

**AMATEUR RADIO EXAMINATION  
SYLLABUS**

**(ADVANCED CLASS)**

**( WITH EFFECT FROM 1990 )**

**PUBLISHED BY**

**TELECOMMUNICATION REGULATORY  
COMMISSION OF SRI LANKA**

**PRICE :- Rs.45/-**



1

**AMATEUR RADIO OPERATOR'S ADVANCED CLASS**  
**CERTIFICATE OF PROFICIENCY**

This examination consists of two parts.

**Part 1** : Two separate written papers.

The questions will be based on the syllabuses attached.

- (i) Advanced Electrical Technology & Radio Communications  
(3 Hours)
- (ii) Licencing conditions, operating practices and procedures  
(2 Hours)

**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 signalling, the correct formation of characters and correctness of spacing is taken into account. The legibility of the transcription is also considered.
- (b) In the sending tests, a candidate is required to send 60 words (averaging five letters per word) in plain language in three minutes without uncorrected error, not more than four corrections being transmitted, and 20 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 60 words (averaging five letters per word) in plain language in three minutes, and 20 five-figure groups in 03 minutes. Each letter or figure incorrectly received counts as one error. A word in which more than one letter is 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.

**ADVANCED ELECTRICAL TECHNOLOGY**  
**& RADIO COMMUNICATIONS**

( Written paper - Syllabus )

**1. ELECTRICAL LAWS AND CIRCUITS**

1.1 Atoms and electrons

1.2 Conductors and insulators

1.3 Sources of electromotive force (EMF)

(a) Cells ;

- (i) Primary cells - composition, construction ;
- (ii) Secondary cells - capacity (ampere hours)
- (iii) Batteries - connection of cells , total voltage/capacity ;
- (iv) Charging methods and rate of charging ;
- (v) Internal resistance ;
- (vi) Typical volts per cell ;

(b) Mechanical generators/alternators - basic principles of conversion of mechanical energy to electrical energy ;

(c) Other sources (e. g. photo - voltaic or solar cells)

1.4 Direct Current (DC) circuits :

(a) electrical units ;

- (i) unit of quantity ;
- (ii) unit of current flow ;
- (iii) unit of electrical pressure ;
- (iv) unit of electrical resistance ;
- (v) unit of electrical power ;
- (vi) relationship between units and calculations ;

(b) resistance ;

- (i) resistance in series ;
- (ii) resistance in parallel ;
- (iii) resistance in series and parallel ;
- (iv) calculation of total value ;
- (v) practical resistors, power rating, colour codes ;
- (vi) power dissipation, formulae, calculations

1.5 Electric and magnetic fields :

- (a) magnetism, permanent magnets ;
- (b) electromagnets, relays ;
- (c) electromagnetic induction

1.6 Alternating current (AC) :

- (a) generation of sine wave ;
- (b) sine wave amplitude values ;
  - (i) root-mean-square (RMS) ;
  - (ii) average ;
  - (iii) peak ;
  - (iv) peak to peak ;
- (c) frequency and period relationship (calculations) ;
- (d) frequency and wavelength relationship (calculations) ;
- (e) harmonics and harmonic relationships (calculations) ;

1.7 Radio frequency (RF) ranges - LF, MF, HF, VHF, UHF & SHF.

1.8 Capacitance :

- (a) unit of capacitance ;
- (b) the capacitor - concept of energy stored in an electrostatic field ;
  - (i) factors which determine capacitance ;
  - (ii) dielectric losses ;
  - (iii) working voltages and characteristics of dielectrics ;
  - (iv) types of capacitors and typical applications ;
  - (v) capacitors in series (calculations) ;
  - (vi) capacitors in parallel (calculations) ;

- (c) alternating voltage applied to a capacitor ;
  - (i) phase relationships of voltage and current ;
  - (ii) capacitive reactance - formula (calculations) ;
  - (iii) effect of frequency and capacitance on reactance ;
- (d) Ohm's Law in capacitive circuits (calculations) ;
- (e) Time constant of a CR network-formulae-calculations-applications

