial, Channel, Initiating and drafting, Replies to general Msgs, Brevity, Intend and propose, Reference to previous message, Drafting of naval Msgs, Abbreviations for use in *IN* signals.

Types of Messages and Filing

Types of General Msgs, rationalisation e-General messages, Message files, Routing responsibility, Organisation & function of a category A COMNETCEN, Command and Control of COMNETCEN, Communication orders Books for Annual inspection, Training and promotion Signal works grant, Logs to be maintained, Disposal of logs, Traffic data record, Communication data book, Return of equipment, Merchant ship traffic return, Originators special instructions, Punctuations, Observations, Isolated letters, Names, Numbers, Use of `DF' and `BUT' etc. DTG in the text, Identification of exercise messages, Authorised abbreviations, Standard format Paragraph numbering, drafting of signals, Precedence designation, Degree of precedence Signification of precedence, Dual precedence, Clearance timings, Need for security classification, Security classification their use and examples.

MODULE 2

Visual Signalling Procedure including Flashlight, Semaphore, Flag hoist

Purpose, Visual Operators, Use, Semaphore Characters, Plain dress Message, Abbreviated Plain Dress Message, Codress Message, Service Message, Abbreviated Service Message, Classification of Service, Abbreviated Message, use of Visual Callsign, restrictions on the use of Visual callsigns, Transmission of Visual Callsigns, Single letter type indicators, International Callsigns (signal letter), Squadron/Division Callsigns, Commercial signal station Callsigns, List of Prosigns.

MODULE 3

Signal Interpretation

Q' Code, Questions, Call Signs, Frequencies Art 11 – Numbered Alternates, Blank Spaces, Units of measurement, Plain languages, Security, Zone Time. Pre Workup Shakeup Routine (PWSR), Preparation for Operational Level Safety Audit Team (OLSAT), FOST Level Safety Audit Team (FOLSAT), Intermediate Sea Training (IST), Operational Sea Training (OST). Indian Naval Book of Reference (INBR) 1525 (Basic manoeuvering & signalling instructions) - Lay out and scope, Fleet reaction exercise, (BR 88), NO'S' 6/03. Communication exercise, Survey and Demand Procedure of communication equipment, BR 222 (Naval Communication management and Equipment

manual) Care and Disposal of VS stores, construction of dressing lines, ACP 168 (Pyrotechnic signals) Purpose, Limitations and usage, BR 69 (INTERCO), Explanations and general remarks, Definition, points of compass, distress signals, language, single letter signals, coding & decoding.

Ceremonials

General Instruction on usage of commonly used operating signals, Naval Communication exercise instruction, Purpose and scope of International Code (INTERCO), Construction of Dressing Line, Naval Control of Shipping Organisation, naval Ceremonials

MODULE 4

Global Maritime Distress Safety System (GMDSS)

Limitations on conventional distress communication, Concept, Growth, Development, Equipment and implementation Practical's on GMDSS equipment and operations, Action on receipt of distress message, rules on warship making.

SAR Organisation

Area of responsibility, MRCCs, forces available, Command and Control on scene communication, Ship reporting systems

References

1. NO'S' (Navy Order Signal Series) 1, 3, 7 and 8
2. BR (Books of Reference) 69 and 222
3. NO (Navy Order) (SPL) 01/21
4. JSCP (Joint Signal Communication Publication) 4
5. Regs Navy Part III
6. NO 'Spl' 03/03 BR 67
7. INCP (Indian Naval Communication Publication) 6
8. ALRS (Allied List of Radio Signal) Vol.
9. GMDSS Docket – Signal School

24-8603-0105 – COMMUNICATION ELECTRONICS

Course Description. To impart training on basics of Electronics and Communication Technology.

24-8603-0105	Communication Electronics	Category	L	T	P	Credit
		-	2	-	-	2

Pre-requisites. Basics of communication like EM Wave, Frequency, amplitude, phase, signal and side bands.

Course Objectives. To impart understanding of basic electronics of Analog and Digital modulation; mobile, Optical Fibre Cable (OFC) and satellite communication.

Course Outcome. After completion of the course, the student will be able to

CO 1	Comprehend satellite and mobile communication architecture
CO 2	Understand and correlate the modulations being used in communication equipment
CO 3	Understand digital and analog communication

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	1	1	3	2	1
CO 2	2	1	1	3	1	1
CO 3	3	3	1	2	2	1

Distribution of Marks

Total Marks	ESE	ESE Duration
50	50	1 hour

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

Pulse Modulation

Types of pulse modulation (PAM,PWM and PPM),Sampling Theorem, Hartley and Shannon Hartley Law, Pulse code modulation (PCM) - principle, advantages, limitation and application.

MODULE 2

Digital to Digital Conversion Methods

Line Coding Schemes- Unipolar, Polar and Bipolar.

MODULE 3

Conversion of Digital Data to Analog Signal

ASK, FSK, PSK MSK and Quadrature Amplitude Modulation (QAM), Constellation diagram.

MODULE 4

Error Detection and Correction Codes

Simple Parity Check, checksum, CRC, Hamming Distance and Hamming Codes (Forward Error Correction)

MODULE 5

Optical Fiber Cable (OFC)

Principle, composition, advantages over conventional copper cable and limitations. OF Communication system, Optical source-LED and Laser, Optical detector, Numerical aperture, Military application of OFC, single mode and multimode cable, Step index and graded index, fusion and mechanical splicing, connectors for OFC

MODULE 6

Multiplexing

Need, Analog and digital multiplexing, Analog multiplexing-FDM and WDM. (Advantages, limitation and application), Digital Multiplexing- TDM (Advantages, limitation, application)

MODULE 7

Multiple Access

Random Access Protocols (ALOHA, CSMA/CD and CSMA/CA), Controlled Access Protocols (Reservation, Polling, Token Passing) , Channelization Protocols (FDMA, TDMA and SDMA),CDMA/ Spread Spectrum Multiple Access - FHSS, DSSS

MODULE 8

Cellular Communication

Hexagonal cell geometry, frequency reuse, hands off procedure, Evolution of mobile communication 1G to 5G, GSM architecture and functions of all subsystems in GSM network, authentication process, types of GSM

MODULE 9

Satellite Orbits

LEO, MEO, GEO, Components of Satcom- Earth and Space Segment, Error correction technique used in Satellite, Frequency allocation in Satellite, Application- GPS, VSAT (shared and mini hub network)

References.

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2013.

2. Anil K. Maini, Versha Agrawal, Satellite Communications, First Edition, Wiley India, 2010.

3. Jochen Schiller, Mobile Communications, Second Edition, Pearson Education India, 2008.

4. Dennis Roddy, Satellite Communications, Fourth Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2017.

5. Tri T. Ha, Theory and Design of Digital Communication Systems, First Edition, Cambridge University Press, 2010.

6. Afif Osseiran Jose F Monserrat, 5G mobile and Wireless Communications Technology, First Edition, Cambridge University Press, 2016.

7. John M Senior, Optical Fibre Communication, Third Edition, Pearson Education, India, 2009.

8. Simon Haykin, Communication Systems, Fourth Edition, Wiley Publisher, 2001.

9. Simon Haykin & Michael Moher, Introduction to Analog and Digital Communication, Second Edition, Wiley Publication, 2007.

10. John, Kraus, Ronald and Marhefka, Antennas Wave Propagation, First Edition, McGraw Hill Education, 2001.

24-8603-0106 - RADAR ELECTRONICS

Course Description. Covers the working principle and types of radar used for naval operations.

24-8603-0106	Radar Electronics	Category	L	T	P	Credit
		-	2	-	-	2

Pre-requisites. Basic knowledge on Electromagnetic waves and its propagation in space, Basic knowledge on Power electronics and semiconductors.

Course Objectives. To understand the working principle of Radar, various types of radar and techniques used in it and latest trends in radar.

Course Outcome. After completion of the course, the student will be able to

CO 1	To understand the principle behind functioning of radar and importance of radar fitted on Naval platforms.
CO 2	Appreciate various parameters in radar in correlation with Electronic Warfare and understand the principles of EW tecniques. help them identify types of radars fitted onboard adversary ships.
CO 3	Ability to identify types of radars fitted onboard adversary ships and correct usage of ECM techniques.
CO 4	To acquire knowledge on electronic beam steering and active phased array radar.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	1	1	1	3	3	2
CO 2	1	1	1	3	3	2
CO 3	1	2	1	2	3	2
CO 4	1	1	1	3	2	2

Distribution of Marks

Total Marks	**ESE**	**ESE Duration**
50	50	2 hours

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

Basics of Radar

The basic function of radar, group and classification of radar, radar operating frequency, the origin of radar, Block diagram of pulse radar and functions of each unit in the radar, Range equation, Factors affecting radar range, Radar parameters, Unambiguous range, Minimum detectable signal, radar display, application of radar, Early warning radar and fire control radar.

MODULE 2

Working Principle of Radar

Block diagram of pulse radar and function of each unit in the radar, basic radar, range equation, radar parameters, unambiguous range and factors affecting range interdependence of radar parameters, case study of navigational radar, early warning radar and fire control radar.

MODULE 3

Types of Radar

Doppler effect, principle of operation and characteristics of various types of radar. Difference between tracking and surveillance radar, Tracking radar – Range tracking technique, sequential lobbing-conical scan, Monopulse tracking-amplitude comparison, phase comparisons, early and late gates, Radar antenna directive gain and polarization used, Propagation of radar waves, types of radar antenna, Beam steering Principles.

MODULE 4

Modern Trends in Radar

Over The Horizon (OTH) radar, Low Probability of Intercept (LPI) radar, Multifunctional surveillance and threat alert radar (MFSTAR) and MRSAM WCS, Phased array radar, Active Electronically Scanned Array(AESA) and Passive Electronically Scanned Array(PESA), Multiple-input, Multiple-Output (MIMO) radar, V beam radar.

References.

1. Radar System Peak Detection and tracking MA Kolawole Elsevier Pvt Ltd 2012
2. Merrill I Skolnik, Introduction to Radar Systems, Third Edition, McGraw Hill Education (India) Pvt Ltd, Chennai, 2008.
3. Mark A Richards, Fundamentals of Radar Processing, Second Edition, McGraw Hill Education (India) Pvt Ltd, Chennai, 2014.
4. George W. Stimson, Introduction to Airborne Radar, First Edition, SciTech Publishers, New Jersey, USA, 2014.
5. Edward Reedy and Jerry Eaves, Principles of Modern Radar, First Edition, Springer, US, 2012.
6. Y.T. Lo and S W Lee, Antenna Handbook, First Edition, Springer, US, 2013
7. EWR Docket – Signal School.

24-8603-0107 - COMMUNICATION CRYPTOLOGY

Course Description. To impart basic knowledge on crypto systems.

24-8603-0107	Communication Cryptology	Category	L	T	P	Credit
		-	2	-	1	2

Pre-requisites. Basic knowledge on crypto publications.

Course Objectives. To understand the working principle of various cryptology systems.

