



European Radiocommunications Committee (ERC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)



**EXAMINATION SYLLABI FOR 1ST CLASS AND 2ND CLASS RADIO-
ELECTRONICS CERTIFICATES FOR THE GMDSS SYSTEM**

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EXAMINATION SYLLABI FOR 1ST CLASS AND 2ND CLASS RADIO-ELECTRONICS CERTIFICATES FOR THE GMDSS SYSTEM

The start of the Global Maritime Distress and Safety System (GMDSS) in February 1992 has made it necessary to harmonise the examination requirements for certificates of maritime radio operators.

Article 55 of the ITU Radio Regulations specifies the conditions governing the issue of GMDSS certificates for the personnel of ship stations and ship earth stations, and Article 56 also requires Administrations to ensure that the personnel of ship stations and ship earth stations operating in accordance with the GMDSS are adequately qualified to enable efficient operation of the station.

Provisions of the GMDSS, closely related to the Maritime Mobile Service and the Maritime Mobile-Satellite Service, are also given in IMO Conventions, notably the International Convention for the Safety of Life at Sea (SOLAS). The International Convention on Standards of Training, Certification and Watch keeping (STCW) also regulates the conditions for the issue of GMDSS certificates.

The GMDSS is to be fully implemented by February 1999 for vessels subject to SOLAS. Harmonised examination procedures for the General Operator's Certificate (GOC) and Restricted Operator's Certificate (ROC) have already been introduced for maritime radio operators performing radiocommunication duties on board vessels subject to SOLAS under ERC Recommendation 31-03. The syllabi contained in Recommendation 31-03 was created in close cooperation with IMO secretariat.

The IMO Sub-Committee on Standards, Training and Watch keeping (STW) has agreed to consider, in its comprehensive review of the STCW Convention, whether the STCW Regulations, instead of cross-referencing in Chapter IV to certificates issued in accordance with the Radio Regulations, should contain all the knowledge and training requirements for the issue of radio certificates rather than, as at present, only the additional safety requirements.

The STW Sub-Committee has already agreed that the CEPT GOC and ROC examination syllabi should be broadened into international standards by using them as a basis for the development of GMDSS model training courses.

The CEPT arrangements for issuing GMDSS certificates to holders of non-GMDSS certificates were also used as the basis of the IMO Assembly Resolution A.769(18) of November 1993.

Several countries reported their preference to have a radio electronics certificate holder on board when sailing in sea areas A3/4 instead of using one of the additional alternatives of equipment duplication or shore based maintenance. They felt that communications duties in A3/4 areas needed the skills of a radio-electronics certificate.

Other countries noted the difficulties that had been experienced with trying to define standards for shore-based maintenance companies and that similar qualifications could be useful for shore based maintenance personnel. The 39th meeting of the IMO Sub-Committee on Radiocommunications had also called for repair and installation personnel to be better trained in order to reduce the excessive number of false alerts - many of which turn out to be associated with servicing and installation tests.

The IMO secretariat requested the work to be extended to examination syllabi for GMDSS Certificates to include the 1st and 2nd Class Radio-electronics Certificates in the hope that a generic family of syllabi could be produced in the CEPT format. The intention was that syllabi for all four GMDSS Certificates defined in the Radio Regulations would form the basis of IMO Model Courses and would be linked with the revision of the International Convention on Standards of Training, Certification and Watch keeping (STCW).

This report describes the examination syllabi for the issue of 1st Class and 2nd Class Radio-electronics Certificates. Since these syllabi are of interest only to a small number of CEPT administrations, they are presented in the form of a report instead of a recommendation. The syllabus for 1st class Radio-electronics Certificate is in annex 1. The syllabus for 2nd class Radio-electronics Certificate is in annex 2.

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ANNEX 1

EXAMINATION SYLLABUS FOR THE 1st CLASS RADIOELECTRONICS CERTIFICATE FOR THE MARITIME MOBILE SERVICE AND THE MARITIME MOBILE-SATELLITE SERVICE

The examination should consist of theoretical and practical tests and should include at least:

- A. DETAILED KNOWLEDGE OF THE MARITIME MOBILE SERVICE AND THE MARITIME MOBILE-SATELLITE SERVICE**
 - A1. The principles and features of the maritime mobile service
 - A2. The principles and features of the maritime mobile-satellite service

- B. DETAILED THEORETICAL KNOWLEDGE AND ABILITY TO USE THE BASIC EQUIPMENT OF A SHIP STATION**
 - B1. Principles of electricity and theory of radio and electronics relevant to GMDSS communications and ancillary equipment
 - B2. Use in practice the basic equipment of a ship station
 - B3. Digital Selective Calling (DSC)
 - B4. General principles of Narrow Band Direct Printing (NBDP) and Telex Over Radio (TOR) systems. Use maritime NBDP and TOR equipment in practice
 - B5. Usage of INMARSAT systems. Use INMARSAT equipment or simulator in practice

- C. OPERATIONAL PROCEDURES IN THE GMDSS AND DETAILED KNOWLEDGE OF THE OPERATION OF THE GMDSS AND SUBSYSTEMS**
 - C1. Global Maritime Distress and Safety System (GMDSS)
 - C2. INMARSAT
 - C3. Marine Safety Information (MSI) and Navtex
 - C4. Emergency Position Indicating Radio Beacons (EPIRBs)
 - C5. Search and Rescue Radar Transponder (SART)
 - C6. Distress, urgency and safety communication procedures in the GMDSS
 - C7. Search and rescue (SAR) operation

- D. GENERAL KNOWLEDGE OF SHIP STATION RADIO NAVIGATION EQUIPMENT**
 - D1. Basic knowledge of navigational techniques
 - D2. General principles and functions of Radar systems
 - D3. General principles and functions of navigational aids

- E. PRACTICAL KNOWLEDGE OF MAINTENANCE PROCEDURES AND ABILITY TO MAINTAIN SHIP STATION EQUIPMENT IN SERVICE**
 - E1. Practical knowledge necessary for carrying out preventive maintenance procedures on ship station communication and radionavigation equipment
 - E2. Detailed practical knowledge necessary for locating faults in ship station communication and radionavigation equipment
 - E3. Detailed practical knowledge necessary for effecting repairs on ship station communication and radionavigation equipment
 - E4. Preparation of technical records and reports concerning repair and maintenance of radio communication and radionavigation equipment

F. MISCELLANEOUS SKILLS AND OPERATIONAL PROCEDURES FOR GENERAL COMMUNICATIONS

- F1. Ability to use English language, both written and spoken, for the satisfactory exchange of communications relevant to the safety of life at sea
- F2. Obligatory procedures and practices
- F3. Practical and theoretical knowledge of general communication procedures
- F4. Telephone systems
- F5. General awareness of Electro-Magnetic Compatibility (EMC)

EXAMINATION SYLLABUS GUIDELINES FOR THE 1st CLASS RADIOELECTRONICS CERTIFICATE

A. DETAILED KNOWLEDGE OF THE MARITIME MOBILE SERVICE AND THE MARITIME MOBILE-SATELLITE SERVICE

A1. The principles and features of the maritime mobile service

- 1.1 Types of communication in the maritime mobile service
 - Distress, urgency and safety communications
 - Public correspondence
 - Port operations service
 - Ship movement service
 - Intership communication
 - On-board communications
- 1.2 Types of station in the maritime mobile service
 - Ship stations
 - Coast stations
 - Pilot stations, port stations etc.
 - Aircraft stations
 - Maritime rescue coordination centre MRCC
- 1.3 Detailed knowledge of frequencies and frequency bands
 - The concept of frequency
 - The equivalence between frequency and wavelength
 - The unit of frequency: Hz, kHz, MHz, GHz.
 - The subdivision of the most significant part of the radio spectrum: MF, HF, VHF, UHF, SHF
- 1.4 Characteristics of frequencies
 - Different propagation mechanisms
 - Free space
 - Ground wave
 - Ionospheric propagation
 - Tropospheric propagation
 - Abnormal propagation
 - Propagation on MF frequencies
 - Propagation on different HF frequency bands
 - Propagation on VHF and UHF frequencies
- 1.5 Communication theory
 - Modulation
 - Amplitude Modulation
 - Frequency Modulation
 - Frequency Shift Keying
 - Pulse Modulation
 - Comparison of modulation technique
 - Effect of under or over modulation
 - Noise
 - White Noise
 - Nyquist (thermal) noise
 - 1/f noise
 - Sources of Noise
 - Stray pickup - Electromagnetic Compatibility
 - Noise figure and noise temperature
 - Information content
 - Continuous systems
 - Discrete systems