### 1.9 Inductance :

- (a) unit of inductance ;
- (b) the inductor-concepts of induced EMF - self inductance - mutual inductance ;
  - (i) factors which determine inductance ;
  - (ii) types of construction ;
  - (iii) types of core, permeability ;
  - (iv) types of practical inductors and typical applications ;
  - (v) inductors in series (calculations);
  - (vi) inductors in parallel (calculations) ;
- (c) alternating voltage applied to an inductor ;
  - (i) phase relationships of voltage and current ;
  - (ii) inductive reactance-formulae-calculations ;
  - (iii) effect of frequency and inductance on reactance ;
- (d) time constant of an LR network-formulae-calculations-applications

### 1.10 Alternating current circuits containing L, C and R

- (a) impedance ;
  - (i) circuits containing reactance and resistance - formula - calculations ;
  - (ii) Ohm's Law for combined LCR circuits ;

(b) tuned circuits ;

- (i) resonance-concept-formula-calculations ;
- (ii) series tuned circuit-impedance at resonance ;
- (iii) parallel tuned circuit-impedance at resonance ;
- (iv) quality factor (Q) ;
- (v) L/C ratio ;
- (vi) Resonance curves and selectivity

1.11 Transformers :

(a) principles of operation ;

(b) construction, types and typical applications;

(c) losses ;

- (i) hysteresis ;
- (ii) eddy currents ;
- (iii) copper loss ;

(d) turns ratio-formula-calculations;

(e) voltage ratio-formula-calculation ;

(f) current ratio-formula-calculation ;

(g) power ratio-formula-calculation ;

(h) efficiency-formula-calculation ;

(i) auto-transformers-applications ;

(j) characteristics of different types of core materials ;

(k) shielding - methods, purpose.

1.12 The piezo-electric effect : characteristics of quartz crystal and typical applications.

## 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) transistors (bipolar and FET)
- (g) antennae
- (h) earth
- (i) loudspeaker and headphones
- (j) microphone
- (k) batteries
- (l) intergrated 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 loss  
Reference equivalent  
Conversion between dB and Neper
- (ii) Power level, dBm  
dBW, dBk, dBRAP
- (iii) Voltage level dBu, measurement of power level
- (iv) relative level dBr
- (v) dBmO, dBmOp

## 4. POWER SUPPLIES

### 4.1 Power mains considerations:

- (a) Voltage and frequency ;
- (b) Wiring standards - safety ;
- (c) Colour coding for mains flexible conductors ;



(d) Safety precautions ;

- (i) fuses-ratings, types and replacement in mains operated equipment;
- (ii) circuit breakers
- (iii) earth methods-importance of earthing power points;
- (iv) mains switches-precautions, accessibility, pilot lamps

4.2 Ratings of power supplies in relation to transmitter output power.

4.3 Rectifiers :

- (a) silicon diodes ;
  - (i) current ratings ;
  - (ii) peak inverse voltage rating (PIV)

4.4 Rectifier circuits :

- (a) rectification ;
  - (i) half wave-output waveform and ripple frequency ;
  - (ii) full wave-output waveform and ripple frequency ;
  - (iii) bridge-output waveform and ripple frequency ;
  - (iv) voltage doublers ;
- (b) current and peak inverse voltage (PIV) ratings of rectifiers with respect to rectifier type, filter and load.

4.5 Filtering :

- (a) requirement for filtering ;
- (b) types of filters ;
  - (i) capacitor input-characteristics ;
  - (ii) choke input-characteristics ;
- (c) typical filters and reasons for difference in component values and ratings for the following power supply types ;
  - (i) high voltage, high current ;
  - (ii) high voltage, low current ;
  - (iii) low voltage, high current ;
  - (iv) low voltage, low current.

## 4.6 Protection :

- (a) bleeder resistors - reasons for use and typical values ;
- (b) fuses and circuit breakers ;
- (c) pilot lamps ;
- (d) metering ;
- (e) methods of overload protection for power supplies

## 4.7 Voltage regulation :

- (a) need for voltage regulation ;
  - (i) effects of variations in load
  - (ii) effects of mains or supply voltage variations ;
- (b) Zener diode regulators ;
  - (i) applications ;
  - (ii) appreciation of degree of regulation ;
  - (iii) zener voltage ;
  - (iv) power rating ;
  - (v) calculation of series resistor value ;
- (c) knowledge of waveforms at various points in a power supply;
- (d) solid state regulator circuits, including integrated circuits (typical applications, features and advantages ~~and advantages~~ only)

