

AMATEUR RADIO EXAMINATION SYLLABUS

(GENERAL CLASS)

(WITH EFFECT FROM 1990)

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SRI LANKA**

AMATEUR RADIO OPERATOR'S GENERAL CLASS

CERTIFICATE OF PROFICIENCY

This examination consist of two parts.

PART 1 Two separate written papers

The questions will be based on the syllabuses attached.

- (1) Fundamentals of Electricity & Radio Communication (Three hours)**
- (2) Licensing conditions , operating practices & procedures (One hour)**

PART 2 PRACTICAL MORSE CODE TEST

- (a) Candidates must be able to send correctly by hand and receive correctly by ear in the Morse code . The accuracy of signaling the correct formation of characters and correctness of spacing is taken in to account. The legibility of the transcription is also considered.**
- (b) In the sending tests, a candidate is required to send 36 words (averaging five letters per word) in plain language in three minutes without uncorrected error, not more than four corrections being transmitted , and 10 five figure groups in 1-1/2 minutes without uncorrected error, not more than two corrections being permitted.**
- (c) In the receiving tests, a candidate is required to receive 36 words (averaging five letters per word) in plain language in three minutes, and 10 five figure groups in 1-1/2 minutes. Each letter or figure incorrectly received counts as two errors . More than four errors in plain language and more than two errors in the figure test will result in failure .**

(1) FUNDAMENTALS OF ELECTRICITY & RADIO
COMMUNICATIONS
(WRITTEN PAPER - SYLLABUS)

1. ELECTRICAL LAWS & CIRCUITS

1.1 Electric and Magnetic fields :

- (a) Permanent magnets
- (b) Electro magnets
- (c) Solenoids, Relays

1.2 Electricity and the electric current ,

- (a) Basic appreciation of electron flow and influencing factors
- (b) Electromotive Force (EMF)

1.3 Conductors and insulators – comparison of properties.

1.4 Direct current (DC)

- (a) Power and energy – Watts, Volts, Amperes and Ohms.
 - (i) Sources of energy-primary and secondary cells-basic theory,methods of connection and rate of charging, internal resistance;
 - (ii) Potential difference
 - (iii) Ohm's law and power formulae
- (b) Resistance (including units)
 - (i) resistance in series
 - (ii) resistance in parallel
 - (iii) colour coding and types of resistors, preferred values

1.5 Alternating current (AC)

- (a) Nature and generation of a sin waves;
 - (i) relationship – peak, average and RMS voltage values
 - (ii) basic knowledge of harmonics, frequency verses wave-length and their relationship
- (b) Capacitance (including units)
 - (i) factors affecting capacitance
 - (ii) dielectric loss
 - (iii) capacitive reactance
 - (iv) capacitor types – parallel aspects, method of connection and equivalent value calculation

- (c) Inductance (including units)
 - (i) factors affecting inductance
 - (ii) inductive reactance
 - (iii) inductance types – applications, practical limitations.

- (d) Impedance – a basic understanding, awareness of distinction between impedance and resistance.
- (e) Transformer Theory;
 - (i) types of transformers – practical applications
 - (ii) turns ratio, voltage ratio, impedance transformation, factors affecting efficiency, losses, electrostatic shielding

- (f) Radio Frequency Circuits;
 - (i) resonance in series circuits
 - (ii) resonance in parallel circuits
 - (iii) effect of “Q” (quality factor) in tuned circuits – basic understanding
- (g) The Piezoelectric Effect – basic knowledge of characteristics and applications of quartz crystal.

