

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
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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) **Practical.** 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: -

$$\text{CGPA} = \frac{(G1C1 + G2C2 + G3C3 + \dots + GnCn)}{(C1 + C2 + C3 + \dots + Cn)}$$

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	<u>Classification</u>	<u>CGPA</u>
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 VERTREP, 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	Advise 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 manoeuvring & 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 techniques. 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.

24-8603-0112	Electronic Warfare SYSTEM	Category	L	T	P	Credit
		-	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, Cisco Press, 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
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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.

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