Course Outcome. After completion of the course, the student will be able to

CO 1	To understand the basic principle of cryptology
CO 2	Code/ decode text messages using digital software and publications
CO 3	Advise CO on the use of crypto systems

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	1	1	3	3	3
CO 2	1	1	1	3	3	3
CO 3	1	2	1	3	3	3

Distribution of Marks

Total Marks	ESE	ESE Duration
100	100	2 hour

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

CONTENT OF THIS COURSE ARE IN CLASSIFIED DOMAIN

24-8603-0108 – COMMUNICATION EQUIPMENT (RF)

Course Description. Exploit and maintain various fixed and portable radio equipment (V/UHF, VLF, HF).

24-8603-0108	Communication Equipment - RF	Category	L	T	P	Credit
		-	3	-	1	2

Pre-requisites. Sound knowledge on Communication fits onboard all platforms (Ship/ Submarine/ Aircraft) and communication requirement for maritime operations.

Course Objectives. To achieve proficiency in exploiting and basic maintenance various radio frequency equipment.

Course Outcome. After completion of the course, the student will be able to

CO 1	Optimally exploit and basic maintenance of various radio fixed and portable equipment (V/UHF, VLF, HF) including data terminals like INCIS
CO 2	Optimally exploit and basic maintenance of various V/UHF, HF and portable equipment including EMI/ EMC
CO 3	To ensure general safety with regards to communication equipment, polar diagrams, aerial maintenance and Radio hazards
CO 4	Understanding of various types of aerials and maintenance

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	3	3	3	1
CO 2	3	2	3	2	3	1
CO 3	3	3	2	2	2	1
CO 4	3	2	2	2	2	1

Distribution of Marks

Total Marks	ESE	ESE Duration
100	100	3 hours

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

General instructions and safety precautions during handling various electrical equipment, first aid due to electrical shock, RADHAZ and maintenance of RADHAZ boards.

MODULE 2

Maintenance of various aerials, EMI/ EMC, polar diagrams for various antennae.

MODULE 3

General capabilities and operation of RF equipment operating in V/UHF ranges.

MODULE 4

General capabilities and operation of RF equipment operating in HF ranges.

MODULE 5

General capabilities and operation of Software Defined Radios.

MODULE 6

General capabilities and operation of Digital Communication Terminals, Remote Communication terminals used in Indian Navy.

References.

1. BR (Books of Reference) 2924

2. BR (Books of Reference) 222

3. Radio Technical Docket – Signal School

4. Equipment Manuals

24-8603-0109 – COMMUNICATION EQUIPMENT (SATCOM)

Course Description. Exploit and basic maintenance of various satellite communication equipment in the Indian Navy

24-8603-0109	Communication Equipment (SATCOM)	Category	L	T	P	Credit
		-	3	-	1	2

Pre-requisites. Basic knowledge on the aspect of satellite communication facilities in the Navy and principle of satellite operations.

Course Objectives. To achieve proficiency in exploiting and basic maintenance of satellite communication equipment available in the Navy for maritime operations.

Course Outcome. After completion of the course, the student will be able to

CO 1	Optimally exploit and basic maintenance of satellite communication equipment in the Navy
CO 2	Optimal allocation and exploitation of the facilities in accordance with the requirement
CO 3	Optimal exploitation and interface of satellite equipment for operational LAN
CO 4	Setup/ configure and exploit Network Centric Operations (NCO) circuits.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	3	3	3	3	3	1
CO 2	3	2	3	2	3	1
CO 3	3	3	2	2	2	1
CO 4	3	2	2	2	2	1

Distribution of Marks

Total Marks	**ESE**	**ESE Duration**
150	150	4 hours

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

Basic concepts and operation of satellites and networks. Different orbits of Satellites, uplink, downlink frequencies, hub structure in Indian Navy.

MODULE 2

Digital Network Terminal

Operations and maintenance, including interface of various RF and SATCOM equipment in Navy's Network Terminal

MODULE 3

Rukmani & UHF Satcom

Operations and maintenance of Indian Navy's indigenous SATCOM terminals.

MODULE 4

Mobile Satellite System (MSS/ MSS MKII)

Operations and maintenance of commercial SATCOM terminal fitted onboard naval ships.

MODULE 5

Network Centric Operations (NCO)

Indian Maritime Situational Awareness System organisation, Network Centric Operations, Trigun, Setting up of Operational LAN, Interfacing of OPLAN with associated peripheral radio/ satellite equipment

References.

1. BR (Books of Reference) 2924

2. BR (Books of Reference) 222

3. Radio Technical Docket – Signal School

4. Equipment Manuals

24-8603-0110 – INFORMATION WARFARE

Course Description. To provide knowledge on Information Warfare for performing duties of IW Officer onboard ships/ ashore units.

24-8603-0110	Information Warfare	Category	L	T	P	Credit
		-	3	-	2	3

Prerequisite. Basic knowledge of Information Technology.

Course Objectives. To impart knowledge on information security and Information Security (INFOSEC) policies existing in Indian Navy.

Course Outcome. After completion of the course, the student will be able to

CO 1	Carry out duties of Network Security Officer
CO 2	Implement INFOSEC policies and audit IT systems for compliance
CO 3	Implement defensive IW Policies

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	3	2	1	3	3	1
CO 2	3	3	1	3	3	1
CO 3	3	3	3	3	3	1

Distribution of Marks

Total Marks	**ESE**	**ESE Duration**
100	100	1 ½ hours

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

Introduction

Concept of information in warfare, cognitive hierarchy, OODA (Observe Orient Decide Decide) loop, information activities. Elements of IW.

Elements of Offensive IW

Operational Security (OPSEC), PSYOPS, EW, physical destruction and computer network attack, privacy and policy, perception management, insider attacks.

Malicious Software

Trojans, viruses and worms.

MODULE 2

Cyber Security Environment

Introduction to INFOSEC policies, implementation and consequences of violating policies, Computer Security Audit (CSAT), Internal and external audit. Security features followed in the Indian Navy. S-Drive, SENIC guard, NAVIOS, SECLORE (RMS).

Linux

Overview of Linux OS, Shell, Directory and file handling in Linux, Soft and hard links, Over the wire practical and tasks, Cryptography (Symmetrical and asymmetrical Keys), system policies and security options, removal of redundant components. Windows & Linux Patch Management Tools, MS Security Rating, Windows Server Update Services (WSUS) installation and configuration, System Center Configuration Manager (SCCM), YUM & APT.

MODULE 3

Web Browsers

Securing web browsers, vulnerabilities and settings for MS Internet Explorer, Google chrome and Mozilla Firefox, Network commands, Wireshark, Nmap, Nessus. Introduction to Intrusion Detection System (IDS)/ Intrusion Prevention System (IPS)/ UTM, Web security model, session management, user authentication, Hacking methodology, prevention, smurf attacks, syn attacks, buffer overflow and countermeasures. Client side attack techniques and countermeasures

References.

1. Daniel Ventre, Information Warfare, Second Edition, Wiley Publications, 2016.

2. Mayank Bhushan, Raj Kumar Singh Rathore and Aatif Jamshed, Fundamentals of Cyber Security: Principles, Theory and Practices, First Edition, BPB Publications, 2017.

3. Nina Godbole and Sunit Belapure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, First Edition, Wiley India Pvt Ltd, 2011.

4. Information Warfare Docket – Signal School.

24-8603-0111 - ELECTRONIC WARFARE PRINCIPLES

Course Description. Fundamentals of Electronic Warfare principles covering understanding of concepts related to EW such as Electronic support, Electronic attack, Electronic protection and EW Organisation. A brief introduction to latest trends and technologies in the field of EW.

24-8603-0111	Electronic Warfare Principles	Category	L	T	P	Credit
		-	3	-	-	2

Prerequisite. Basic knowledge of EM wave propagation, EM spectrum, various applications involving selection of various EM waves and band designation of the EM spectrum.

Course Objectives. To teach basic principles of Electronic Warfare that would aid in utilizing the EM spectrum to one's own advantage while operating on various EW systems available.

Course Outcome. After completion of the course, the student will be able to

CO 1	Understand basics of Electronic Warfare to carry out EWO duties
CO 2	**Control** the entire spectrum of EW operations of the fleet
CO 3	**Formulate** and **Implement** the Electronic Emission Policy (EEP) of the entire Fleet.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	3		3	1	2	
CO 2	3		3	1	2	
CO 3	3		3	1	2	

Distribution of Marks

Total Marks	**ESE**	**ESE Duration**
50	50	02 hours

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

Basics of EW

Objectives of EW, EW Tree. Division of tree with emphasis on Electronic Support (ES), Electronic Attack (EA) and Electronic Protection (EP) with further divisions in each

category, Introduction on Directed Energy Weapon (DEW) and Anti-Radiation Missile (ARM).

DB Value and Equation

Decibel notation, Conversion to and from dB form, Common dB definitions/ uses, One way link equation, propagation losses, Effective range Antenna Beam pattern, Polarisation and its implication w.r.t antenna design.

MODULE 2

Objectives of ES (Electronic Support) and Search Receivers

Objectives and importance of ES, Search Tasks, Range advantage of Electronic Support Measures (ESM) Rx against Radar, Range Advantage Factor (RAF), RHR limitation, Basics of ESM search receivers, Frequency converters and concept of radar Warning Receiver (RWR). Probability of Intercept (POI) considerations for high POI receivers, factors affecting intercept receiver design, functional block diagram, basic understanding of various types of intercept receivers – crystal Video Receivers (CVR), Instantaneous Frequency Measurement (IFM), Digital Instantaneous Frequency Measurement (DIFM), Super heterodyne, Homodyne, Microscan, Channelised, digital and Hybrid Receivers), Sensitivity of receivers.

Non Communication Intercepts

Radar parameter and their analysis, Identity of radar based on parameters, function and purpose of radar.

Signal Processing

Basics of intercept parameters. Radio Frequency (RF) threat identification. Inter Pulse and Intra Pulse modulations, De interleaving (concept and tools), histograms.

MODULE 3

Direction Finding (DF) Techniques

Basic Concept of Direction Finding (DF), Emitter Location Geometry, Emitter Location Accuracy, RMS Error, Introduction to Amplitude Comparison and Phase Comparison techniques. Amplitude based emitter location, Single directional antenna, Watson Watt technique, Multiple Directional Antennae, Phase Comparison techniques, Interferometric Triangle, Correlative interferometry concept, calculation of Base Line Interferometry (BLI), Single and Multiple baseline interferometers. Mirror Image, Long base line ambiguities, DF using Doppler Principle. DF using Time Difference of Arrival (TDOA), Frequency Difference of Arrival (FDOA) and combined FDOA and TDOA.

Radar Finger Printing System

Intra pulse and Inter pulse analysis.