## 4.8 Solid state power supplies:

- (a) principles of operation ;
  - (i) typical systems ;
  - (ii) operation of control elements, purpose, ratings - including electronic current limiting ;
  - (iii) typical efficiency in relation to load ;
  - (iv) effect of shorted load ;
- (b) regulation

## 5. SEMICONDUCTORS

### 5.1 Semiconductor materials

- (a) germanium-effect of impurities-P type, N type ;
- (b) silicon-effect of impurities-P type, N type ;
- (c) the PN junction ;
  - (i) barrier region-effect of applied potential (forward and reverse bias) ;
  - (ii) junction capacitance/barrier region width ;
  - (iii) forward voltage drop Ge ;
  - (iv) forward voltage drop Si ;
- (d) other common semiconductor materials

### 5.2 Diodes :

- (a) point contact diodes ;
  - (i) applications ;
  - (ii) power limitations ;
  - (iii) frequency limitations ;
- (b) Junction diodes (silicon) ;
  - (i) advantages for power handling ;
  - (ii) ratings - peak inverse voltage (PIV)
  - (iii) ratings - maximum average current ;
  - (iv) typical ratings and applications ;
- (c) zener diodes ;
  - (i) applications ;
  - (ii) principle of operation - zener control region ;
- (d) voltage variable capacitor diodes (varicap/varactor) ;
  - (i) applications (including use as frequency multiplier and frequency tuning element);
  - (ii) principle of operation - variation in capacitance with respect to reverse voltage ;
  - (iii) typical capacitance and frequency range ;

- (e) hot carrier diode ; typical applications and advantages only ;
- (f) SCR -Triac ;
  - (i) applications
  - (ii) comparison with silicon diode ;
  - (iii) interference considerations ;
- (g) light emitting diodes (LED) ;
  - (i) applications ;
  - (ii) voltage drop and typical forward current

### 5.3 Transistors and integrated circuits :

- (a) bipolar transistors ;
  - (i) principles of operation-transistor action-amplification description as a current controlled device ;
  - (ii) PNP / NPN -polarity of supply ;
  - (iv) characteristics as an amplifier-current amplification factor ( $\beta$ ) - gain bandwidth product ( $f_T$ ) ;
  - (v) ratings - collector current, collector voltage, collector dissipation ;
  - (vi) circuit configuration;
    - common emitter ; bias provision and stabilisation (combination bias - calculations not required ) ; input and output impedances ; phase shift, typical applications ;
    - common base ; input and output impedances ; phase shift ; typical applications ;
    - common collector ; input and output impedances, phase shift ; typical applications ;

(b) field effect transistors (FETs) ;

- (i) principles of operation - amplification - description as a voltage controlled device - appreciation of FET types available and their uses (e. g. Junction FET, MOSFET, Dual-Gate MOSFET) ;
- (ii) biasing ;
- (iii) P channel, N channel ;
- (iv) typical input and output impedances ;
- (v) applications and advantages ;
- (vi) power ratings

5.4 Integrated circuits :

- (a) recognition of common types and basic knowledge of applications ;
- (b) general appreciation of types available

5.5 Using solid state devices :

- (a) precautions in handling ;
- (b) protection methods

## 6 VACUUM TUBES

6.1 Basic principles and applications

6.2 Vacuum tube construction and characteristics :

- (a) diode ;
- (b) triode ;
- (c) tetrode ;
- (d) pentode ;
- (e) cathode ray tube (CRT)

6.3 Vacuum tube amplifiers : application and function of common types, importance of bias.

## 7. OSCILLATOR AND AMPLIFIER PRINCIPLES

### 7.1 Basic concept of sinusoidal oscillation :

- (a) power source ;
- (b) gain ;
- (c) positive feedback

### 7.2 Crystal oscillators :

- (a) quartz crystals - basic knowledge of types / cut, limitations frequency range and adjustment ;
- (b) principles of operation and circuit configuration of crystal oscillators ;
  - (i) Pierce ;
  - (ii) Colpitts ;
  - (iii) Overtone ;
  - (iv) Series mode, parallel mode