- Radiocommunication link budget
 - Transmission losses
 - Channel capacity and bandwidth
 - Signal-to-noise criteria
- Radar systems
 - The concept of Radio Detection And Ranging
 - Propagation and the Radar range equation
 - Doppler radar

1.6 The various modes of communication

- DSC
- Radio telephony
- NBDP
- Facsimile
- Data
- Morse telegraphy (Knowledge of system only, no speed requirement)
- Classes of emission
 - Carrier frequency and assigned frequency
 - Bandwidth of different emissions
 - Official designations of emission (e.g. F1B, J3E, A3E, A1A etc.)
 - Unofficial designations of emissions (e.g. TLX, SSB, AM, CW etc.)

1.7 Frequencies allocated to the maritime mobile service

- The usage of MF, HF, VHF, UHF and SHF frequencies in the maritime mobile service
- The concept of radio channel. Simplex, semi-duplex and duplex. Paired and unpaired frequencies
- Frequency plans and channelling systems
 - HF telephony (Relevant appendix of the Radio Regulations)
 - VHF telephony (Relevant appendix of the Radio Regulations)
 - HF NBDP (Relevant appendixes of the Radio Regulations)
 - MF telephony and NBDP for Region 1 (Geneva 85 plan)
- GMDSS distress and safety frequencies
- Distress and safety frequencies of the non-GMDSS system
- Calling frequencies

A2. The principles and features of the maritime mobile-satellite service

2.1 Maritime satellite communications

- INMARSAT space segment
 - Satellite orbits
 - Up and down links
 - Single and multiple access channelling
 - Link budget
 - Path loss and antenna gain
 - Information capacity
 - Noise temperature
 - Bit Error Rates (BER)
- Modes of communication
 - Telex services
 - Telephone services
 - Data and facsimile communications
 - Store and forward operation
- Distress communications
- INMARSAT-A communications services
- INMARSAT-C communications services
- INMARSAT Enhanced Group Call (EGC) system
- INMARSAT-B communications services
- INMARSAT-M communications services

- 2.2 Types of station in the maritime mobile satellite service
- Coast Earth Stations (CES)
 - Network Co-ordination Station (NCS)
 - Ship Earth Stations (SES)

B. DETAILED THEORETICAL KNOWLEDGE AND ABILITY TO USE THE BASIC EQUIPMENT OF A SHIP STATION (FOR TRAINING, ACTUAL EQUIPMENT IS PREFERABLE)

B1. Principles of electricity and theory of radio and electronics relevant to GMDSS communications and ancillary equipment

- 1.1 Detailed knowledge of electricity and magnetism
- Electro-motive force (emf): primary and secondary cells
 - Electrostatics and the origin of capacitance
 - Magnetic materials and permanent magnets
 - Electromagnetism and electromagnets
 - Interaction of magnetic fields
 - Electromagnetic induction and origin of inductance
 - Magnetic field produced by a current: Ampere's Law
 - Induced emf: Faraday's Law
 - Self inductance and mutual inductance and relationship to the transformer principle: Lenz's Law
 - Basic electrical components: resistors, capacitors, inductors and transformers
 - Rotating electrical machines: motors and generators
- 1.2 Electrical circuit analysis
- Sinusoidal waveforms
 - Frequency, amplitude and phase
 - Peak, RMS, and average values
 - Power factor
 - Complex waveforms
 - Analysis theorems for direct and alternating current circuits
 - Kirchoff's Law
 - Maximum power transfer
 - Principle of superposition
 - Series and parallel networks
 - Potentiometer and bridge circuits
 - Reactance and impedance
 - Decibels
 - Transient currents and responses
 - Inductive and capacitive time constants
 - Square wave response and ringing
 - RC and RL networks
 - Differentiating and integrating circuits
 - Tuned circuits
 - LCR resonant circuits
 - Quartz crystal resonance
 - Series resonant circuits (acceptor)
 - Parallel resonant circuits (rejector)
 - Resonance curves and selectivity
 - Magnification Q Factor
 - Bandwidth and $\frac{1}{2}$ power points
 - Dynamic resistance
 - L/C Ratio
 - Coupled circuits
 - Filters
 - LCR lumped component filters
 - Crystal and ceramic filters
 - Surface acoustic wave filters (SAWF)

- Transformers and transformer ratio
- Screening
- Balanced and unbalanced circuits

1.3 Semiconductor devices and thermionic valves

- Thermionic, photo-electric and secondary emission
- Conduction in semiconducting materials
 - Energy bands
 - Electrons and holes
 - Electro-optical effects
- Characteristics, functions and usage of standard semiconductor devices
 - Semiconductor diodes
 - Junction and field effect transistors
 - Other semiconductor devices, including tunnel diodes, Zener diodes, varicap diode, silicon controlled rectifiers, photo-electric cells and light emitting diodes (LEDs)
- Semiconductor integrated circuit technology
- Characteristics, functions and usage of standard thermionic valves
 - Thermionic diodes
 - Thermionic triodes, beam tetrodes, pentodes and other multi-grid valves
 - Voltage regulator tubes
 - Cathode ray tubes

1.4 Analogue electronics

- Voltage amplifiers
 - Cascading
 - Low frequency gain
 - High frequency gain
 - Decoupling
- Feedback Amplifiers
 - Negative feedback
 - Voltage feedback
 - Current feedback
 - Gain, bandwidth and distortion
 - Stability
- Power amplifiers
 - Classes of operation
 - Coupling
 - Efficiency
- Tuned amplifiers
 - Tuned couplings
 - Neutralisation
- Operational amplifiers
 - Operational feedback
 - Simple mathematical operations
 - Analogue computers
 - Measurement and control
- Special purpose amplifiers
 - Cascode amplifiers
 - DC amplifiers
 - Differential amplifiers
 - Chopper amplifier
 - Lock-in amplifier
- Voltage regulators
 - Series regulator
 - Practical circuits

- Servo amplifiers and control circuits
 - Feedback mechanisms
 - Stability and system response
 - Open/closed loop gain and response
 - Step, ramp, exponential and steady inputs
 - Inertia: transport and transfer lags
- Oscillators
 - Positive feedback
 - RC Oscillators: phase shift and Wien-bridge
 - Resonant circuit oscillators: LC and crystal
 - Relaxation oscillators: sawtooth and blocking
 - Voltage controlled oscillators (VCO)
 - Frequency stability and control
 - Converters and inverters
 - Regenerative and super-regenerative detectors
- Pulse Circuits
 - Multivibrators and triggers
 - Astable, bistable and monostable multivibrators
 - Schmitt trigger
 - Gate and switching circuits
 - Pulse amplifiers
 - Pulse width and amplitude
 - Rise and decay times
 - Tilt, overshoot and sag
 - Square wave response, repetition frequency and mark/space ratio
 - Waveform generators and time bases
 - The diode pump
 - Ramp generators
 - Pulse regeneration
- Linear integrated circuits