MODULE 4

Electronic Attack (EA)

Object and effect of jamming. Broad classification under EA tree. Basics of denial and deception, Advantages and Disadvantages. Generic terms related to jamming (Self screening, support, escort standoff and stand forward jamming). Classification of Jamming - Communication and Radar, Jamming to Signal ratio, Received signal power, Received Jamming power, Jamming to signal ratio, Burn Through Range (BTR), BTR for standoff and self protection jamming, Look through, Techniques of look through, Selection of target for Jamming, Disruptive Jammers-Spot barrage and sweep through, Concept of Expendable jammers

Deception Techniques

Jamming concepts against Range, velocity and angle tracking radars, Range Gate Pull Off (RGPO), EP for RGPO, Range Gate Pull In (RGPI), Velocity Gate Pull Off (VGPO) technique, Angle tracking radars, Inverse gain jamming (IGJ) against Track While Scan (TWS), IGJ against SORO, AGC Jamming, Deceptive technique against Monopulse, Range resolution cell, Formation Jamming, Terrain Bounce, Cross Polarisation and Cross eye Jamming, Data-link Jamming, Communication Deception - Manipulation, Simulation and Impersonation.

Chaff

Chaff – Characteristics, Advantages, Disadvantages, Materials used, Bloom Time, Chaff effect on Bloom time, method of launching Chaff, Radar Cross Section (RCS) of Chaff and factors affecting chaff, Bird-nesting & Shielding. Tactical deployment of Chaff, radar Camouflage, Stealth technology, Types of RAM. Concept of Active offboard decoys viz Nulka and Siren.

Factors Affecting Digital Communication

Ionosphere reflection, Background noise, Digitization, digital signal format, Signal to Noise ratio, Bit error rate and RF SNR, Bandwidth required for digital signals, spread spectrum signals, frequency hopping, chirp signals, direct sequence spread spectrum, Jamming frequency hop, chirp and DSSS signals. Follower jamming, Partial band jamming, Jamming DSSS signals.

MODULE 5

Electronic Protection (EP)

Definition, EP tree, Electronic Emission Policy (EEP) criteria for selection, Radar Status Indicator (RSI), Policy before/ after contact, Emission Control (EMCON) plan.

Electronic Emission Security (EES)

Definition - EES Measures, anti-jamming measures, anti-deception measures.

Anti-Jamming and Anti Deception Methods

Anti-jamming measures - operative, tactical and technical, against communication and radar jamming - frequency agility and diversity, Pulse Repetition Frequency (PRF) jitter and staggered PRF, IAGC-side lobe sensing, blanking and cancelling. Anti-deception measures- means of identifying chaff.

References.

1. David Adamy, EW 101 - A First Course in Electronic Warfare, First Edition, Artech House Publishers, 2001.

2. David Adamy, EW 102 - A Second Course in Electronic Warfare, First Edition, Artech House Publishers, 2004.

3. David Adamy, EW 103 – Tactical Battlefield Communications Electronic Warfare, First Edition, Artech House Publishers, 2008.

4. David Adamy, EW 104 – EW Against a New Generation of Threats, First Edition, Artech House Publishers, 2015.

5. David Adamy, EW 105 – Space Electronic Warfare, First Edition, Artech House Publishers, 2021.

6. Richard A Poisel, Electronic Warfare – Receivers and Receiving Systems, First Edition, Artech House Publishers, 2004.

7. VAdm Sangram Singh Byce, Dr Rajani Kant Tiwari, Maritime Electronic Warfare – Soft Kill Measures, First Edition, Anamaya Publishers, New Delhi, 2008.

8. Wing Cdr Sanjay Poduval, Electronic Warfare – War in the Fourth Dimension, First Edition, KW Publishers Pvt Ltd, New Delhi, 2009.

9. Electronic Warfare Docket – Signal School

10. Equipment Manuals

24-8603-0112 - ELECTRONIC WARFARE SYSTEMS

Course Description. Introduction to various EW equipment fitted onboard all Naval platforms with focus on system characteristics, operating instructions and tactical exploitation during various scenarios at sea.

		Category	L	T	P	Credit
24-8603-0112	Electronic Warfare SYSTEM	-	3	-	3	3

Prerequisite. Understanding and knowledge of Electronic Warfare Principles for utilizing EM spectrum for own advantage.

Course Objectives. To teach basic operating mechanism of Electronic Warfare equipment fitted in Indian Navy.

Course Outcome. After completion of the course, the student will be able to

CO 1	**Operate** and **exploit** all EW equipment fitted onboard to its fullest operational capability
CO 2	**Intercept** and **Analyse** all the intentional/ unintentional electromagnetic transmissions
CO 3	**Conduct** EW exercises planned at sea

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3		2	3	3	
CO 2	3		2	3	3	
CO 3	3		2	3	3	

Distribution of Marks

Total Marks	ESE	ESE Duration
100	100	02 hrs

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

CONTENT OF THIS COURSE ARE IN CLASSIFIED DOMAIN

NETWORKING AND INFORMATION TECHNOLOGY

Course Description. This course provides the student understanding on computer hardware and networking.

24-8603-0113	Networking & Information Technology	Category	L	T	P	Credit
		-	3	-	3	4

Pre-requisites. Basic knowledge of computers.

Course Objectives. To impart knowledge on computer hardware, networking and networking equipment.

Course Outcome. After completion of the course, the student will be able to

CO 1	DI/DR of network devices, server and management of network.
CO 2	Network configuration on devices, implement security parameters.
CO 3	Implementation of existing IT policies on devices, servers and their audit.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	2	1	1	3	1	1
CO 2	3	3	1	2	1	1
CO 3	2	3	2	2	1	1

Distribution of Marks

Total Marks	**ESE**	**ESE Duration**
100	100	3 hours

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

Introduction to the computer and define the basic functions to know how the computer works. Define Memory and types of memory. Introduction to PC based networks. Types of Networks based on Architecture (Client/Server, Peer-to-Peer) and based on Area (LAN, CAN, MAN, WAN), Bus, Star, Ring, Mixed LAN topologies. Comparative advantages, Layered approach of data in Networks, Open Systems Interconnection (OSI) Layer and TCP/IP layer.

MODULE 2

Network Devices

National Informatics Centre (NIC), Hubs, Bridges, Switches, Routers, Firewalls, Media Converters and gateways. Difference between IP address and Machine Access Control (MAC) address.

IP Addressing

IPv4 and IPv6, A detail Understanding about IPv4 and IPv6 including procedures of assigning IP's in Networking Devices, Subnetting and supernetting, Fixed Length Subnet Mask (FLSM) and Variable Length Subnet Mask (VLSM).

Multi Protocol Label Switching (MPLS)

Overview of (MPLS) Technology

Switch and Router Configuration

Understand about the basic configuration of Switch including Port Security and Router including difference between Static and Dynamic Routing.

MODULE 3

Transmission Media Overview

Network Media - Cables and connectors, Twisted Pair (TP) - (UTP) - (STP) and Optical Fiber Cable (OFC) – single mode – multi mode. Crimping of RJ 45 connector. Use of cables in different scenarios.

Linux Configurations

Introduction to Linux, Configuration of Network Settings, access printer settings, Network Trouble shooting and Antivirus Updation in Navios / BOSS Linux and Redhat Operating Systems.

Installation of Windows 10 and BOSS Linux OS

Installation of Windows 10 and BOSS Linux (NAVIOS) including BIOS configuration. How to take Backup of SENIC volume data and its procedures. Understanding about GPT and MBR formatting of Hard disk.

User Rights Management

How to change / assign domain or local user rights to the file, folder, SENIC Volumes (.sev files). Backing up of data. File Transfer Protocol (FTP), Dynamic Host Configuration Protocol (DHCP), Domain Name System (DNS)

Troubleshooting

(a) Installation of Network Printer
(b) Installation of NIC
(c) Upgradation of RAM
(d) Switch Mode Power Supply (SMPS)
(e) Seclore

References.

1. Wendell Odom, Official Cert Guide, CCNA 200 – 301, Volume 1 and 2, Ciscopress, Cisco.

2. James F. Kurose, Computer Networking A Top-Down Approach, Eight Edition, Pearson Education, 2022.

3. Christopher Negus, Linux Bible The Comprehensive Tutorial Resource, Tenth Edition, Wiley, 2020.

4. Jordan Krause, Mastering Windows Server 2019, Second Edition, Packt Publishing Limited, 2019.

5. V Rajaraman, Fundamentals of Computers, Sixth Edition, Prentice - Hall of India Pvt Ltd, New Delhi, 2014.

6. Behrouz A Forouzan, Data Communications and Networking, Fourth Edition, McGraw Hill Education, 2006.

7. What's new in Windows Server 2019 | Microsoft Learn, https://learn.microsoft.com

24-8603-0114 – NAVAL NETWORK FRAMEWORK

Course Description. Purpose of Navy Network Framework, Naval Communication Network (NCN) architecture, types of network and security overlay, network component and services implemented

24-8603-0114	Naval Network Framework	Category	L	T	P	Credit
		-	3	-	2	2

Pre-requisites. Basic knowledge of IT.

Course Objectives. To explain the installation of OFC, architecture of NCN, various layers of security overlay, network services implemented, and functions of Sanchar 2.0

Course Outcome. After completion of the course, the student will be able to

CO 1	Understand design and laying of OFC. Maintenance philosophy.
CO 2	Understand network components installed for services viz networking and security overlay.
CO 3	Undertake configuration and DI/DR of networking and security components.
CO 4	Understand usage and functioning of messaging application Sanchar 2.0

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	3	3	2	2	1	1
CO 2	2	3	2	1	1	1
CO 3	3	3	2	2	1	1
CO 4	2	3	3	3	2	2

Distribution of Marks

Total Marks	**ESE**	**ESE Duration**
100	100	3 hours

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

Network for Spectrum

Function of NFS, Network components used in NFS and services being provided. Areas of responsibility, maintenance and repair philosophy.

Navy Wide Area Network

Network Backbone, Types of Services running in Navy over NEWN, NEWN architecture and security implemented.

MODULE 2

Naval Communication Network

Features of NCN, NFS components implemented in navy. Architecture of NCN, working principle of DWDM, types of security implemented for NCN.

Navy IP-MPLS

Brief on High Level Design and Low level design, Types of services in NCN, working principle of Content Deliver Network and Big Data Analytics, multimedia services implemented in navy and integration of Navy existing telephone exchange with NCN voice.

MODULE 3

OFC Technologies

Principle of fibre communication, types of modes in OFC, monitoring and maintenance technique used.

OFC in Navy

Brief on Navy access OFC, laying of OFC, types equipment used for laying of OFC, types of OFC used in navy based on location requirement, and monitoring of OFC.

References.

1. Operator and Maintenance Manuals of Sanchar 2.0

2. Operator Level Training, book and CD.

3. NFS training manual Vol 1 to 5.

24-8603-0115 – SMALL ARMS AND SAFETY

Course Description. To provide fundamental concepts of handling Small Arms.

24-8603-0115	Small Arms & Safety	Category	L	T	P	Credit
		-	2	-	-	1

Prerequisite. Basic knowledge on types of Small Arms available in IN.