### 7.3 Variable frequency oscillators (VFOs) :

- (a) frequency determining components ;
- (b) principles of operation and circuit configuration of VFOs ;
  - (i) Armstrong ;
  - (ii) Colpitts ;
  - (iii) Hartley ;
  - (iv) Clapp ;
- (c) Varicap tuning ;
- (d) Phase locked loop (PLL) VFOs ;
  - (i) broad understanding of PLL concept ;
  - (ii) basic understanding of control elements and overall function of the PLL (block diagram only)

### 7.4 Factors affecting oscillator stability :

- (a) supply voltage - need for regulation ;
- (b) temperature ;
- (c) mechanical stability ;
- (d) L/C ratio ;
- (e) isolation from loading effects ;
- (f) reason for crystal control

7.5 Basic principles of amplification :

(a) characteristics, method of biasing and operating efficiencies for :

- (i) Class A operation ;
- (ii) Class B operation ;
- (iii) Class C operation ;
- (iv) Class AB operation ;

(b) parallel and push-pull connection; advantages of each

**8. TRANSMITTERS**

8.1 Transmitter principles :

(a) bandwidth of emission, comparison of modes ;

(b) transmitter stages ;

- (i) oscillator, need for stability ;
- (ii) buffer, purpose, typical gain ;
- (iii) driver ;
- (iv) power amplifier ;
- (v) frequency doubler and tripler ;
- (vi) modulator ;
- (vii) coupling methods ;

(c) keying methods ;

- (i) clicks and chirps - causes, effects and remedies ;
- (ii) typical keying waveforms - recognition of appropriate oscilloscope displays ;

(d) frequency translation (heterodyning) ;

- (i) reason for heterodyning ;
- (ii) methods used - simple mixers - recognition of stages in block diagram of typical transmitters ;

(e) transmitter tuning, neutralising; criteria for minimisation potential for spurious radiation and generation of parasitics

## 8.2 Amplitude modulated telephony :

- (a) concept of amplitude modulation ;
- (b) bandwidth of emission - typical spectrum - range of audio frequencies used - reasons for restricting ;
- (c) microphones - principles of operation and construction, impedance and method of connection to speech amplifier stage ;
  - (i) dynamic (moving coil) ;
  - (ii) crystal ;
  - (iii) capacitor (condenser) ;
  - (vii) electret ;
  - (viii) ceramic ;
- (d) modulation ;
  - (i) concept of high and low level modulation and the need for linear amplification after low level modulation ;
  - (ii) principles of :
    - anode and screen modulation ;
    - grid modulation ;
    - collector modulation ;
    - emitter modulation ;
    - other methods ;
  - (iii) depth of modulation :
    - causes and consequences of over modulation ;
    - effect of under modulation ;
  - (iv) relationship of carrier and sideband power ;
  - (v) efficiency of power amplifier stage ;
  - (vi) speech processing system principles - advantages and limitations

## 8.3 Single sideband suppressed carrier amplitude modulated telephony :

- (a) bandwidth of emission - typical spectrum - range of audio frequencies used - reason for restricting ;
- (b) advantages compared to double sideband amplitude modulation ;
- (c) filter method of SSB generation ;
  - (i) circuit diagram analysis of balanced modulator ;
  - (ii) types of filters :
    - low frequency crystal ;
    - high frequency crystal ;
    - low frequency mechanical ;



- (iii) required filter characteristics ;
  - (iv) placement of carrier frequency ;
- (d) sideband switching USB/LSB ;
  - (e) spurious mixing products ;
  - (f) frequency translation for multiband operation ;
  - (g) need for linear amplification ;
  - (h) criteria for linear amplifiers ;
    - (i) class of operation ;
    - (ii) power supply requirements ;
    - (iii) operation within dynamic range ;
  - (i) effects of non-linearity on signal quality and bandwidth-"flat-topping";
  - (j) matching of power amplifier stage to load ;
    - (i) pi (II) tank circuit ;
    - (ii) broadband circuits ;
  - (k) typical circuits for individual stages ;
  - (l) block diagram knowledge of complete transmitter, including frequencies at each stage.