1.5 Digital electronics

- Number systems: Binary and decimal
- Codes: binary, Binary Coded Decimal (BCD), Johnson and Gray
- Combinatorial logic and analysis
 - Boolean algebra
 - Truth tables, Venn diagrams and Karnaugh maps
 - Logic gates
 - AND, OR, NOT, NOR, NAND, Exclusive-OR and Wired-OR gates
 - Simple networks
- Sequential logic
 - Flip-flops: basic types, clocked and Master-Slave
 - Counters: synchronous and asynchronous, shift registers and ring counters
 - Dividers: binary, quinary, bi-quinary, decade
 - Encoders and decoders: binary/decimal and Johnson
 - Displays: driver circuits for LED and LCD displays
- Operational characteristics of digital integrated circuits
 - TTL, CMOS and ECL technology
 - Loading: fan-in and fan-out
 - Propagation delay
 - Logic levels and polarity
 - Very Large Scale Integration (VLSI)
- Frequency synthesisers
- Digital to analogue and analogue to digital conversion
- Microprocessors
 - Registers: instruction, store address, accumulator, status
 - Memory: Read Only Memory (ROM), Random Access Memory (RAM) static and dynamic
 - Arithmetic and logic unit
 - Program counter, control and timing

- Microprocessor control units and digital computers
 - The SECD-Machine archetype
 - Stack: data and instruction transfer within and between registers and memory
 - Environment: instruction set, address bus, control bus and data bus
 - Control: logic and arithmetic instruction processing, timing, system interrupts and stored program control
 - Dump: input, output and garbage collection

- 1.6 Technology of maritime radiocommunication and radionavigation equipment
 - Power supply stages and voltage regulation
 - RF small signal and power amplifier stages
 - Oscillators and frequency synthesiser stages
 - Frequency conversion, multiplication and mixer stages
 - Signal modulation and demodulation
 - Signal multiplexing and demultiplexing
 - Audio input/output and amplification stages
 - Analogue transducers
 - Microphones
 - Loudspeakers
 - Magnetic tape recording
 - Data input and output
 - Basic computing theory and application skills
 - Microprocessor control functions and techniques
 - Microcomputer interfaces
 - Terminal equipment
 - Video Display Units (VDUs)
 - 2/4 wire sound circuits, hybrid couplers and echo suppression
 - Modems
 - Narrow Band Direct Printing (NBDP) techniques
 - Fundamental principles
 - Methods of error protection including Acknowledge/Request (ARQ) & Forward Error Correction (FEC)
 - Effect of noise and propagation conditions
 - Auxiliary equipment
 - Digital Selective Calling (DSC) systems
 - Fundamental principles
 - Effect of noise and propagation conditions
 - Effect of excessive channel loading
 - Data output and control functions
 - Facsimile techniques
 - Fundamental principles
 - Transducers
 - Modulation systems
 - Reproduction
 - Recorder circuits
 - Synchronisation
 - Picture faults
 - Television
 - Fundamental principles
 - Camera systems
 - Scanning
 - Receiver display units
 - Video recording units
 - Emergency Position Indicating Radio Beacons (EPIRBs)
 - Search And Rescue Radar Transponders (SARTs)
 - Ship station transmitters
 - Purpose and function of the various stages, modules and component parts

- Ship station receivers
 - Purpose and function of the various stages, modules and component parts
 - Principles of the superheterodyne: single/double conversion, intermediate frequency
 - Considerations of sensitivity and selectivity and gain control
 - Reception difficulties: effect of noise, intermodulation and image frequency response
- Satellite SES equipment
 - Purpose and function of the various stages, modules and component parts
 - INMARSAT SES stabilised platforms and reserve power supplies

1.7 Antennas, transmission lines and waveguides

- Antenna design, characteristics and usage
 - Aperture and gain
 - Impedance
 - Radiation resistance
- Antenna matching and radiation
 - Hertzian type antennas
 - Marconi type antennas
 - Antenna tuning unit
 - Ground connections
- Matching feeder lines, cables and waveguides
 - Reflections, delay time, resonance and VSWR
- Ship station antennas
 - Isolators
 - VHF whip antennas
 - MF/HF whip antennas
 - MF/HF wire antennas
 - Microwave antennas for Radar and SES

1.8 Construction and safety ratings of electrical and electronic components

- Fuses, current and earth leakage circuit breakers
- Resistors, insulators and capacitors
- Wound components: transformers, relays, inductors and motors
- Semiconductor components
- Thermionic components

1.9 Shipboard power supplies, including emergency sources

- Electrical generators
- Single phase AC power supplies
- 3-phase AC power supplies
- Voltage stabilisers
- DC to AC converters
- DC to DC converters
- Uninterrupted battery-backed power supply units
- Main, reserve and standby power supplies

B2. Use in practice the basic equipment of a ship station

2.1 Watchkeeping Receivers

- The controls and usage of 2182 kHz watch receiver
- The controls and usage of VHF DSC watch receiver
- The controls and usage MF DSC watch receiver and MF/HF DSC watch receiver

2.2 VHF radio installation

- Channels
- Controls
- Usage
- DSC
- VHF DSC controller

- 2.3 MF/HF radio installation
 - Frequencies
 - Typical controls and usage, E.g.
 - connecting the power
 - selecting RX frequency
 - selecting TX frequency
 - selecting ITU channel number
 - tuning the transmitter
 - selecting the class of emission
 - using volume control and squelch
 - using clarifier or RX fine tuning
 - controlling RF gain
 - using automatic gain control
 - using the 2182 kHz instant selector
 - testing the alarm generator
 - using the alarm generator
 - MF/HF DSC controller

- 2.4 Survival craft radio equipment
 - Portable two-way VHF radiotelephone apparatus
 - SART including installation techniques
 - EPIRB including installation techniques

B3. Digital Selective Calling (DSC)

- 3.1 Call format specifier
 - distress call
 - all ships call
 - call to individual station
 - geographic area call
 - group call
 - automatic/semiautomatic service

- 3.2 Call address selection with the MMSI number system
 - the nationality identification
 - group calling numbers
 - coast station numbers
 - MMSI number with three trailing zeros

- 3.3 Call categorisation
 - distress
 - urgency
 - safety
 - ship business
 - routine

- 3.4 Call telecommand and traffic information
 - distress alerts
 - other calls
 - working frequency information

B4. General principles of NBDP and TOR systems. Use maritime NBDP and TOR equipment in practice

- 4.1 NBDP systems
 - Automatic systems
 - Semiautomatic systems
 - Manual systems
 - Acknowledge/Request (ARQ) mode
 - Forward Error Correcting (FEC) mode
 - ISS/IRS arrangement
 - Master and slave
 - Radio telex number
 - Answerback
 - Numbering of the SSFC selective calling system (SSFC = Sequential Single-Frequency Code System)
- 4.2 TOR equipment
 - Controls and indicators
 - Keyboard operation

B5. Usage of INMARSAT systems. Use INMARSAT equipment or simulator in practice

- 5.1 INMARSAT-A and INMARSAT-B Ship Earth Stations
 - Satellite acquisition
 - Telex services
 - Telephone services
 - Data and facsimile communications
- 5.2 INMARSAT EGC Receiver
 - Pre-programming an SES for EGC message reception
 - Selecting operating mode for EGC reception
- 5.3 INMARSAT-C Ship Earth Station
 - Components of an INMARSAT-C terminal
 - Entering/updating position
 - Usage of an INMARSAT-C Ship Earth Station
 - Sending and receiving test messages
- 5.4 INMARSAT-M Ship Earth Station
 - Components of an INMARSAT-M terminal
 - Usage of an INMARSAT-M ship earth station

C. OPERATIONAL PROCEDURES IN THE GMDSS AND DETAILED KNOWLEDGE OF THE OPERATION OF THE GMDSS AND SUBSYSTEMS

C1. Global Maritime Distress and Safety System (GMDSS)

- 1.1 Sea Areas and GMDSS Master Plan
- 1.2 Watchkeeping on distress frequencies
- 1.3 Functional requirements of ship stations
- 1.4 Carriage requirements of ship stations
- 1.5 Sources of energy of ship stations
- 1.6 Means of ensuring the functionality of ship station equipment
- 1.7 Licences, radio safety certificates, inspections and surveys