Course Objectives. To teach principles of Small Arms firing and its application.

Course Outcome. After completion of the course, the student will be able to

CO 1	Carry out duties of Range Officer/ OOD
CO 2	To advise the Command on utilization of Small Arms onboard.
CO 3	Supervise the handing over and taking over of Small Arms by sentries

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2					
CO 2			1			
CO 3	1					

Distribution of Marks

Total Marks	ESE	ESE Duration
50	50	45 Mins

End Semester Examination Pattern.
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains objective questions (which may contain fill in the blank or choose the correct answer or true or false or match the following). Part B contains subjective questions.

MODULE 1

Small Arms Handling

Basic knowledge of small arms, definition of small arms, list of small arms used in IN, safe handling of small arms, safety rules. Basic facts of each small arms, external and internal parts of the small arms, principle of operation, handling, aiming and firing positions, loading and unloading drill, stoppages and remedial actions.

References.

1. Small Arms docket at Signal School.

2. Operating manuals of various Small Arms.

24-8603-0116 – ORAL BOARD

Course Description. Oral Board will be conducted for all the courses mentioned above.

24-8603-0116	Oral Board	Category	L	T	P	Credit
		-	-	-	3	3

Prerequisite. Thorough knowledge of all the courses covered during the curriculum.

Course Objectives. To test the knowledge gained by the trainee.

Course Outcome. After completion of the course, the student will be able to

CO 1	Have a thorough understanding of the courses covered in the curriculum and be able to put into effect the concepts, whilst carrying out the duties of SCO

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	3	3	3	3	3	3

Distribution of Marks

Total Marks	**ESE**	**ESE Duration**
200	200	01 Hr

24-8603-0117- DISSERTATION

Course Description. Research paper will be submitted by the trainees on topics based on maritime communication and latest technology, as promulgated by the school.

		Category	L	T	P	Credit
24-8603-0117	Dissertation	-	-	-	-	4

Prerequisite. Basic knowledge of Maritime communication and latest technologies.

Course Objectives. Carry out research work on the assigned topic and prepare report of the research work.

Course Outcome. After completion of the course, the student will be able to

CO 1	Submit a well reasoned report on the subject, and present the findings to a professional audience.

Mapping of course outcomes with program outcomes: Level - Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	2	2	2	2

Distribution of Marks

Total Marks	ESE	ESE Duration
100	100	02 Hrs

Appendix - V (P)

Enclosure 3
(Refers to Para 3 of CTESS Note 850/16 /CTESS dated 09 Apr 24)

CURRICULUM FRAMEWORK AND COURSE CONTENT FOR OUTCOME BASED EDUCATION

IN

MSc in Underwater Science and Technology
(Programme No 24 - 8803)

Conducted By

ANTI SUBMARINE WARFARE SCHOOL
TO SEEK TO CLASSIFY TO DESTROY

ASW SCHOOL

ASW School
Naval Base PO
Kochi 682004
Phone 04842896656
E-Mail - sncasws@navy.gov.in

REGULATIONS FOR MSc (UNDERWATER SCIENCE AND TECHNOLOGY)

1.	**Programme No**	:	24 - 8803
2.	**Programme Name**	:	MSc in Underwater Science and Technology Sensor
3.	**Programme Name (Naval Equivalent)**	:	Long ASW (Indian)
4.	**Approving authority**	:	IHQ MoD(Navy)
5.	**Eligibility criteria for admission**	:	(a) Officer Nominated by IHQ MoD(Navy) or HQ ICG (b) A Bachelor's Degree in Science or BE/ BTech, in any discipline, from a recognized university.
6.	**Duration**	:	Phase I (a) Semesters I & II - 48 weeks of Technical Training and OJT Phase II (b) Semesters III & IV - 48 weeks Specialisation Training at ASW School
7.	**Attendance requirement**	:	85% minimum
8.	**Nature**	:	Full Time Contact Programme
9.	**Approved intake capacity**	:	As approved by IHQ MoD(Navy)
10.	**Examination Pattern**	:	The examination paper setter will be an officer/ sailor other than the subject instructor, nominated by the Chief Instructor.
11.	**Minimum qualifying marks**	:	Theory 55% and Practical 70 %

12. **Grading.**

(a) The grading of the students is based on the final result, which is as follows:-

Range of Marks	Grades	Weightage
90% of above	S - Outstanding	10
80 – 90 %	A - Excellent	09
70 – 80 %	B - Very Good	08
60 – 70 %	C - Good	07
55 - 60 %	D – Satisfactory	06
Below 55 %	F – Failed	00

* Where (X – Y %) means X is included and Y is excluded.

(b) **Cumulative Grade Point Average (CGPA)**. Overall performance at the end of the course is indicated by Cumulative Grade Point Average (CGPA) calculated as follows for all subject: -

CGPA = (G1C1 + G2C2 + G3C3 + …… + GnCn) / (C1 + C2 + C3 +……Cn)

Where, G = Grade weightage.
C = Credit value corresponding to the subject.

(c) **Classification**. The classification of MSc in Underwater Science and Technology will be given as follows: -

Ser	Classification	CGPA
1.	First Class with distinction	8 and above
2.	First Class	7 < 8
3.	Second Class	6 < 7

13. **Failure in Examinations**.

(a) Failure in one subject will result in warning by Chief Instructor and re-examination.

(b) Failure in two subjects or in one subject more than once will result in warning by Officer-in-Charge and re-examination.

(c) Failure in three or more subjects or in re-examination will be considered as failure in the whole course and trainee will be withdrawn from the course.

14. **Synopsis of the Subjects and Credit Points**.

Subject Code	Subject	Credit
	SEMESTER III	
24-8803-1001	Underwater Acoustics	3
24-8803-1002	Sonar Theory I	2
24-8803-1003	Sonar Theory II	3
24-8803-1004	Sonar Theory III	3
24-8803-1005	Naval Weapon Systems	3
24-8803-1006	Equipment Group I	2
24-8803-1007	Equipment Group II	2
24-8803-1008	Equipment Group III	1
24-8803-1009	Applied Mathematics	1
	Total	20
	SEMESTER IV	
24-8803-1010	Torpedo A244S	2
24-8803-1011	Torpedo CET 65E	2
24-8803-1012	Mine Warfare	2
24-8803-1013	Rocket Launcher RBU 6000 and Fire Control System (FCS)	2
24-8803-1014	Tactics I	4

Subject Code	Subject	Credit
24-8803-1015	Tactics II	4
24-8803-1016	Project	2
24-8803-1017	Oral Board	4
Total		22
Grand Total		42

SCHEME OF INSTRUCTIONS (SOI) AND SCHEME OF EXAMINATIONS (SOE)

CODE	SUBJECT	HOURS/ WEEK				CREDIT	MARKS		
		L	T	P	TOTAL		TH	PR	TOTAL
	Semester III								
24-8803-1001	Underwater Acoustics	2	-	1	3	3	50	10	60
24-8803-1002	Sonar Theory I	2	-	1	3	2	40	10	50
24-8803-1003	Sonar Theory II	3	-	1	4	3	40	40	80
24-8803-1004	Sonar Theory III	3	-	2	5	3	70	20	90
24-8803-1005	Naval Weapon Systems	4	-	1	5	3	125	20	145
24-8803-1006	Equipment Group I	2	-	1	3	2	60	20	80
24-8803-1007	Equipment Group II	2	-	1	3	2	40	10	50
24-8803-1008	Equipment Group III	2	-	1	3	1	60	20	80
24-8803-1009	Applied Mathematics	1	-		1	1	45	10	55
	Total				**30**	**20**	**530**	**160**	**690**
	Semester IV								
24-8803-1010	Torpedo A244S	3	-	1	4	2	70	30	100
24-8803-1011	Torpedo CET 65E	3	-	1	4	2	70	30	100
24-8803-1012	Mine Warfare	3	-	1	4	2	70	30	100
24-8803-1013	Rocket Launcher RBU 6000 and Fire Control System (FCS)	3	-	2	5	2	90	60	150
24-8803-1014	Tactics I	4	-	1	5	4	200	0	200
24-8803-1015	Tactics II	4	-	1	5	4	200	0	200
24-8803-1016	Project	1	1	-	2	2	200	0	200
24-8803-1017	Oral Board	1	-	-	1	4	210	-	210
	Total				**30**	**22**	**1110**	**150**	**1250**
	Grand Total				**60**	**42**	**1640**	**310**	**1940**

Total Credits: **42**

Total Exam Marks: **1940**

SYLLABI FOR PROGRAMME 24 - 8803

MSc IN UNDERWATER SCIENCE AND TECHNOLOGY

VISION

Practicalisation of training, building up of new resources, maximising of the existing resources, impetus on safety related training and maximise fleet exposure opportunities of trainees. The School aims to provide the right balance of theoretical and practical training to the entire spectrum of ASW trainees. The emphasis of training has been directed towards preparing them for the immediate next job, while broadening their horizon for future responsibilities. The School shall, through professional research, contribute towards development of ASW Tactics and Doctrine and also advice higher command formations on ASW, Mine Warfare and Underwater Domain Awareness.

MISSION

The School is responsible for producing 'Fleet-ready' officers and sailors and act as a repository of knowledge on all aspects of ASW, Mine Warfare and Underwater Domain Awareness. Its mandate is to actively contribute to the advancement of ASW tactical thinking and doctrine through rigorous professional research.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PE01: To provide trainees with an academic setting that nurtures learning and empowers them to excel in the naval profession, mastering the necessary skills for successful operations in Anti-Submarine Warfare.

PE02: To provide a thorough knowledge of various weapons and sensors, enabling trainees to operate them in various diverse environment to undertake operations and consequently building a successful career in Anti-Submarine Warfare, staying abreast of technological advancements in the field.

PE03: To provide trainees with comprehensive knowledge of underwater operations and the technical expertise necessary to address field challenges, enabling them to fulfill the responsibilities while undertaking the role of Command/Anti-Submarine Warfare Officer (ASWO) when implementing operational tactics.

PE04: To engage trainees in continuous professional development, staying abreast of advancements in submarine warfare tactics, strategies and technologies to ensure readiness for evolving operational challenges.

PROGRAMME OUTCOMES (PO)

PO1: To suitably comprehend the principles of underwater acoustics and applications of sonar towards effective utilisation of ASW sensors and weapons under varying operating conditions.

PO2: To be able to exploit the sensors and weapon systems by operators on various ASW platforms.

PO3: To effectively apply concepts of various underwater detection and tracking systems, decoy systems, advanced torpedo defense systems and mine warfare onboard ships.

PO4: To analyse a tactical scenario and advise Command in conduct of coordinated operations.

PO5: Function effectively as an ASWO, and as a leader in diverse teams with varying platforms, and in multi-disciplinary settings.

24-8803-1001 UNDERWATER ACOUSTICS

Course Description. This course covers concepts of underwater acoustics and principles of sound systems in water

24-8803-1001	Under Water Acoustics	Category	L	T	P	Credit
		-	2	-	1	3

Pre-requisites. Basic concepts of characteristics of sound, sound propagation and velocity of sound.