2. CIRCUIT SYMBOLS

Candidates should be familiar with the symbols employed in circuit drawings using one or more of the following;

- (a) resistors
- (b) capacitors
- (c) inductors
- (d) diodes (including zener, varicap)
- (e) thermionic vacuum tubes (triodes, pentodes)
- (f) transistor (bipolar and FET)
- (g) antennas
- (h) earth
- (i) loudspeaker and headphones
- (j) microphone
- (k) batteries
- (l) integrated circuits (amplifier and voltage regulators only)
- (m) inductors and transformers
- (n) meters

3. LOGARITHMIC UNITS & SCALES FOR LOSS/GAIN/LEVEL

- (i) loss, gain, dB
 - over all losses
 - Reference equivalent
 - Conversion between dB and Neper
- (ii) Power level, dBm, dBw, dBk, dB RAP
- (iii) Voltage level dBV, measurement of power level

- (iv) Relative level dBr
- (v) dBmO, dBmOp

4. SEMICONDUCTORS

4.1 Semiconductor diodes

characteristics and construction

- (i) comparison of germanium and silicon
- (ii) forward conduction
- (iii) ratings of diodes in current and peak inverse voltage (PIV)

4.2 Voltage variable capacitor diodes (varicap/varactor)

- (a) basic theory
- (b) uses

4.3 Zener diodes

- (a) basic theory
- (b) uses

4.4 Transistors

- (a) Types
 - (i) NPN and PNP, bipolar
 - (ii) field effect transistors (FET)
 - (iii) characteristics
 - (iv) advantages and disadvantages, practical applications
- (b) Amplification
 - (i) current gain – use of term β
 - (ii) basic knowledge of types of circuits
Common emitter/common source

4.5 Integrated circuits – amplifiers and voltage regulators only – recognition and basic application.

4.6 Solid state devices (general) – practical limitations in use

(e.g. voltage/power ratings protective arrangements)

5. VACUUM TUBES

5.1 Basic principles and applications

5.2 The triode vacuum tube – uses

5.3 The pentode vacuum tube – uses

6. POWER SUPPLIES

6.1 AC power mains consideration (240V, 50 Hertz)

- (a) safety precautions, fuses and other protective devices – ratings
- (b) awareness of wiring standards and colour coding of mains flexible conductor/power points – importance of earthing

6.2 Ratings of power transformers in relation to power limitations of the novice licence

6.3 Rectifier circuits

- (a) Types (solid state only)
 - (i) full wave
 - (ii) half wave
 - (iii) bridge circuits
- (b) Current ratings
- (c) Peak inverse voltage ratings (PIV)

6.4 Filtering, requirement of filtering - awareness of typical filters commonly used

6.5 Voltage regulation principles

- (a) zener diode regulation
- (b) solid state regulator devices – typical application

7. OSCILLATOR AND AMPLIFIER PRINCIPLES

7.1 Crystal oscillators and variable frequency oscillators (VFO)

- (a) appreciation of comparative properties
- (b) awareness of other types likely to be used in modern amateur equipment (e.g. PLL) – a recognition of application only.
- (c) stability – basic understanding

7.2 Frequency conversion – doublers and triplers, heterodyning

7.3 Amplification

- (a) classes of amplifiers
 - (i) class A operation
 - (ii) class B operation
 - (iii) class C operation

- (b) importance of bias

7.4 Radio frequency amplification

Amplifier stability and efficiency

- (i) neutralisation
- (ii) parasitic suppression
- (iii) harmonics suppression

8. TRANSMITTERS

8.1 Transmitter principle

8.2 Morse code transmission

- (a) basic keying methods
 - keying of appropriate stages in a transmitter
- (b) key clicks – cause and cures
- (c) monitoring of keying; interpretation of simple wave shapes on a cathode ray oscilloscope

8.3 Amplitude modulation (AM) and single side band (SSB) transmission

- (a) sidebands and bandwidth - basic theory
- (b) the modulation envelope – recognition of modulation percentage
- (c) power in a modulated wave (related to 100% modulation)
- (d) over modulation – understanding of effects (i.e. interference)
- (e) methods of amplitude modulation
 - (i) high level modulation
 - (ii) low level modulation
- (f) microphones – dynamic (moving coil), ceramic/crystal, capacitor, electret.