C2. INMARSAT

- 2.1 INMARSAT-A and INMARSAT-B Ship Earth Stations
- Distress communications
 - Use of the distress facility
 - Satellite acquisition
 - Telex and telephony distress calls
 - Procedures for distress calls
 - Rescue Co-ordination Centres associated with the Coast Earth Stations
- 2.2 INMARSAT-C Ship Earth Station
- Distress and safety services
 - Sending a distress alert
 - Sending a distress priority message
 - The INMARSAT-C safety services
 - 2 digit code sequences
- 2.3 INMARSAT EGC
- Purpose of EGC system
 - All-ships messages and INMARSAT system messages
 - Classes of INMARSAT-C SES and their EGC reception
- 2.4 INMARSAT-M Ship Earth Stations

C3. MARITIME SAFETY INFORMATION (MSI) AND NAVTEX

- 3.1 Maritime Safety Information
- International SafetyNET Service
 - Frequencies
 - Reception range
 - Types of message
- 3.2 The NAVTEX system
- Purpose of NAVTEX
 - NAVTEX frequencies
 - Reception range
 - Message format (transmitter ID, message type, message number)
- 3.3 NAVTEX receiver
- Selection of transmitters
 - Selection and identification of message types
 - Messages which cannot be rejected
 - Use of subsidiary controls and changing paper

C4. Emergency Position Indicating Radio Beacons (EPIRBs)

- 4.1 Satellite EPIRBs
- Basic characteristics of operation on 406 MHz (121.5 MHz including homing functions)
 - Basic characteristics of operation on 1.6 GHz
 - Information contents of a distress alert
 - Manual usage
 - Float-free function
 - Routine maintenance
 - Testing
 - Checking battery expiry date
 - Cleaning of the float-free release mechanism

- 4.2 VHF-DSC-EPIRB
- The main technical characteristics
 - Information contents of a distress alert
 - Manual operation
 - Float-free function
 - Routine maintenance
 - Testing
 - Checking battery expiry date
 - Cleaning of the float-free release mechanism

C5. Search and Rescue Radar Transponder (SART)

- 5.1 Search and Rescue Radar Transponder SART
- The main technical characteristics
 - Operation
 - Range of a SART transmitter
 - Routine maintenance of a SART
 - Checking battery expiry date

C6. Distress, urgency and safety communication procedures in the GMDSS

- 6.1 Distress communications
- DSC distress alert
 - The definition of a distress alert
 - Transmission of a distress alert
 - Transmission of a shore-to-ship distress alert relay
 - Transmission of a distress alert by a station not itself in distress
 - Receipt and acknowledgement of DSC distress alert
 - Acknowledgement procedure by radiotelephony
 - Acknowledgement procedure by NBDP
 - Receipt and acknowledgement by a coast station
 - Receipt and acknowledgement by a ship station
 - Handling of distress alerts
 - Preparations for handling of distress traffic
 - Distress traffic terminology
 - Testing DSC distress and safety calls
 - On-scene communications
 - SAR operation
- 6.2 Urgency and Safety communications
- The meaning of urgency and safety communications
 - Procedures for DSC urgency and safety calls
 - Urgency communications
 - Medical transports
 - Safety communications
- 6.3 Communication by radiotelephony with stations of the old distress and safety system
- Radiotelephone alarm signal
 - Distress signal
 - Distress call
 - Distress message
 - Acknowledgement of a distress message
 - Distress traffic terminology
 - Transmission of a distress message by a station not itself in distress
 - Medical advice

- 6.4 Reception of maritime safety information (MSI)
 - Reception by NAVTEX
 - Reception by INMARSAT EGC
 - Reception by HF NBDP
 - The navigational warning signal of the old distress and safety system
 - The navigational warnings transmitted by radio telephony

- 6.5 Protection of distress frequencies
 - Guard bands
 - Tests on distress frequencies
 - Transmissions during distress traffic
 - Avoiding harmful interference - with special attention to avoiding transmission of false distress alerts
 - Prevention of unauthorized transmissions

C7. Search and rescue operation (SAR)

- 7.1 The role of Rescue Coordination Centres (RCCs)
- 7.2 Merchant Ship Search and Rescue Manual (MERSAR)
- 7.3 Maritime rescue organisations
- 7.4 Ship reporting systems

D. GENERAL KNOWLEDGE OF SHIP STATION RADIO NAVIGATION EQUIPMENT

D1. Understanding of navigational techniques

- 1.1 Types of navigation chart and their information contents
 - Latitude and longitude
 - Distance and bearing
 - Depth

- 1.2 Navigational methods and interpretative skills
 - Methods of fixing position
 - Sources of position lines
 - Plane and Mercator sailing
 - Effect of currents and tides

- 1.3 Radio direction finding and calibration procedures
 - Fundamental principles of radio direction finding apparatus
 - Antenna patterns and determination of alignment
 - Factors affecting quality and accuracy of observations
 - Environmental factors
 - Nocturnal effects
 - Coastline effects
 - Common observational errors
 - Precautions to be observed in the interpretation of displayed information
 - Operate representative equipment and interpret the information displayed competently

D2. General principles and functions of Radar systems

- 2.1 Radar apparatus technology
 - Purpose and function of Radar systems
 - Navigational Radar
 - Anti collision Radar
 - Types of Radar display presentation and their information contents
 - Plan Position Indicator (PPI) display
 - Raster display
 - Automatic Radar Plotting Aids (ARPA)
 - Radar subsystems and component parts
 - Power supplies
 - Initiation and synchronising circuits
 - Time base circuits
 - Brightening and blanking circuits
 - Bearing transmission systems
 - Ranging circuits
 - Azimuth stabilisation circuits
 - Anti-clutter circuits
 - Microwave oscillators
 - Radar transmitters
 - Radar receivers
 - Electro-mechanical components

- 2.2 Radar system performance and standard types of error
 - Basic accuracy and performance capabilities of Radar systems and equipment
 - Characteristic errors of Radar systems
 - Common observational errors
 - Maladjustment and input errors
 - Setting of heading marker

- 2.3 Ability to use Radar and ARPA equipment or simulators in practice
 - Carry out performance checks
 - Optimise display via operational controls
 - Recognise and rectify maladjustment and input errors
 - Interpret and appreciate information displayed
 - Detect and recognise targets
 - Measure and interpret target range and bearing data
 - Assess the effects of alterations in course and speed of the vessels involved
 - Recognise and rectify systematic errors
 - Construct a standard Radar plot
 - Plot position by range and bearing
 - Recognise accuracy of position obtained
 - Maintain ARPA plot by automatic and manual acquisition of targets
 - Radar reporting procedures

D3. General principles and functions of navigational aids

- 3.1 Hyperbolic and satellite position fixing equipment
 - Fundamental principles of hyperbolic navigation
 - Time difference and phase difference
 - Sources and causes of errors
 - Corrections and expected accuracy
 - Coverage areas
 - Operate standard shipboard equipment or simulators according to equipment manuals
 - Decca navigator and systems based on Decca
 - Omega
 - Loran C
 - Major satellite navigational systems

- Interpret observed information
 - Apply error corrections
 - Plot data on appropriate chart
 - Determine expected accuracy

3.2 Gyro compass and repeaters

- Fundamental principles of the gyro controlled north seeking compass
 - Difference between true and magnetic poles
 - Corrections for latitude, course and speed
 - Settling time
 - Characteristic errors
- Carry out start up procedure and performance checks on representative equipment
 - Adjust operational controls
 - Align repeaters with master compass
 - Recognise any errors

3.3 Echo sounding equipment

- Fundamental principles of shipboard echo sounders
- Methods of displaying information
- Transducers
- Transmitter and receiver systems such as pulse and Doppler
- Factors affecting quality and accuracy of soundings
- Precautions to be observed in the interpretation of displayed information
- Operate representative equipment and interpret the information displayed competently

3.4 Speed and distance measuring equipment

- Fundamental principles of electronic speed and distance measuring equipment
- Factors affecting quality and accuracy of readings
- Precautions to be observed in the interpretation of the course and speed information provided
- Operate representative equipment and interpret the information provided competently

3.5 Auto pilot

- Application of basic control theory to auto pilot systems
 - Steering characteristics
 - Effect of adjustment of operational controls
- Operate and adjust representative equipment to provide optimum course accuracy