Course Objectives. To be able to apply concepts of underwater sound towards exploitation of various ASW sensors.

Course Outcome. After completion of the course, trainee will be able to:-

CO 1	Analyse the propagation of sound wave as per existing hydrological conditions

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	3	3

Distribution of Marks.

Total Marks	ESE	ESE Duration
60	60	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of three parts; Part A, B and C. Part A contains 30 questions (10 – fill in the blanks, 10 – choose the correct answer and 10 short answer) from each module, each question will be of one mark. Part B contains 08 questions from each module, 04 Three-mark question and 04 Two-mark question each. Each question can have maximum 2 sub-divisions. Part C consists of practical viva comprising of 10 marks.

Module 1

1. Utility of acoustic energy in naval operations such as Anti-Submarine Warfare, Mine Warfare, Submarine Operations, Ocean Surveillance, Underwater Communication etc.

2. The physical properties of acoustic wave's intensity – acoustic impedance, acoustic energy power

3. Units – decibel notations, standard reference pressure used in U/W sound.

Module 2

1. Existence of Acoustic Path, Background Signal and Signal to Back Ground Noise ratio

2. Derivation of Sonar Equation in logical steps, Active and Passive Sonar Equation, definitions of various Sonar Parameters, limitation of Sonar Equation, Figure of Merit

Module 3

1. Velocity of sound in the sea, variation of the profile with latitude, season and time of day, deep sea velocity profile

2. Various acoustic paths, sound propagation in positive, negative and isothermal gradient, sound channel propagation

3. Mixed layer sound channel, deep sound channel and shallow water sound channel, bottom bounce paths, convergence zones, various paths

Module 4

1. Source of Ambient Noise, Source and path of Self Noise, Self-Noise Measurement, Flow Noise

2. Source of Radiated Noise, Machinery Noise, Propeller Noise, variation with speed and frequency

3. Types of causes of losses of sound energy in sea - Spreading Losses (spherical and cylindrical) Absorption Loss, causes of variation with frequency, temperature and depth, Theory of Reverberation, types of Reverberation.

Module 5

1. The concept of geometry of Target Strength, Variation of Target Strength of a submarine with aspects, Pulse length, depth and range.

2. Doppler Effect, Doppler Shift, cause of Doppler shift, Echo Pitch, Echo Duration

3. Transducers, Constructions, types of materials used in construction of transducers e.g. Piezo-electric, directional properties of transducer

4. Definition of Directivity Index (array gain) and Detection Threshold, receiver operating curves and advantages of an array over a single hydrophone

References.

1. Principles of Underwater Sound by RJ Urick, Third Edition, published by Peninsula publishing 2013.
2. An introduction to underwater acoustics – Principles and applications by Xavier Lurton, first edition, published by Springer, 2016
3. Sonar for Practicing Engineers by A.D Waite, third edition, published by Wiley, 2002
4. Mechanics of Underwater Noise by Donald Ross, Third Edition published by Peninsula Publishing Los Altos, California 1984
5. An Introduction to underwater acoustics by Dr Xavier Lurton published by Springer Praxis Books in 2002

24-8803-1002 SONAR THEORY I

Course Description. This course covers concepts of Basic Sonar Theory

24-8803-1002	Sonar Theory I	Category	L	T	P	Credit
		-	2	-	1	2

Pre-requisites. Basic knowledge on the operation of Sonar Systems

Course Objectives. (i) To be conversant on operations including waveforms of sonar
(ii) To be conversant with exploitation of various sonar systems.

Course Outcome. After completion of the course, the student will be able to

CO 1	Acquire knowledge and operate sonar for detection of target
CO2	To be able to control operations of Sonar through various modes

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	1		3
CO 2	3	3			3

Distribution of Marks.

Total Marks	**ESE**	**ESE Duration**
50	50	2 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of three parts; Part A, B and C. Part A contains 20 questions (05 – fill in the blank, 05 – choose the correct answer, 05 – Match the following and 05– true or false) from each module, each question will be of one mark. Part B contains questions- 02 five-mark questions, 02 Three-mark question and 02 Two-marks question each. Part C contains practical examination on equipment handling for 10 marks.

Module 1

1. Introduction to SONAR and Components of a Sonar System.

2. Typical Layout of sonar and its associated fitting

3. Classification of sonars: MF, LOW Frequency Bi Static, Multi Static, Parametric, Side Scan and High-Definition Mine Hunting.

4. Concept of Beam Forming.

5. System block diagram and major sub systems.

6. Types of Wave forms, types of transmission and display.

Module 2

1. Various Display characteristics.

2. Initial search and track active targets.

3. Initial search and track passive targets.

4. Mine detection and tracking of torpedo HE.

References.

1. Sonar for Practicing Engineers by A.D Waite, third edition, published by Wiley, 2002
2. Sonar system Design by SP Pillai, first edition, published by Defence research and development organization, 2013
3. Introduction to theory & design of sonar transducer by Oscar Bryan Wilson 1998 publishing by peninsula publishers USA, first edition
4. Sonar and Underwater Acoustics by Jean-Paul Marage and Yvon Mori, 1st edition, ISTE Ltd and John Wiley & Sons Inc Publisher, 2010
5. Transducers and Arrays for Underwater Sound by Charles H Sherman and John L Butler, Springer publishers, 1st edition, 2011
6. Technical Specification docket for HUMSA NG, HUMSA UG, ATAS

24-8803-1003 SONAR THEORY II

Course Description. This course covers concepts of Sonar HUMSA NG and UG.

24-8803-1003	Sonar Theory II	Category	L	T	P	Credit
		-	3	-	1	3

Pre-requisites. Basic knowledge on the operation of Sonar Systems

Course Objectives. (i) To operate sonar as per the hydrological conditions
(ii) To be conversant with exploitation of sonar systems.

Course Outcome. After completion of the course, the student will be able to

CO 1	Acquire knowledge and operate sonar for detection of target
CO2	To be able to control operations of Sonar through active and passive operator

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	1		3
CO 2	3	3			3

Distribution of Marks.

Total Marks	ESE	ESE Duration
80	80	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists will be three parts; Part A, B and Part C. Part A 20 contains questions (10 – fill in the blank, 05 – choose the correct answer, and 05 – true or false) from each module, each question will be of one mark. Part B contains - 02 Five-mark question, 02 Three-mark question and 02 Two-mark question each. Part C contains practical examination on equipment handling for 40 marks.

Module 1

1. Sonar HUMSA NG
   (a) Location of major units and sub units and their functions
   (b) system operation, Generic Settings, Active Transmitter
   (c) Functional features
   (d) signal processing
   (e) Tactical use of display formats
   (f) Transmission Waveforms, Modes of Transmission and exploitation commensuration with environment

2. Tactical Operation of sonar
   (a) practical utility of shifting between modes, Bistatic/ multistatic operations
   (b) Safety precautions prior operation of sonar
   (c) Sea and action drills

Module 2

1. Sonar HUMSA UG
   (a) Location of major units and sub units and their functions
   (b) system operation,
   (c) operator console,
   (d) signal processing
   (e) Tactical use of display formats
   (f) Duties of Sonar Controller

2. Tactical Operation of sonar
   (a) practical utility of shifting between modes
   (b) Safety precautions prior operation of sonar
   (c) Sea and action drills

References.

1. Sonar for Practicing Engineers by A.D Waite, third edition, published by Wiley, 2002
2. Sonar system Design by SP Pillai, first edition, published by Defence research and development organization, 2013
3. Introduction to theory & design of sonar transducer by Oscar Bryan Wilson 1998 publishing by peninsula publishers USA, first edition

4. Sonar and Underwater Acoustics by Jean-Paul Marage and Yvon Mori, 1st edition, ISTE Ltd and John Wiley & Sons Inc Publisher, 2010
5. Transducers and Arrays for Underwater Sound by Charles H Sherman and John L Butler, Springer publishers, 1st edition, 2011
6. Technical Specification docket for HUMSA NG, HUMSA UG, ATAS

24-8803-1004 SONAR THEORY III

Course Description. This course covers concepts of Sonar systems

24-8803-1004	Sonar Theory III	Category	L	T	P	Credit
		-	3	-	2	3

Pre-requisites. Basic knowledge on the operation of Sonar systems

Course Objectives. (i) To analyse concepts of spectrum processing of underwater acoustics and harmonics in LOFAR
(ii) To be conversant with exploitation of LOFAR systems.
(iii) To be conversant with exploitation of ATAS System onboard.

Course Outcome. After completion of the course, the student will be able to:-

CO 1	To be able to analyse various machinery noise using low frequency propagation and its interaction with medium
CO 2	To be able to exploit the operations of Sonar in various mode
CO 3	Acquire knowledge and operate ATAS for detection of target
CO 4	To be able to control operations of ATAS streaming and recovery operations with observance of safety onboard

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	1	2	3
CO 2	3	3	1	2	3
CO 3	3	3	1	2	3
CO 4	3	3	2	2	3

Distribution of Marks.

Total Marks	**ESE**	**ESE Duration**
90	90	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of three parts: Part A, B and Part C. Part A contains 20 questions (05 – fill in the blank, 05 – choose the correct answer, 05 – Match the following and 05– true or false)) from each module, each question will be of one mark. Part B contains questions-06, Five-mark question, 04 Three-mark question and 04 Two-mark question each. Students should answer all questions. Part C contains practical examination on equipment handling and viva voce for 20 marks.

Module 1

Low Frequency Analysis and Ranging (LOFAR)
(a) Low frequency propagation and its characteristics. Functional features
(b) Components of radiated noise, In hull and out hull noise and transmission characteristics, Machinery Noise, Propeller Noise
(c) Pattern recognition, spectrum predominance
(d) Calculation and Solving LOFAR grams using Signature analysis, Interpretation of Lofargrams

Module 2

Active Towed Array Sonar (ATAS)
(a) components and their purpose
(b) basic operating principles
(c) Introduction to lowering and hoisting system and operation of the system
(d) Safety precautions prior operating ATAS

References.

1. Sonar for Practicing Engineers by A.D Waite, third edition, published by Wiley, 2002
2. Sonar system Design by SP Pillai, first edition, published by Defence research and development organization, 2013
3. Introduction to theory & design of sonar transducer by Oscar Bryan Wilson 1998 publishing by peninsula publishers USA, first edition
4. Sonar and Underwater Acoustics by Jean-Paul Marage and Yvon Mori, 1st edition, ISTE Ltd and John Wiley & Sons Inc Publisher, 2010
5. Transducers and Arrays for Underwater Sound by Charles H Sherman and John L Butler, Springer publishers, 1st edition, 2011

24-8803-1005 NAVAL WEAPON SYSTEMS

Course Description. This course covers concepts of underwater weapon DC Mk II, Seaward Defense, General ASW, Towed Decoys and Demolition.