8.4 Principles of Single Sideband (SSB) generation – Filter methods.

Basic function of;

- (i) balanced modulator
- (ii) filters
- (iii) carrier oscillator
- (iv) mixing
- (v) amplifiers – need for linearity

8.5 Practical methods of tuning power amplifier (PA) stages

8.6 Frequency Modulation (FM)

- (a) basic concept
- (b) pre-emphasis
- (c) appreciation of the advantages of FM compared to AM & SSB

NOTE: An ability to be able to identify the function of each section in block diagram of transmitters is required.

9. RECEIVERS

9.1 Receiver characteristics:

- (a) definition of selectivity
- (b) definition of selectivity

9.2 Detectors (elementary knowledge only)

- (a) detection for AM reception
- (b) detection for Morse Code (CW) reception
- (c) detection for SSB reception
- (d) detection for FM reception

9.3 The Superheterodyne receiver:

- (a) RF amplifiers
- (b) mixers
- (c) IF amplifiers
- (d) automatic gain control (AGC)
- (e) oscillators
- (f) audio amplifiers
- (g) single conversion, double conversion – relative merits;
- (h) limiters for FM
- (i) capture effect (FM)
- (j) de-emphasis

9.4 Direct conversion receivers

- (a) principle of operation
- (b) unique properties, reasons for use

9.5 Transceivers

- (a) basic concept of transceivers (combined functions using common circuitry for transmit and receive)
- (b) appreciation of control functions on modern transceivers.

Note: An ability to be able to identify the function of each section in block diagram of receivers/transceivers required.

10. PROPAGATION

10.1 Radio waves – basic concept

- (a) characteristics
 - (i) vertical polarization
 - (ii) horizontal polarization
- (b) properties of the ionosphere

10.2 Means of propagation

- (a) ionospheric (sky wave)
 - (i) skip distance
 - (ii) maximum usable frequency (MUF)
 - (iii) variation due to time of day , frequency and seasonal changes
- (b) ground wave, variation due to time of day and frequency.

10.3 Fading – types of fading

10.4 Reliability of high frequency propagation for long distance communications, effect of sunspot cycle.

11. ANTENNAS & TRANSMISSION LINES

11.1 Basic principles of transmission lines

- (a) line impedance
- (b) line characteristics – practical understanding of properties :
 - (i) coaxial lines
 - (ii) balanced line
- (c) need for matching of transmitter to line and line to antenna.
Basic understanding of typical matching devices (e.g. balun, antenna tuning unit (ATU);
- (d) practical considerations, transmit – receive switching or antenna changeover methods.

11.2 High frequency antennas (for use on novice bands)

- (a) antenna consideration
 - (i) vertical antennas
 - (ii) horizontal antennas
 - (iii) standing wave ratio (SWR) – desirability of low SWR
- (b) the half wave antenna;
 - (i) voltage and current distribution
 - (ii) impedance effect of ground proximity.
 - (iii) method of feeding a half wave antenna
- (c) the quarter-wave vertical antenna;
 - (i) voltage and current distribution
 - (ii) impedance effect of ground proximity
 - (iii) method of feeding a quarter wave antenna
 - (iv) angle of radiation
- (d) artificial antenna (dummy load), use of artificial antenna for transmitter testing
- (e) basic knowledge of parasitic arrays;
 - (i) the three element beam antenna – purpose of director, reflector, and driven element
 - (ii) advantage over non-directional antennas – directional gain, interference reduction efficiency of communication.

12. TEST EQUIPMENT & MEASUREMENT

12.1 DC moving coil meter:

- (a) extending the DC current range
- (b) DC voltmeter
- (c) ohm meter

12.2 AC instruments:

- (a) voltage measurement
- (b) current measurement

12.3 Frequency measurements:

- (a) digital frequency meter (DFM) - practical uses and limitations
- (b) the dip meter

12.4 RF measurements

- (a) transmitter power output measurements – methods; non radiating load-artificial antenna
- (b) transmission line measurements
 - (i) standing wave ratio (SWR)
 - (ii) forward power
 - (iii) reflected power

12.5 Cathode ray Oscilloscope (CRO) – an ability to interpret basic wave shapes, and practical limitations of use – measurements of modulation levels.