E. PRACTICAL KNOWLEDGE OF MAINTENANCE PROCEDURES AND ABILITY TO MAINTAIN SHIP STATION EQUIPMENT IN SERVICE

E1. Practical knowledge necessary for carrying out preventive maintenance procedures on ship station communication and radionavigation equipment

- 1.1 Proficiency in performing preventive maintenance procedures, according to manufacturers' instructions,
- using appropriate standard test facilities and tools
 - Routine and preventative maintenance procedures
 - Purpose and use of test programmes and any other possible check facilities
 - Setting up procedures
 - Problem areas and means of avoiding wear, malfunctions and failures
 - Use of various lubricants and cleaning agents
 - Problems caused by damaged or corroded transducers
 - Need to prevent condensation and ingress of water

1.2 Different kinds of batteries and their characteristics

- Primary cells
 - Zinc-Carbon
 - Alkaline
 - Lithium
- Secondary cells
 - Lead-Acid
 - Nickel-Cadmium (NiCd)
 - Nickel-Iron (NiFe)

1.3 Maintenance of batteries and battery charger/invertor systems

1.4 Maintenance of ship station antenna systems and cable/waveguide runs

E2. Detailed practical knowledge necessary for locating faults in ship station communication and radionavigation equipment

2.1 Apply safety precautions and use safe working practices

2.2 Proficiency in detailed fault localisation and logical fault finding techniques

- waveform and
- Interpret information provided by means of data output, built-in measuring instruments/software, or by appropriate selection and use of standard test and measuring equipment (e.g., Moving coil instruments, digital instruments, oscilloscopes, spectrum analysers) and tools
 - Use technical installation and service manuals, interpret circuit diagrams and engineering drawings
 - Locate area of fault to modular/unit level and, depending upon constraints of equipment design, down to component level

E3. Detailed practical knowledge necessary for effecting repairs on ship station communication and radionavigation equipment

3.1 Proficiency in fault repair down to component level using appropriate standard test equipment and tools

- Apply relevant regulations and codes of practice for the repair and replacement of electronic units and components
- Correct representative faults/defects in all areas of ship station equipment through repair or replacement of modular units or components as appropriate, demonstrating the necessary practical skills
 - Active component (or module) fault
 - Passive component (or module) fault
 - Fuse fault
 - Maladjusted preset control

3.2 Construction of an MF emergency antenna

3.3 Jointing and termination techniques for RF cables and waveguides

E4. Preparation of technical records and reports concerning repair and maintenance of radio communication equipment and electronic navigational aids

4.1 Requirements for keeping technical records

4.2 Presentation of the standard types of technical report

- Maintenance records and reports
- Analysis, diagnosis and correction of faults
- Performance testing
- Recommended modifications
- Maintaining correct numbers of spare parts

F. MISCELLANEOUS SKILLS AND OPERATIONAL PROCEDURES FOR GENERAL COMMUNICATIONS

F1. Ability to use English language, both written and spoken, for the satisfactory exchange or communications relevant to the safety of life at sea

- 1.1 Use of the International Code of Signals and the IMO Standard Marine Navigational Vocabulary/Seaspeak
- 1.2 Recognised standard abbreviations and commonly used service codes
- 1.3 Use of international phonetic alphabet

F2. Obligatory procedures and practices

- 2.1 Effective use of obligatory documents and publications
- 2.2 Radio record keeping
- 2.3 Knowledge of the regulations and agreements in force governing the maritime mobile service and the maritime mobile-satellite service

F3. Practical and theoretical knowledge of general communication procedures

- 3.1 Selection of appropriate communication methods in different situations
- 3.2 Traffic lists
- 3.3 Radio telephone call
 - Method of calling a coast station by radiotelephony
 - Ordering for a manually switched link call
 - Ending the call
 - Special facilities of calls
 - Method of calling a coast station by DSC
 - Selecting an automatic radiotelephone call
- 3.4 Radio telegram
 - The parts of a radio telegram
 - preamble
 - service instructions and indications
 - address
 - text
 - signature
 - Addresses
 - full address
 - registered address
 - telephonic address
 - telex address
 - Counting of words
 - Transmission of a telegram by radiotelephony
 - Transmission of a telegram by radiotelex
- 3.5 Traffic charges
 - International charging system
 - INMARSAT communication charging system
 - Accounting Authority Identification Code (AAIC)
 - The meaning of land line charge (LL), coast charge (CC) and ship charge (SS)
 - Currencies used in international charging

- 3.6 Practical traffic routines
- 3.7 World geography, especially the principal shipping routes and related communication routes

F4. Telephone Systems

- 4.1 Theoretical and operational knowledge of shipboard telephone systems
- 4.2 Theoretical and operational knowledge of the Cellular Telephone Network

F5. Electro-Magnetic Compatibility (EMC)

- 5.1 Awareness of possible dangers posed to marine radio and navigational equipment operation by Electro-Magnetic Interference (EMI) and the need to ensure compatibility
- 5.2 Common causes of EMI in marine radio and navigational equipment
- 5.3 Precautions for minimising EMC problems
 - Observe and maintain manufacturer's specifications and arrangements for avoiding EMI
- 5.4 Existence of EMC type approval standards for classes of marine radio and navigational equipment and the "CE" mark

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ANNEX 2

EXAMINATION SYLLABUS FOR THE 2nd CLASS RADIOELECTRONICS CERTIFICATE FOR THE MARITIME MOBILE SERVICE AND THE MARITIME MOBILE-SATELLITE SERVICE

The examination should consist of theoretical and practical tests and should include at least:

A. GENERAL KNOWLEDGE OF THE MARITIME MOBILE SERVICE AND THE MARITIME MOBILE-SATELLITE SERVICE

- A1. The principles and features of the maritime mobile service
- A2. The principles and features of the maritime mobile-satellite service

B. DETAILED KNOWLEDGE AND ABILITY TO USE THE BASIC EQUIPMENT OF A SHIP STATION

- B1. General principles of electricity and theory of radio and electronics relevant to GMDSS communications and ancillary equipment
- B2. Use in practice the basic equipment of a ship station
- B3. Digital Selective Calling (DSC)
- B4. General principles of Narrow Band Direct Printing (NBDP) and Telex Over Radio (TOR) systems. Use maritime NBDP and TOR equipment in practice
- B5. Usage of INMARSAT systems. Use INMARSAT equipment or simulator in practice

C. OPERATIONAL PROCEDURES IN THE GMDSS AND DETAILED KNOWLEDGE OF THE PRACTICAL OPERATION OF THE GMDSS AND SUBSYSTEMS

- C1. Global Maritime Distress and Safety System (GMDSS)
- C2. INMARSAT
- C3. Maritime Safety Information (MSI) and Navtex
- C4. Emergency Position Indicating Radio Beacons (EPIRBs)
- C5. Search and Rescue Radar Transponder (SART)
- C6. Distress, urgency and safety communication procedures in the GMDSS
- C7. Search and rescue operation (SAR)

D. GENERAL KNOWLEDGE OF SHIP STATION RADIO NAVIGATION EQUIPMENT

- D1. Basic knowledge of navigational techniques
- D2. General principles and functions of Radar systems
- D3. General principles and functions of navigational aids

E. PRACTICAL KNOWLEDGE OF MAINTENANCE PROCEDURES AND ABILITY TO MAINTAIN SHIP STATION EQUIPMENT IN SERVICE

- E1. Practical knowledge necessary for carrying out preventive maintenance procedures on ship station communication and radionavigation equipment
- E2. Practical knowledge necessary for localising faults in ship station communication and radionavigation equipment
- E3. Practical knowledge necessary for returning ship station communication and radionavigation equipment to service
- E4. Preparation of technical records and reports concerning repair and maintenance of radio communication and radionavigation equipment

F. MISCELLANEOUS SKILLS AND OPERATIONAL PROCEDURES FOR GENERAL COMMUNICATIONS

- F1. Ability to use English language, both written and spoken, for the satisfactory exchange of communications relevant to the safety of life at sea
- F2. Obligatory procedures and practices
- F3. Practical and theoretical knowledge of general communication procedures
- F4. General awareness of Electro-Magnetic Compatibility (EMC)