24-8803-1005	Naval Weapon Systems	Category	L	T	P	Credit
		-	4	-	1	3

Pre-requisites. Basic knowledge on seaward defense organization.

Course Objectives. (i) To be able to exploit the concepts of underwater weapon DC Mk 11 and principles of towed decoy PNM during coordinated exercise.

(ii) To be able to perform and supervise actions during seaward defense and be able to be conversant with survey/demand procedures of Naval/armament stores and their stowage
(iii) To acquire functional knowledge of theory of demolition and underwater explosives

Course Outcome. After completion of the course, the student will be able to

CO 1	Prepare DC Mk 11 for deployment
CO 2	Deploy towed decoy under various tactical scenarios
CO 3	Perform duties of Officer of the day and ensure security of ship
CO 4	Early detection, localization and identification of target
CO 5	To Identify and exploit the use of naval explosives underwater
CO 6	Operate and supervise the conduct of demolition exercises underwater

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	2	3	3
CO 2	3	2	2	2	2
CO 3	3	3	1	3	2
CO 4	3	3	1	3	3
CO 5	3	3	1		2
CO 6	3	3	2	1	2

Distribution of Marks.

Total Marks	**ESE**	**ESE Duration**
145	145	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of 3 parts; Part A, B and C. Part A contains 35 questions (10 – fill in the blank, 10 – choose the correct answer, 05 – Match the following and 10– true or false) from each module, each question will be of one mark. Part B contains; 10 five-mark questions, 06 Three-mark question and 06 Two-mark question each and 10 one-mark question. Each question can have maximum 2 sub-divisions. Part C contains practical examination on equipment handling for 20 marks.

Module 1

1. DC Mk II-
   (a) Preparation of DC Mk 11 system,
   (b) Parts and function of system
   (c) Exploitation of system
   (d) Tactical deployment during exercise
   (e) Safety precautions to be followed

2. Towed Decoy PNM
   (a) Parts and Use of towed decoy
   (b) Procedure for deployment
   (c) Maintenance of PNM

Module 2

1. Aim / principles of Seaward Defense
   (a) Water borne attacks
   (b) Components of Harbor security
   (c) Introduction to references for Seaward defense

2. Conduct of Higher Security state
   (a) Types of threat
   (b) Types of underwater saboteurs
   (c) Defensive measures
   (d) Safety precautions
   (e) Positioning of lookouts and sentries
   (f) Signals used during exercise

3. Roles / functions of ASW Department onboard
   (a) Duties/ responsibilities of ASW sailors as PO US I.
   (b) Maintaining of books and records
   (c) Function of Naval organization
   (d) Underwater signature management

Module 3

1. Naval Stores
   (a) Types of Naval Stores
   (b) Demanding accounting procedure
   (c) Material organization
   (d) Ledger Muster

2. Naval Armament Stores
   (a) Types of Naval Armament Stores
   (b) Demanding /accounting/ stowage procedure
   (c) Magazine and Keyboard organization
   (d) Safety precautions

Module 4

1. Demolition, Combustion, Explosion and Detonation; Classes of Explosives, Low Explosive, High Explosive and Primary Explosives.

2. Initiation of Explosive, Partial Detonation, Sympathetic Detonation, Hot Spot theory, velocities of Detonation, burning of Explosive, Brilliance, Tampering and Initiation Train; Effect of addition of Non-Explosive Ignition; Simple explosives, TNT, CE, RDX, PETN, Amatol, fuse TNT/AL RDX/TNT Topre, MDX RDX/W AX/AL and Plastic explosive-PE 3A.

References.

1. Integrated Headquarters, Ministry of Defence (Navy), Doctrine on Coastal Security, Naval Operational Publication, 2017
2. BR 338(I), Handbook of Demolition and Explosives
3. INBR 1862/2019 Handbook for Indian Naval Magazine and Explosives Regulation

24-8803-1006 EQUIPMENT GROUP I

Course Description. This course covers concepts of electrical equipment for maintenance of Sonar/ ASW Equipment onboard which includes- Expendable bathy thermograph (XBT), Underwater acoustics Communication system (UWACS), Self-Propelled Underwater Re-usable Target (SPURT), Major firefighting System (MFFS) and application of computer

24-8803-1006	Equipment Group I	Category	L	T	P	Credit
		-	2	-	1	2

Pre-requisites. Technical specification, Calibration checks, Deployment of XBT probe

Course Objectives. To be able to carry out effective operation/ supervision of exploitation of underwater equipment's and its associated software.

Course Outcome. After completion of the course, the student will be able to

CO 1	Calculate Sonar Range using PROSPER and PROBS and use PROSIM software
CO2	To deploy and exploit SPURT, MFFS
CO3	To ensure data security in naval environment

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	2	2	2	2	2

Distribution of Marks.

Total Marks	**ESE**	**ESE Duration**
80	80	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of 3 parts; Part A, B and C. Part A contains 20 questions (10 – fill in the blank, 10 – choose the correct answer) from each module, each question will be of one mark. Part B contains; 04 Five-mark question 04 three mark and 04 two-mark questions from module. Students should answer all questions. Part B contains practical examination on equipment handling for 20 marks.

Module 1

1. Operation of XBT System
   (a) Sequence of operation,
   (b) calibration checks,
   (c) Requirements of operation and maintenance by operator

2. Analysis of Temperature Profile
   (a) Parameters of PROSPER software
   (b) Application of Sonar Tote
   (c) Target profiling
   (d) Predicted / Estimated Sonar Range and Ray trace plot
   (e) Record keeping and sending of Bathy returns

Module 2

3G UWACS and UWACS TRITON

(a) Modes of operation, difference between Keltron UWT, 3G UWACS and UWACS Triton

(b) Switching ON procedure, Function of keys and communication procedure in various modes

(c) Safety precautions while transmitting on UWT

(d) Sea and action drills

Module 3

1. Self-Propelled Underwater Reusable Target (SPURT)
   (a) Parts of SPURT
   (b) Preparation onboard prior deployment at sea
   (c) Lowering and recovery procedure
   (d) Technical description and capability/limitation of SPURT
   (e) Pre deployment checks and Operating procedure for SPURT

2. ASW Wave Glider/ UUVs/ AUVs
   (a) Operation of Wave Glider, monitoring system, record the data
   (b) classify the data and analysis the LOFAR Gram
   (c) recovery procedure
   (d) Post recovery routine and routine checks of Glider in Harbour.

Module 5

Major Fire fighting system (MFFS)
(a) Parts of MFFS
(b) Use of MFFS
(c) Technical description and capability/limitation
(d) Checks and Operating procedure

Module 6

Naval Network Security
(a) Overview of network security
(b) Awareness regarding IT/Infosec policies in IN.
(c) Use of internet in Naval environment and sensitization regarding social media and risks posed by them.
(d) Handling security issues, user notifications, vulnerability fixing, security measures for safe disposal.

References.

1. Sea surface Temperature edited by Jorge Vazquez- Cuervo and Xiaofeng Li published by MDPI, Switzerland, 2018
2. Bathymetry and its applications by Philippe Blondel published by INTECH in 2012
3. Data and Computer Communications by William Stallings, Eighth Edition, Pearson Education Publishers, 2007
4. Fundamentals of Computers by E Balagurusamy, 2nd edition, published by Mc Graw Hill Education, 2009
5. Computer Networking with Internet Protocols and Technology by William Stalling, 1St edition, Pearson Education India, 2003
6. Fundamentals of Computers by V Rajaraman and Neeharika Adabala, 6th Edition, Prentice - Hall of India Pvt Ltd, New Delhi, 2014

24-8803-1007 EQUIPMENT GROUP II

Course Description. This course covers concepts of Decoy/ Sonar health check systems

24-8803-1007	Equipment Group II	Category	L	T	P	Credit
		-	2	-	1	2

Pre-requisites. Nil

Course Objectives.
(i) To be able to control the operation of the Torpedo Decoy System ATDS
(ii) To be able to operate, maintain and to supervise the operation of varunastra and Mk 54 torpedo
(iii) Apply concepts of seamanship

Course Outcome. After completion of the course, the student will be able to

CO 1	Acquire knowledge on the Torpedo decoy systems and operate Advanced Torpedo Defense Systems (ATDS)
CO2	Operate and supervise the operation of Varunastra and Mk 54 torpedo
CO3	Supervise seamanship evolutions

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	1		2
CO2	3	3	2	1	2

Distribution of Marks.

Total Marks	**ESE**	**ESE Duration**
50	50	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of 3 parts; Part A, B and C. Part A contains 10 questions (05 – fill in the blank, 05 – choose the correct answer) from each module, each question will be of one mark. Part B contains; 02 five marks questions, 04 Three-mark question and 04 Two-mark question each. Each question can have maximum 2 sub-divisions. Students should answer all questions. Part C will have practical viva comprising of 10 marks.

Module 1

MK 54

(a) Components of MK 54
(b) Technical details and operational limitations
(c) Safety precautions whilst launching and recovering
(d) Logic Operation

Module 2

Advanced torpedo Defence systems (ATDS) - MAREECH/ Torpedo Decoy

(e) Components of ATDS
(f) Technical details and operational limitations
(g) Safety precautions whilst streaming and recovering ATDS, Pipe Noise Maker(PNM)

Module 3

Varunastra torpedo A244S

(a) Exploder mechanism, description, function and Circuit diagram
(b) Pre-settable data on the torpedo and Transmission configuration
(c) Reception beam, Search pattern, Attack phase, Acquisition criteria, Lost contact procedure and re-attack

Module 4

Seamanship phase

(a) Introduction to seamanship
(b) Safety precautions
(c) Seamanship evolutions

References.

1. Time Frequency Signal Analysis and Processing by Boualem Boashash, 2nd Edition published by Academic Press, 2015
2. Handbook on ATDS
3. Introduction to theory & design of sonar transducer by Oscar Bryan Wilson 1998 publishing by peninsula publishers USA, first edition
4. Digital Principles and Applications by A P Molvino and Donald P Leach Fourth Edition published by Tata Mcgraw Hill sixteenth reprint 1999
5. INBR (Indian Naval Book of Reference) 1424, The Operational Manual for GI 738

8803-1008 EQUIPMENT GROUP III

Course Description. This course covers concepts of digital electronics for maintenance of Sonar/ ASW Equipment onboard, Underwater Telephony, principles of sonobuoys and of underwater weapon guidance control propulsion and launching system (PUWW).

24-8803-1008	Equipment Group III	Category	L	T	P	Credit
		-	2	-	1	1

Pre-requisites. Basic knowledge of the principles of digital electronics, principles and functioning of basic sonar.