13. INTERFERENCE

13.1 Basic effects of interference and recognition of symptoms

13.2 Types of interference

- (a) television interference (TVI)
 - (i) receiver overload
 - (ii) effect on reception due to radiation of harmonics; parasitic oscillations; excessive sidebands or “splatter” resulting from non-linear operation
- (b) broadcast interference (BCI)
 - (i) receiver overload
 - (ii) cross modulation
- (c) interference to other domestic equipment

13.3 Remedial measurements:

- (a) use of filters
 - (i) transmitter low pass or band pass filters – to reduce harmonics.
 - (ii) receiver band pass or high pass filters – to prevent overload.

- (iii) mains line filters – to prevent conducted RF interference.
- (b) other preventive measures (bypassing, shielding, adequate earthing).

14. SAFTY

14.1 The human body

- (a) variations in body resistance
- (b) consequences of electric shock

14.2 Safety with high voltage

Safety standards

- (i) bare wires
- (ii) loss of earth connection (including RF earth)
- (iii) charged capacitors

14.3 Mains wiring

- (a) mains power point configuration
- (b) colour code for active, neutral and earth
- (c) difference between active, neutral and earth
- (d) basic principles of earth connection
- (e) fuses and circuit breakers
 - (i) principles of operation
 - (ii) importance of using appropriate ratings

14.4 Lightning

- (a) danger of lightning strikes
- (b) paths of entry
- (c) lightning arresters and other precautions

14.5 Safety in use of hazardous materials or equipment (e.g. high voltage power supplies; batteries electrolyte, ventilation charge/discharge rate. Beryllium encapsulated solid state devices)

14.6 Safety in mobile station operation – awareness of hazards (e.g. ballasting areas, mains power lines and explosive atmosphere).

**(2) LICENCING CONDITIONS, OPERATING PRACTICES
AND PROCEDURES
(WRITTEN PAPER - SYLLABUS)**

1. Definitions of Amateur stations, Amateur Radio service and General terms in usage with Amateur Radio services.
2. Qualifications for Amateur station licensees, General Conditions to be observed by Amateur station licensee.
3. Technical Provisions:
 - Manner of Erection and operation of apparatus
 - Safety precautions
 - Transmitting equipments
 - Authorised radio frequency bands
 - Types of Emission
 - Stability of Emissions
 - Automatic Radio Telegraph Systems
 - Data & Facsimile Transmission
 - Television Experiments
 - Inspection of stations
 - Avoidance of interference
 - Quality of transmission
 - Transmitter power
 - Antenna Gain
 - Use of Satellites & Repeaters; accessing a repeater
4. General Provisions :
 - Use of stations in the amateur services
 - Prohibited traffic
 - Licensee Responsible for operation of station
 - Secrecy of communications
 - Log keeping
 - Change of address of Amateur station
 - Mobile Operations (Land, Maritime and Aeronautical)
 - Emergency Amateur Networks
 - Call sign of identifications
 - Liability for breaches of Law
 - Offences against regulations/rules
 - Licensee to receive distress signals
 - Recording and replaying transmission
 - Replaying transmission

5. Operating Procedures :

Call and Tests

Calling procedures

Call and reply

Mobile stations & stations operating at locations other than the authorized Fixed locations

Distress procedure

Distress call and messages

Distress traffic, obligations

Urgency signals

Emergency position indicating radio beacons

6. Miscellaneous :

Abbreviations and signals

Phonetic Alphabet

Morse Code

Q – Code

7. Regulations/Rules:

Local Radio Regulations and Rules

ITU Radio Regulations

Terms and conditions of the licence