EXAMINATION SYLLABUS GUIDELINES FOR THE 2nd CLASS RADIOELECTRONICS CERTIFICATE

A. GENERAL KNOWLEDGE OF THE MARITIME MOBILE SERVICE AND THE MARITIME MOBILE-SATELLITE SERVICE

A1. The principles and features of the maritime mobile service

- 1.1 Types of communication in the maritime mobile service
 - Distress, urgency and safety communications
 - Public correspondence
 - Port operations service
 - Ship movement service
 - Intership communication
 - On-board communications
- 1.2 Types of station in the maritime mobile service
 - Ship stations
 - Coast stations
 - Pilot stations, port stations etc.
 - Aircraft stations
 - Maritime rescue coordination centre (MRCC)
- 1.3 General knowledge of frequencies and frequency bands
 - The concept of frequency
 - The equivalence between frequency and wavelength
 - The unit of frequency: Hz, kHz, MHz, GHz.
 - The subdivision of the most significant part of the radio spectrum : MF, HF, VHF, UHF, SHF
- 1.4 Characteristics of frequencies
 - Different propagation mechanisms
 - Free space
 - Ground wave
 - Ionospheric propagation
 - Tropospheric propagation
 - Abnormal propagation
 - Propagation on MF frequencies
 - Propagation on different HF frequency bands
 - Propagation on VHF and UHF frequencies
- 1.5 Basic communication theory
 - Modulation
 - Amplitude Modulation
 - Frequency Modulation
 - Frequency Shift Keying
 - Pulse Modulation
 - Comparison of modulation techniques
 - Effect of under or over modulation

- Radiocommunication links
 - Information content
 - Channel capacity and bandwidth
 - Transmission losses
 - Noise considerations
- Radar systems
 - The concept of Radio Detection and Ranging
 - Propagation and the Radar range equation
 - Doppler radar

1.6 The various modes of communication

- DSC
- Radio telephony
- NBDP
- Facsimile
- Data
- Morse telegraphy - knowledge of system only, no speed requirement
- Classes of emission
 - Carrier frequency and assigned frequency
 - Bandwidth of different emissions
 - Official designations of emission (e.g. F1B, J3E, A3E, A1A etc.)
 - Unofficial designations of emissions (e.g. TLX, SSB, AM, CW etc.)

1.7 Frequencies allocated to the maritime mobile service

- The usage of MF, HF, VHF, UHF and SHF frequencies in the maritime mobile service
- The concept of radio channel. Simplex, semi-duplex and duplex. Paired and unpaired frequencies
- Frequency plans and channelling systems
 - HF telephony (Relevant appendix of the Radio Regulations)
 - VHF telephony (Relevant appendix of the Radio Regulations)
 - HF NBDP (Relevant appendixes of the Radio Regulations)
 - MF telephony and NBDP for Region 1 (Geneva 85 plan)
- GMDSS distress and safety frequencies
- Distress and safety frequencies of the non-GMDSS system
- Calling frequencies

A2. The principles and features of the maritime mobile-satellite service

2.1 Maritime satellite communications

- INMARSAT space segment
 - Up and down links
 - Single and multiple access channelling
 - System constraints
- Modes of communication
 - Telex services
 - Telephone services
 - Data and facsimile communications
 - Store and forward operation
- Distress communications
- INMARSAT-A communication services
- INMARSAT-C communication services
- INMARSAT Enhanced Group Call (EGC) system
- INMARSAT-B communication services
- INMARSAT-M communication services

2.2 Types of station in the maritime mobile-satellite service

- Coast Earth Station (CES)
- Network Co-ordination Station (NCS)
- Ship Earth Stations (SES's)

**B. DETAILED KNOWLEDGE AND ABILITY TO USE THE BASIC EQUIPMENT OF A SHIP STATION
(FOR TRAINING, ACTUAL EQUIPMENT IS PREFERABLE)**

**B1. Principles of electricity and theory of radio and electronics relevant to GMDSS communications
and ancillary equipment**

- 1.1 Technology of maritime radiocommunication and radionavigation equipment
- Power supply stages and voltage regulation
 - RF small signal and power amplifier stages
 - Oscillators and frequency synthesiser stages
 - Frequency conversion, multiplication and mixer stages
 - Signal modulation and demodulation
 - Signal multiplexing and demultiplexing
 - Audio input/output and amplification stages
 - Analogue transducers
 - Microphones
 - Loudspeakers
 - Magnetic tape recording
 - Data input and output
 - Basic computer theory and application skills
 - Microprocessor control functions and techniques
 - Microcomputer interfaces
 - Terminal equipment
 - Video Display Units (VDUs)
 - 2/4 wire sound circuits, hybrid couplers and echo suppression
 - Modems
 - Narrow Band Direct Printing (NBDP) techniques
 - Fundamental principles
 - Methods of error protection including Acknowledge/Request (ARQ) & Forward Error Correction (FEC)
 - Effect of noise and propagation conditions
 - Auxiliary equipment
 - Digital Selective Calling (DSC) system
 - Fundamental principles
 - Effect of noise and propagation conditions
 - Effect of excessive channel loading
 - Data output and control functions
 - Facsimile techniques
 - Fundamental principles
 - Transducers
 - Modulation systems
 - Reproduction
 - Synchronisation
 - Picture faults
 - Television
 - Fundamental principles
 - Camera systems
 - Scanning
 - Receiver display units
 - Video recording units
 - Emergency Position Indicating Radio Beacons (EPIRBs)
 - Search And Rescue Radar Transponders (SARTs)
 - Ship station transmitters
 - Purpose and function of modules and key component parts
 - Ship station receivers
 - Purpose and function of modules and key component parts
 - Principles of the superheterodyne: single/double conversion, intermediate frequency
 - Considerations of sensitivity and selectivity and gain control
 - Reception difficulties: effect of noise, intermodulation and image frequency response.

- Satellite SES equipment
 - Purpose and function of modules and key component parts
 - Stabilised platform and reserve power supply for INMARSAT-A and INMARSAT-B SES's

- 1.2 Antennas, transmission lines and waveguides
 - Antenna design, characteristics and usage
 - Aperture and gain
 - Impedance
 - Radiation resistance
 - Antenna matching and radiation
 - Hertzian type antennas
 - Marconi type antennas
 - Antenna tuning unit
 - Ground connections
 - Matching feeder lines, cables and waveguides
 - Reflections, delay time, resonance and vertical standing wave ratio (VSWR)
 - Ship station antennas
 - Isolators
 - VHF whip antennas
 - MF/HF whip antennas
 - MF/HF wire antennas
 - Microwave antennas for Radar and SES

- 1.3 Construction and safety ratings of electrical and electronic components
 - Fuses, current and earth leakage circuit breakers
 - Resistors, insulators and capacitors
 - Wound components: transformers, relays, inductors and motors
 - Semiconductor components
 - Thermionic components

- 1.4 Shipboard power supplies, including emergency sources
 - Electrical generators
 - Single phase AC power supplies
 - 3-phase AC power supplies
 - Voltage stabilisers
 - DC to AC converters
 - DC to DC converters
 - Uninterrupted battery-backed power supply units
 - Main, reserve and standby power supplies

B2. Use in practice the basic equipment of a ship station

- 2.1 Watchkeeping Receivers
 - The controls and usage of 2182 kHz watch receiver
 - The controls and usage of VHF DSC watch receiver
 - The controls and usage MF DSC watch receiver and MF/HF DSC watch receiver

- 2.2 VHF radio installation
 - Channels
 - Controls
 - Usage
 - DSC
 - VHF DSC Controller

- 2.3 MF/HF radio installation
 - Frequencies
 - Typical controls and usage
 - connecting the power
 - selecting RX frequency
 - selecting TX frequency
 - selecting ITU channel number
 - tuning the transmitter
 - selecting the class of emission
 - using volume control and squelch
 - using clarifier or RX fine tuning
 - controlling RF gain
 - using automatic gain control
 - using the 2182 kHz instant selector
 - testing the alarm generator
 - using the alarm generator
 - MF/HF DSC Controller