Course Objectives. (i) Impart theoretical and practical knowledge on system maintenance
(ii) Able to comprehend operation of common test equipment onboard
(iii) To be able to handle various electrical equipment and follow electrical engineering practice.
(iv) To be able to operate/supervise the operation of underwater telephone (UWT)
(v) To analyse the deployment of sonobuoys in tactical scenarios

Course Outcome. After completion of the course, the student will be able to

CO 1	Comprehend the maintenance routine of Sonar
CO 2	Advice crew during the use of equipment for Sonar Parameter checks.
CO 3	follow safe electrical engineering practice onboard
CO 4	Analyse the use of equipment for Sonar Parameter checks.
CO 5	To be able to carry out and supervise the operations on sonobuoy
CO 6	To be able to operate and supervise the operation of UWT KELTRON

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	2	1	1
CO 2	3	1			1
CO 3	3	1			1
CO 4	3	2	1		1
CO 5	3	3	1	2	1
CO 6	3	2	2	2	3

Distribution of Marks.

Total Marks	**ESE**	**ESE Duration**
80	80	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of 3 parts; Part A, B and C. Part A contains 20 questions (10 – fill in the blank, 10 – choose the correct answer) from each module, each question will be of one mark. Part B contains; 04 questions five-mark question, 04 three mark questions and

04 two-mark question each. Students should answer all questions. Part C contains practical examination on equipment handling for 20 marks.

Module 1

1. Calculation of Binary, octal, hexadecimal, binary addition subscription, positive logic, negative logic need for BCD encode/ decoding, parity cycle code. Application of Logic Gates

2. Use of Multi vibrator, mono shot, bi-stable, a-stable RS Flipflop, latches, propagation delay time, set up time, hold time race problem, master slave set up time, hold time race problem, master slave Flipflop, clock system. Concept of timers and counters.Types of memories. Analog to digital conversion and digital to Analog conversion. Linear frequency modulation. Application of Step frequency modulation, hyperbolic frequency modulation. Concepts of Detection problem, various functions and their definitions. Types of modulation in sound waves used for under water transmission.

Module 2

1. Introduction to torpedo propulsion, Close looped cycles and open loop cycles for underwater Propulsion, U/W propulsion technologies around the world. Theory of super cavitation.

2. Sensors, signal processing and algorithms for detecting classifying and tracking targets, Safeties involving warheads and firing. Challenges in u/w homing and guidance.

Module 3

1. Introduction to Sonobuoys; Capabilities of Sonobuoys; Various types of Sonobuoys.

2. Functional features; Operational features; General description of Sonobuoys used by world navies and their tactical exploitation.

Module 4

UWT- KELTRON; Modes of operation; Switching ON procedure; Function of keys and communication procedure in various modes; Safety precautions while transmitting on UWT.

References.

1. Electronics Devices and Circuit Theory by Robert L Boylestad and Loius Nashelsky Fourth Edition Published by Pearson in 1987
2. Digital Principles and Applications by A P Molvino and Donald P Leach Fourth Edition published by Tata Mcgraw Hill sixteenth reprint 1999
3. Electronics Instrumentation by HS Kalsi, 2nd edition published by Tata Mc Graw hill, 2015
4. Introduction to Naval Engineering by David A Blank, Arthur E Block and David J Richardson Second Edition published by Naval Institute Press, Annapoils, Maryland 1983
5. Electrical equipment Handbook by Philip Kiameh published by Mc Graw Hill Education in May 2003
6. INBR (Indian Naval Book of Reference) 1806- Guide to Cyber Forensics of Digital Artefacts

7. Headquarters Integrated Defence Staff, Cyber Security Policy – 202
Torpedoes and Torpedo Warfare by Charles William Sleeman, first edition, published by Wentworth Press, 2016
8. Torpedo by Katherine C Epstein, First edition, published by Harvard University press, 2014
9. The Underwater Handbook by Charles W Shilling, Margaret F Werts and Nancy R Schandelmeier, 1976th edition, published by Springer, 1977
10. Marine Propellers and Propulsion by John Carlton, Fourth Edition, Pubished by Butterworth-Heinemann, 2018
11. Sensors Handbook, Sabaree Solomon, 2nd edition published by McGraw Hill, 1998
12. Sonar system Design by SP Pillai, first edition, published by Defence research and development organization, 2013
13. Introduction to theory & design of sonar transducer by Oscar Bryan Wilson 1998 publishing by peninsula publishers USA, first edition
14. INBR 2651 User Handbook Keltron on Underwater telephone
15. Principles of Naval Weapon Systems by Craig Payne, Second edition, published by Naval Institute Press, 2010

24-8803-1009 – APPLIED MATHEMATICS

Course Description. This course covers concepts of Statistics and probability and its use in naval operations and analysis

24-8803-1010	Applied Mathematics	Category	L	T	P	Credit
		-	1	-	-	1

Pre-requisites. Basic working knowledge in solving statics and probability problems

Course Objectives. (i) To acquire functional knowledge of statics and probability to interpret situational plans during operations
(ii) To apply concepts of Operational analysis and undertake conditional study

Course Outcome. After completion of the course, the student will be able to

CO 1	To interpret search plans using basic probability theory
CO2	To apply, simulate and model various situations and tactical conditions

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	1		2
CO2	3	3	2	1	2

Distribution of Marks.

Total	**ESE**	**ESE**

Marks		Duration
55	55	2 hours

End Semester Examination Pattern.

End Semester Examination Pattern: There will be three parts; Part A, B and C. Part A contains 15 questions (05– fill in the blank, 05 – choose the correct answer and 05 short answer) from each module, each question will be of one mark. Part B contains 08 questions; 04 Three-mark question and 04 Two-mark question each. Each question can have maximum 2 sub-divisions. Part C will have practical comprising of 10 marks.

Module 1

1. Calculating Dispersion, standard deviation, significance of standard deviation, Descriptive statistics

2. Joint, Marginal and conditional probability, Bayes Theorem, Discrete and continuous probability, testing of hypothesis

Module 2

1. Linear programming, optimization; Theory of simplex method, slack surplus variables, optimality condition, extreme points and basic feasible solutions

2. Introduction to game theory, two person zero sum games- saddle points, mixed strategies, symmetric games, matrix games, non zero sum games

3. Simulation and queuing systems, forecasting techniques, Regression analysis and applications in ASW operations

References.

1. Introduction to Probability and statistics by Seymour Lipschuz and John Schiller published by McGraw Hill Education, 2011
2. An Introduction to Probability Theory and its applications by William Feller, third edition, published by Wiley, 1968
3. Probability and Statistics by Morris H. DeGroot, fourth edition, published by Pearson, 2010
4. Mathematical Fundamentals by Gupta and Vashishtha By Krishna Prakashan Mandir Meerut, Third Edition, 1998.
5. Probability Theory by Jim Pitman published by Narosa Publishing House, 1996
6. Theory of Ordinary Differential Equations by Earl A Coddington and Normal Levinson THM fifth Edition published by McGraw Hill New York, 1998
7. Statistics A Beginners Text VOl I by BR Bhat , KS Mahava Rao and T Srivenkataramana Volume I published by New Age International Publishers, 1990
8. Probability Theory: The logic of Science by Edwin T Jaynes edited by G. Larry Bretthorst published by Cambridge University Press, 2003
9. Testing Statistical Hypotheses, Second edition by EL Lehmann and Joseph P Romano published by Springer, 1998
10. An Introduction to Multivariate Statistical Analysis, Third Edition by T W Anderson published by Wiley- Interscience, 2003

24-8803-1010 – TORPEDO A244S

Course Description. This course covers concepts of A244S Torpedo an its deployment

24-8803-1010	Torpedo A244S	Category	L	T	P	Credit
		-	3	-	1	2

Pre-requisites. Basic working knowledge in Torpedo and principles of its operation

Course Objectives. (i) To acquire functional knowledge of A244S torpedo

Course Outcome. After completion of the course, the student will be able to

CO 1	To control deployment and supervise maintenance of torpedo A244S and its system
CO2	To acquire knowledge on the safety and maintenance of torpedo tubes

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	3	3	2
CO2	3	3	2	3	2

Distribution of Marks.

Total Marks	**ESE**	**ESE Duration**
100	100	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of three parts; Part A, B and C. Part A contains 30 questions (10 – fill in the blank, 10 – choose the correct answer and 10 short answer) from each module, each question will be of one mark. Part B contains 08 questions; 04 five-mark question 04 Three-mark question and 04 Two-mark question each. Each question can have maximum 2 sub-divisions. Part C will have practical comprising of 30 marks.

Module 1

1. Parts of A244s and its Operational Capabilities

2. Reception beam, Search pattern, Attack phase, Acquisition criteria, Lost contact procedure and re-attack

3. Preparation onboard ship and recovery first aid routines- FIAM gear, air launch/ tube launch

4. Loading and unloading procedures for torpedoes in tubes.

5. Ship borne pre-setter, portable pre-setter and simulator.

References.

1. Torpedoes and Torpedo Warfare by Charles William Sleeman, first edition, published by Wentworth Press, 2016

2. Torpedo by Katherine C Epstein, First edition, published by Harvard University press, 2014

3. Weapon System Safety Guidelines Handbook

4. Docket on A244S, TTL and SPS

5. Submarines and Deep Sea Vehicles by Jeffrey Tall, 2002 edition, published by Thunder BayPr

6. Sonar-Sensors & Systems(ICONS-2002) by HRS Sastry, DD Ebenezer and TVS Sundaram, organized by NPOL, Published by Allied Publishers Pvt Ltd, 2002

24-8803-1011 - TORPEDO CET 65E

Course Description: This course covers concepts of CET 65E Torpedo and its deployment

24-8803-1011	Torpedo CET 65E	Category	L	T	P	Credit
		-	3	-	1	2

Pre-requisites. Basic working knowledge of Torpedo and principles of operation.

Course Objectives. (i) To acquire functional knowledge of CET 65E torpedo

Course Outcome. After completion of the course, the student will be able to

CO 1	To control deployment and supervise maintenance of torpedo CET65E and its system
CO2	To acquire knowledge on the safety and maintenance of torpedo tube QTTM

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	3	3	2
CO2	3	3	2	3	2

Distribution of Marks.

Total Marks	**ESE**	**ESE Duration**
100	100	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of three parts; Part A, B and C. Part A contains 30 questions (10 – fill in the blank, 10 – choose the correct answer and 10 short answer) from each module, each question will be of one mark. Part B contains 08 questions;04 five-mark question 04

Three-mark question and 04 Two-mark question each. Each question can have maximum 2 sub-divisions. Part C will have practical comprising of 30 marks.

Module

1. Parts of CET65E and its Operational Capabilities

2. Reception beam, Search pattern, Attack phase, Acquisition criteria, Lost contact procedure and re-attack

3. Preparation onboard ship and recovery first aid routines- tube launch

4. Loading and unloading procedures for torpedoes in tubes.

5. Safety precautions

References.

1. Torpedoes and Torpedo Warfare by Charles William Sleeman, first edition, published by Wentworth Press, 2016

2. Torpedo by Katherine C Epstein, First edition, published by Harvard University press, 2014

3. Weapon System Safety Guidelines Handbook

4. Docket on A244S, TTL and SPS

5. Submarines and Deep Sea Vehicles by Jeffrey Tall, 2002 edition, published by Thunder BayPr

6. Sonar-Sensors & Systems(ICONS-2002) by HRS Sastry, DD Ebenezer and TVS Sundaram, organized by NPOL, Published by Allied Publishers Pvt Ltd, 2002

24-8803-1012 MINE WARFARE

Course Description. This course covers concepts of Mine Warfare

24-8803-1012	Mine Warfare	Category	L	T	P	Credit
		-	3	-	1	2

Pre-requisites. Knowledge on basic Mine warfare

Course Objectives. To be conversant with mine warfare and coordinate MCM operations.

Course Outcome. After completion of the course, the student will be able to:-

CO 1	To be able to lay down principles of mine warfare
CO2	To advice command on material and tactical aspects of mine warfare

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	1	3	1
CO2	3	1	1	1	2

Distribution of Marks.

Total Marks	ESE	ESE Duration
100	100	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of three parts; Part A, B and C. Part A contains 30 questions (10 – fill in the blank, 10 – choose the correct answer and 10 short answer) from each module, each question will be of one mark. Part B contains 08 questions;04 five-mark question 04 Three-mark question and 04 Two-mark question each. Each question can have maximum 2 sub-divisions. Part C will have practical comprising of 30 marks.

Module 1

Principles of Mine Warfare
(a) Types and Characteristics of mines
(b) Types of Mine Layers
(c) Types of Mine Fields

Module 2

Principles of Mine counter measures
(a) Types of mine counter measure operations
(b) Safety aspects for mined waters
(c) Mine and MCM Capabilities of Navy

References.

1. Naval Mine Warfare by Louis Gerken published by Armer Scientific Corp, First Edition printed in USA, 1989

4. INBR (Indian Naval Book of Reference)1836- Mine Counter Measure Doctrine
5. INBR (Indian Naval Book of Reference)1463- Mine and mining stores, Mine sweeping manual published in 1953
6. BR (Book of Reference) 2751/69/MOD – Handbook for mine disposal weapons published in 1969 by Ministry of Defence, Director General Weapons

24-8803-1013- ROCKET LAUNCHER RBU 6000 AND FIRE CONTROL SYSTEM (FCS)

Course Description. This course covers concepts of RBU6000, exploitation of RGB 60 rocket and Fire Control Systems

24-8803-1013	Rocket Launcher RBU 6000 and Fire Control System (FCS)	Category	L	T	P	Credit
		-	3	-	2	2

Pre-requisites. Basic working knowledge in rockets and principles of operation

Course Objectives (i) To acquire functional knowledge of RBU6000
(ii) To exploit the features of RGB 60 rocket
(iii) To carry out operation of ASW Fire Control Systems (FCS)

Course Outcome. After completion of the course, the student will be able to

CO 1	To conduct deployment and supervise maintenance of RBU 6000 and its system
CO 2	To acquire knowledge on the safety and maintenance of rocket launcher
CO 3	To be able to carry out and supervise the operations on anti-submarine computer PURGA, IAC Mod '0'/ 'C'

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	3	3	2
CO 2	3	3	2	3	2
CO 3	3	3	1	2	1

Distribution of Marks.

Total Marks	**ESE**	**ESE Duration**
150	150	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of three parts; Part A, B and C. Part A contains 30 questions (10 – fill in the blank, 10 – choose the correct answer and 10 short answer) from each module, each question will be of one mark. Part B contains 08 questions; 04 five-mark question, 04 three-mark question and 04 two-mark question each. Each question can have maximum 2 sub-divisions. Part C will have practical comprising of 50 marks

Module 1

1. Parts of RBU and its operational capabilities

2. Operation of A/S r/l RBU 6000

3. Loading, operation and safety precautions.

4. A/S rocket technical data, construction, function of propellant, fuzing/ defuzing of rocket

2. Safety precautions while handling rockets and pistols.

Module 2

1. Fire Control Systems (FCS)
   (a) Composition of Fire Control System with Class of Ships
   (b) Selection and operation of all pages/ display
   (c) Firing Procedure Main/Reserve Mode
   (d) Safety precautions, routine and maintenance
   (e) Sea and Action drills

2. IAC Mod '0' and IAC Mod 'C'
   (a) Introduction and purpose
   (b) Differentiate between IAC MOD `0' and MOD `C'
   (c) Modes of firing, Various data input for RL and torpedo firing
   (d) Practice of command-and-control order

References.

1. Rocket Launcher RBU 6000 Operating/Maintenance Instructions

2. Electrical Servo Drive Technical/Instructions/Descriptions on maintenance and care

3. RGB 60 Description and Handling Instructions Main Hoist and Small Hoist ML 36 Albums of Drawings

4. Principles of Naval Weapon Systems by DAVID R, Third Edition published by Naval Institute Press, Annapolis, Maryland 1985

5. Naval Operations Analysis, Third Edition by Daniel H Wagner, W Charles and Thomas J Sanders Naval Institute Press USA ,2002

6. Introduction to Torpedo Technology by Rear Admiral NK Ramanarasaiah (Retd), VSM ,DRDO, New Delhi, 1993

24-8803-1014 TACTICS I

Course Description. This course covers concepts of Seaward Defense

24-8803-1014	Tactics I	Category	L	T	P	Credit
		-	4	-	1	4

Pre-requisites. Nil

Course Objectives. To be able to comprehend ASW Tactics and carryout duties of anti-submarine warfare officer (ASWO) to conduct Anti-submarine operations

Course Outcome. After completion of the course, the student will be able to

CO 1	Conduct anti-submarine operations as anti-submarine warfare officer
CO2	Acquire knowledge on ASW operations, Sub surface domain awareness, attack plans and evasion by surface force.

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	1	2	2
CO 2	3	2	1	3	3

Distribution of Marks.

Total Marks	**ESE**	**ESE Duration**
200	200	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: Consists of two parts; Part A and B. Part A contains 40 questions (10 – fill in the blank, 10 – choose the correct answer 10 true and false and 10 short answer) from each module, each question will be of one mark. Part B contains 20 five-mark question, 10 Three-mark question and 15 Two-mark question each. Each question can have maximum 2 sub-divisions.

Module 1

Surface Operations
(a) Urgent attack, deliberate attack, Defensive measures
(b) Officer of tactical Command, Scene of action commander, Positioning of lookouts and sentries

Module 2

Screens
(a) Introduction to concepts of TDZ, MDZ, WDZ
(b) Evasive steering
(c) Datum
(d) Introduction to CLASP A and B and evasion course by surface forces
(e) Introduction to basics of screening.

Module 3

Air operations.
(a) Types of ASW aircraft
(b) Close support, distant support
(c) Safety precautions
(d) Airplans, conduct of ASW Air ops

Module 4

1. Submarine Operations
   (a) Actions on SUBMISS/ SUBSUNK
   (b) Safety of Submarine
   (c) Submiss/Subsunk organization, onboard sonar silence period
   (d) Identification of Submarine accident.
   (e) Communication with Submarine during ASW exercises

2. Operations room organization
   (a) Classification procedure
   (b) Antisubmarine action plot
   (c) Maintenance of various boards

Module 5

Coordinated operations.
(a) Phases of coordinated ops
(b) Actions on gaining contact
(c) Flow chart of action

References.

1. INMI (Indian Naval Maneuvering Instructions)
2. INCB (Indian Naval Charge Book) 38
3. MXP (Multinational Exercise Publication) 2 C and MXP 1 D

24-8803-1015 TACTICS II

Course Description. This course aims to assess the assimilation of knowledge by the trainee.

24-8803-1015	Tactics II	Category	L	T	P	Credit
		-	4	-	1	4

Pre-requisites. Concept of Operations, tactics and warfare planning

Course Objectives. To be able to comprehend Tactical scenarios and carryout planning for coordinated operations

Course Outcome. After completion of the course, the student will be able to

CO 1	Analyse, interprets and effectively undertake tactical scenarios onboard

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	3	3	1	2	2

Distribution of Marks.

Total Marks	ESE	ESE Duration
200	200	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: It will be conducted in two phases: theory based and practical with scenario based questions on tactical operations.

Module

Scenario based testing held at Maritime Warfare Centre on execution of operations which includes-

(a) Tactical scenario-based deductions and coordinated Operation
(b) Command planning
(c) Simulator handling
(d) Wargaming
(e) Safety precautions whilst handling of equipment and operating at sea
(f) Rules and regulations of safe navigation

References.

1. INMI (Indian Naval Maneuvering Instructions)
2. INCB (Indian Naval Charge Book) 38
3. MXP (Multinational Exercise Publication) 2 C and MXP 1 D
4. INBR 8

24-8803-1016 – PROJECT

Course Description. This course aims to assess the assimilation of knowledge by the trainee by undertaking a project on ASW based systems

24-8803-1016	Project	Category	L	T	P	Credit
		-	1	1	-	2

Pre-requisites. Should have undertaken course instruction on Sonar Systems/ functioning of ASW sensors and weapons

Course Objectives. To undertake a comprehensive study on ASW based systems

Course Outcome. After completion of the course, the student will be able to

CO 1	To apply concepts of ASW warfare to tactical scenarios

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	1	2	2

Distribution of Marks.

Total Marks	ESE	ESE Duration
200	200	2 hours

End Semester Examination Pattern.

End Semester Examination Pattern: It will be conducted as presentation along with viva with scenario-based questions covering aspects of ASW operation as per topic provided by the nominating authority at ASW School.

Module

Topics as relevant to ASW will be assigned by ASW School

(a) Research the subject topic assigned.

(b) Preparation of written report and presentation of findings to a professional audience.

Officers work results in developing ideas, concepts and procedures, which may assist in improving tactical, conceptual and strategic aspects of ASW Operations.

24-8803-1017 - ORAL BOARD

Course Description. This course aims to assess the assimilation of knowledge by the trainee.

24-8803-1017	Oral Board	Category	L	T	P	Credit
		-	1	-	-	4

Pre-requisites. Should be a full time trainee for the Long Course and have qualified in all subjects.

Course Objectives. To perform the duties of ASWO

Course Outcome. After completion of the course, the student will be able to

CO 1	Analyse a prevailing situation at sea and take appropriate measures to counter the threat from the perspective of ASW and mine countermeasures operations.

Mapping of course outcomes with program outcomes: Level-Low (1), medium (2) and high (3)

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	1	2	2

Distribution of Marks.

Total Marks	ESE	ESE Duration
210	210	3 hours

End Semester Examination Pattern.

End Semester Examination Pattern: It will be conducted in two phases: theory based and practical with scenario-based questions on sonar operations.

Module

Scenario based testing on equipment handling which includes-

(a) Tactical scenario-based deductions and Operation of sonar and sonar controller
(b) Command and control orders
(c) Simulator handling
(d) Safety precautions whilst handling of equipment

References.

1. INMI (Indian Naval Maneuvering Instructions)
2. INCB (Indian Naval Charge Book) 38
3. MXP (Multinational Exercise Publication) 2 C and MXP 1 D
4. INBR 8 (Indian Maritime Doctrine)
5. INTI (Indian Naval Tactical Instructions)