- 2.4 Survival craft radio equipment
 - Portable two-way VHF radiotelephone apparatus
 - SART including installation techniques
 - EPIRB including installation techniques

B3. Digital Selective Calling (DSC)

- 3.1 Call format specifier
 - distress call
 - all ships call
 - call to individual station
 - geographic area call
 - group call
 - automatic/semiautomatic service

- 3.2 Call address selection with the MMSI number system
 - the nationality identification
 - group calling numbers
 - coast station numbers
 - MMSI number with three trailing zeros

- 3.3 Call categorisation and priority
 - distress
 - urgency
 - safety
 - ship business
 - routine

- 3.4 Call telecommand and traffic information
 - distress alerts
 - other calls
 - working frequency information

B4. General principles of NBDP and TOR systems. Use maritime NBDP and TOR equipment in practice

- 4.1 NBDP systems
 - Automatic systems
 - Semiautomatic systems
 - Manual systems
 - Acknowledge/Request (ARQ) mode
 - Forward Error Correcting (FEC) mode
 - ISS/IRS arrangement
 - Master and slave
 - Radio telex number
 - Answerback
 - Numbering of the SSFC selective calling system (SSFC = Sequential Single-Frequency Code System)
- 4.2 TOR equipment
 - Controls and indicators
 - Keyboard operation

B5. Usage of INMARSAT systems. Use INMARSAT equipment or simulator in practice

- 5.1 INMARSAT-A and INMARSAT-B Ship Earth Stations
 - Satellite acquisition
 - Telex services
 - Telephone services
 - Data and facsimile communications
- 5.2 INMARSAT EGC Receiver
 - Pre-programming an SES for EGC message reception
 - Selecting operating mode for EGC reception
- 5.3 INMARSAT-C Ship Earth Station
 - Components of an INMARSAT-C terminal
 - Entering/updating position
 - Usage of an INMARSAT-C Ship Earth Station
 - Sending and receiving test messages
- 5.4 INMARSAT-M Ship Earth Station
 - Components of an INMARSAT-M terminal
 - Usage of an INMARSAT-M Ship Earth Station

C. OPERATIONAL PROCEDURES IN THE GMDSS AND DETAILED KNOWLEDGE OF THE OPERATION OF THE GMDSS AND SUBSYSTEMS

C1. Global Maritime Distress and Safety System (GMDSS)

- 1.1 Sea Areas and GMDSS Master Plan
- 1.2 Watchkeeping on distress frequencies
- 1.3 Functional requirements of ship stations
- 1.4 Carriage requirements of ship stations
- 1.5 Sources of energy of ship stations
- 1.6 Means of ensuring the functionality of ship station equipment
- 1.7 Licences, radio safety certificates, inspections and surveys

C2. INMARSAT

- 2.1 INMARSAT-A and INMARSAT-B Ship Earth Stations
 - Distress communications
 - Use of the distress facility
 - Satellite acquisition
 - Telex and telephony distress calls
 - Procedures for distress calls
 - Rescue Co-ordination Centres associated with the Coast Earth Stations

- 2.2 INMARSAT-C Ship Earth Station
 - Distress and safety services
 - Sending a distress alert
 - Sending a distress priority message
 - The INMARSAT-C safety services
 - 2 digit code sequences

- 2.3 INMARSAT EGC
 - Purpose of EGC system
 - All-ships messages and INMARSAT system messages
 - Classes of INMARSAT-C SES and their EGC reception

- 2.4 INMARSAT-M Ship Earth Station

C3. MARITIME SAFETY INFORMATION (MSI) AND NAVTEX

- 3.1 Maritime Safety Information
 - International Maritime SafetyNET Service
 - Frequencies
 - Reception ranges
 - message format

- 3.2 The NAVTEX system
 - Purpose of NAVTEX
 - NAVTEX frequencies
 - Reception range
 - Message format (transmitter ID, message type, message number)

- 3.3 NAVTEX receiver
 - Selection of transmitters
 - Selection and identification of message types
 - Messages which cannot be rejected
 - Use of subsidiary controls and changing paper

C4. Emergency Position Indicating Radio Beacons (EPIRBs)

- 4.1 Satellite EPIRBs
 - Basic characteristics of operation on 406 MHz (121.5 MHz including homing functions)
 - Basic characteristics of operation on 1.6 GHz
 - Information contents of a distress alert
 - Manual usage
 - Float-free function
 - Routine maintenance
 - Testing
 - Checking battery expiry date
 - Cleaning of the float-free release mechanism

- 4.2 VHF-DSC-EPIRB
- The main technical characteristics
 - Information contents of a distress alert
 - Manual operation
 - Float-free function
 - Routine maintenance
 - Testing
 - Checking battery expiry date
 - Cleaning of the float-free release mechanism

C5. Search and Rescue Radar Transponder (SART)

- 5.1 Search and Rescue Radar Transponder SART
- The main technical characteristics
 - Operation
 - Range of a SART transmitter
 - Routine maintenance of a SART
 - Checking battery expiry date

C6. Distress, urgency and safety communication procedures in the GMDSS

- 6.1 Distress communications
- DSC distress alert
 - The definition of a distress alert
 - Transmission of a distress alert
 - Transmission of a shore-to-ship distress alert relay
 - Transmission of a distress alert by a station not itself in distress
 - Receipt and acknowledgement of DSC distress alert
 - Acknowledgement procedure by radiotelephony
 - Acknowledgement procedure by NBDP
 - Receipt and acknowledgement by a coast station
 - Receipt and acknowledgement by a ship station
 - Handling of distress alerts
 - Preparations for handling of distress traffic
 - Distress traffic terminology
 - Testing DSC distress and safety calls
 - On-scene communications
 - SAR operation
- 6.2 Urgency and Safety communications
- The meaning of urgency and safety communications
 - Procedures for DSC urgency and safety calls
 - Urgency communications
 - Medical transports
 - Safety communications
- 6.3 Communication by radiotelephony with stations of the old distress and safety system
- Radiotelephone alarm signal
 - Distress signal
 - Distress call
 - Distress message
 - Acknowledgement of a distress message
 - Distress traffic terminology
 - Transmission of a distress message by a station not itself in distress
 - Medical advice

- 6.4 Reception of maritime safety information (MSI)
 - Reception by NAVTEX
 - Reception by INMARSAT EGC
 - Reception by HF NBDP
 - The navigational warning signal of the old distress and safety system
 - The navigational warnings transmitted by radio telephony

- 6.5 Protection of distress frequencies
 - Guard bands
 - Tests on distress frequencies
 - Transmissions during distress traffic
 - Avoiding harmful interference - with special attention to avoiding transmitting false distress alerts
 - Prevention of unauthorised transmissions

C7. Search and rescue operation (SAR)

- 7.1 The role of Rescue Coordination Centres (RCCs)
- 7.2 Merchant Ship Search and Rescue Manual (MERSAR)
- 7.3 Maritime rescue organisations
- 7.4 Ship reporting systems

D. GENERAL KNOWLEDGE OF SHIP STATION RADIO NAVIGATION EQUIPMENT

D1. Understanding of navigational techniques

- 1.1 Types of navigation chart and their information contents
 - Latitude and longitude
 - Distance and bearing
 - Depth

- 1.2 Navigational methods and interpretative skills
 - Methods of fixing position
 - Sources of position lines
 - Plane and Mercator sailing
 - Effect of currents and tides

- 1.3 Radio direction finding and calibration procedures
 - Fundamental principles of radio direction finding apparatus
 - Antenna patterns and determination of alignment
 - Factors affecting quality and accuracy of observations
 - Environmental factors
 - Nocturnal effects
 - Coastline effects
 - Common observational errors
 - Precautions to be observed in the interpretation of displayed information
 - Operate representative equipment and interpret the information displayed competently

D2. General principles and functions of Radar systems

- 2.1 Radar apparatus technology
 - Purpose and function of Radar systems
 - Navigational Radar
 - Anti collision Radar

- Types of Radar display presentation and their information contents
 - Plan Position Indicator (PPI) display
 - Raster display
 - Automatic Radar Plotting Aids (ARPA)
- Radar subsystems and component parts
 - Power supplies
 - Initiation and synchronising circuits
 - Time base circuits
 - Brightening and blanking circuits
 - Bearing transmission systems
 - Ranging circuits
 - Azimuth stabilisation circuits
 - Anti-clutter circuits
 - Microwave oscillators
 - Radar transmitters
 - Radar receivers
 - Electro-mechanical components
- 2.2 Radar system performance and standard types of error
 - Basic accuracy and performance capabilities of Radar systems and equipment
 - Characteristic errors of Radar systems
 - Common observational errors
 - Maladjustment and input errors
 - Setting of heading marker
- 2.3 Ability to use Radar and ARPA equipment or simulators in practice
 - Carry out performance checks
 - Optimise display via operational controls
 - Recognise and rectify maladjustment and input errors
 - Interpret and appreciate information displayed
 - Detect and recognise targets
 - Measure and interpret target range and bearing data
 - Assess the effects of alterations in course and speed of the vessels involved
 - Recognise and rectify systematic errors
 - Construct a standard Radar plot
 - Plot position by range and bearing
 - Recognise accuracy of position obtained
 - Maintain ARPA plot by automatic and manual acquisition of targets
 - Radar reporting procedures

D3. General principles and functions of navigational aids

- 3.1 Hyperbolic and satellite position fixing equipment
 - Fundamental principles of hyperbolic navigation
 - Time difference and phase difference
 - Sources and causes of errors
 - Corrections and expected accuracy
 - Coverage areas
 - Operate standard shipboard equipment or simulators according to equipment manuals
 - Decca navigator and systems based on Decca
 - Omega
 - Loran C
 - Major satellite navigational systems
 - Interpret observed information
 - Apply error corrections
 - Plot data on appropriate chart
 - Determine expected accuracy

- 3.2 Gyro compass and repeaters
 - Fundamental principles of the gyro controlled north seeking compass
 - Difference between true and magnetic poles
 - Corrections for latitude, course and speed
 - Settling time
 - Characteristic errors
 - Carry out start up procedure and performance checks on representative equipment
 - Adjust operational controls
 - Align repeaters with master compass
 - Recognise any errors

- 3.3 Echo sounding equipment
 - Fundamental principles of shipboard echo sounders
 - Methods of displaying information
 - Transducers
 - Transmitter and receiver systems such as pulse and Doppler
 - Factors affecting quality and accuracy of soundings
 - Precautions to be observed in the interpretation of displayed information
 - Operate representative equipment and interpret the information displayed competently

- 3.4 Speed and distance measuring equipment
 - Fundamental principles of electronic speed and distance measuring equipment
 - Factors affecting quality and accuracy of readings
 - Precautions to be observed in the interpretation of the course and speed information provided
 - Operate representative equipment and interpret the information provided competently

- 3.5 Auto pilot
 - Application of basic control theory to auto pilot systems
 - Steering characteristics
 - Effect of adjustment of operational controls
 - Operate and adjust representative equipment to provide optimum course accuracy

E. PRACTICAL KNOWLEDGE OF MAINTENANCE PROCEDURES AND ABILITY TO MAINTAIN SHIP STATION EQUIPMENT IN SERVICE

E1. Practical knowledge necessary for carrying out preventive maintenance procedures on ship station communication and radionavigation equipment

- 1.1 Proficiency in performing preventive maintenance procedures, according to manufacturers' instructions,
 - using appropriate standard test facilities and tools
 - Routine and preventative maintenance procedures
 - Purpose and use of test programmes and any other possible check facilities
 - Setting up procedures
 - Problem areas and means of avoiding wear, malfunctions and failures
 - Use of various lubricants and cleaning agents
 - Problems caused by damaged or corroded transducers
 - Need to prevent condensation and ingress of water

- 1.2 Different kinds of batteries and their characteristics
 - Primary cells
 - Zinc-Carbon
 - Alkaline
 - Lithium
 - Secondary cells
 - Lead-Acid
 - Nickel-Cadmium (NiCd)
 - Nickel-Iron (NiFe)

1.3 Maintenance of batteries and battery charger/invertor systems

1.4 Maintenance of ship station antenna systems and cable/waveguide runs

E2. Practical knowledge necessary for localising faults in ship station communication and radionavigation equipment

2.1 Apply safety precautions and use safe working practices

2.2 Proficiency in detailed fault localisation and logical fault finding techniques

- Interpret information provided by means of data output, built-in measuring instruments/software, or by appropriate selection and use of standard test and measuring equipment (e.g., Moving coil instruments, digital instruments, oscilloscopes, spectrum analysers) and tools
- Use technical installation and service manuals, interpret schematic diagrams and engineering drawings
- Locate area of fault to modular/unit level

E3. Practical knowledge necessary for returning ship station communication and radionavigation equipment to service

3.1 Proficiency in fault repair down to the level of service replaceable modular units using appropriate standard test equipment and tools

- Apply relevant regulations and codes of practice for the repair and replacement of electronic units
- Correct representative faults/defects in all areas of ship station equipment through repair or replacement of modular units, demonstrating the necessary practical skills
 - Active module fault
 - Passive module fault
 - Fuse fault
 - Maladjusted preset control

3.2 Construction of an MF emergency antenna

3.3 Jointing and termination techniques for RF cables and waveguides

E4. Preparation of technical records and reports concerning repair and maintenance of radio communication equipment and electronic navigational aids

4.1 Requirements for keeping technical records

4.2 Presentation of the standard types of technical report

- Maintenance records and reports
- Analysis, diagnosis and correction of faults
- Performance testing
- Recommended modifications
- Maintaining correct numbers of spare parts

F. MISCELLANEOUS SKILLS AND OPERATIONAL PROCEDURES FOR GENERAL COMMUNICATIONS

F1. Ability to use English language, both written and spoken, for the satisfactory exchange or communications relevant to the safety of life at sea

1.1 Use of the International Code of Signals and the IMO Standard Marine Navigational Vocabulary/Seaspeak

- 1.2 Recognised standard abbreviations and commonly used service codes
- 1.3 Use of international phonetic alphabet

F2. Obligatory procedures and practices

- 2.1 Effective use of obligatory documents and publications
- 2.2 Radio record keeping
- 2.3 Knowledge of the regulations and agreements in force governing the maritime mobile service and the maritime mobile-satellite service

F3. Practical and theoretical knowledge of general communication procedures

- 3.1 Selection of appropriate communication methods in different situations
- 3.2 Traffic lists
- 3.3 Radio telephone call
 - Method of calling a coast station by radiotelephony
 - Ordering for a manually switched link call
 - Ending the call
 - Special facilities of calls
 - Method of calling a coast station by DSC
 - Selecting an automatic radiotelephone call
- 3.4 Radio telegram
 - The parts of a radio telegram
 - preamble
 - service instructions and indications
 - address
 - text
 - signature
 - Addresses
 - full address
 - registered address
 - telephonic address
 - telex address
 - Counting of words
 - Transmission of a telegram by radiotelephony
 - Transmission of a telegram by radiotelex
- 3.5 Traffic charges
 - International charging system
 - INMARSAT communication charging system
 - Accounting Authority Identification Code (AAIC)
 - The meaning of land line charge (LL), coast charge (CC) and ship charge (SS)
 - Currencies used in international charging
- 3.6 Practical traffic routines
- 3.7 World geography, especially the principal shipping routes and related communication routes

F4. Electro Magnetic Compatibility (EMC)

- 4.1 Awareness of possible dangers posed to marine radio and navigational equipment operation by EMC
- 4.2 Common causes of EMC interference to marine radio and navigational equipment
- 4.3 Precautions for minimising EMC problems
 - Observe and maintain manufacturer's specifications and arrangements for avoiding EMI
- 4.4 Existence of EMC type approval standards for classes of marine radio and navigational equipment and the "CE" mark