#### 8.4 Frequency modulation / phase modulation :

- (a) concept ;
- (b) bandwidth of emission ;
  - (i) narrow band frequency modulation (NBFM) ;
  - (ii) wide band frequency modulation (WBFM) ;
  - (iii) existence of sidebands - deviation - modulation index ;
- (c) generation of FM/PM ;
  - (i) reactance modulator (variable L or C) ;
  - (ii) other modulation methods - varacor, PLL ;
  - (iii) effect of frequency multiplication of deviation ;
  - (iv) audio preamplifier characteristics - pre-emphasis - clipping ;
  - (v) class of operation of typical power amplifier stages ;
- (d) block diagram - knowledge of complete transmitter, including frequencies at each stage

### 8.5 VHF / UHF techniques :

- (a) transverters - block diagram ;
- (b) varactor multipliers
- (c) tank circuit design, cavity resonators, strip lines (efficiency considerations) ;
- (d) general design considerations of these frequencies.

## 9. RECEIVERS

### 9.1 Receiver principles :

- (a) Interference considerations (i. e. image, crossmodulation, intermodulation, fundamental overload) ;
  - (i) recognition of symptoms ;
  - (ii) potential remedies

### 9.2 The superheterodyne receiver :

- (a) principles of operation - advantages - typical block diagram - circuit diagram and component function of :
  - (i) RF amplifier stage ;
  - (ii) local oscillator stage - fixed tuned - variable ;
  - (iii) intermediate frequency (IF) amplifier stage ;
  - (iv) crystal calibrator ;
  - (iv) detectors (AM-SSB-CW) ;
  - (v) beat frequency oscillator (BFO) stage - application ;
  - (vi) audio amplifier stage ;
  - (vii) automatic gain control (AGC) - simple, delayed ;
  - (viii) S meter ;
  - (ix) Noise limiters / blankers ;
- (b) double conversion and direct conversion receivers - reasons for use, advantages / disadvantages ;
- (c) receiver specifications ;
  - (i) selectivity ;
  - (ii) sensitivity ;
  - (iii) stability ;
  - (iv) image rejection ;
  - (v) dynamic range ;
  - (vi) cross modulation ;
  - (vii) signal - to-noise ratio ;

(d) frequency modulation receivers - typical block diagram, functional description ;

- (i) detectors - ratio detector - discriminator ;
- (ii) limiters ;
- (iii) capture effect ;
- (iv) quieting and signal / noise ratio considerations ;
- (v) de-emphasis ;

(e) frequency readout ;

- (i) analogue ;
- (ii) digital

(f) phase locked loops (PLL)

- (i) concept of basic loop - explanation of operation in block diagram format ;
- (ii) applications, detector - oscillator ;

(g) transceivers ;

- (i) basic concept of transceiver ;
- (ii) common stages in transceivers ;
- (iii) transmit /receive switching methods ;
- (iv) appreciation of function of the various controls on a modern transceiver

## 10. ANTENNAS & TRANSMISSION LINES

### 10.1 Fundamentals of antennas :

- (a) antenna resonance and standing waves ;
- (b) polarisation ;
- (c) field strength ;
- (d) the dipole ;
  - (i) length - formulae and calculations ;
  - (ii) current and voltage distribution ;
  - (iii) impedance ;
  - (iv) radiation characteristics ;
  - (v) methods of feeding ;
  - (vi) reference - isotropic radiator ;

- (e) long-wire antennas (e. g. Rhombic, V-beam) ;
  - (i) long-wire characteristics ;
  - (ii) current and voltage distribution ;
  - (iii) physical lengths ;
  - (iv) impedance ;
  - (v) gain-directional characteristics ;
  - (vi) methods of feeding ;
  
- (f) multiband antennas ;
  - (i) common feed dipoles, impedance considerations ;
  - (ii) tuned trap antennas ;
  - (iii) angle of radiation - radiation patterns, polarisation ;
  
- (g) vertical antennas ;
  - (i) the ground plane, 1/4 and 5/8 wavelength ;
  - (ii) voltage-fed half wave
  
- (h) directive array with parasitic elements ;
  - (i) the yagi - element names, length and spacing - gain effect of additional elements on feed impedance - methods of matching;
  - (ii) cubical quad - element names, length, structure and spacing - gain ;
  - (iii) other directional antenna types (including those suitable for UHF/ SHF) practical applications;
  
- (i) Artificial antenna (dummy load);
  - (i) circuit configuration including current and voltage measurement;
  - (ii) method of calculating output power in the load;
  - (iii) ratings and cooling ;
  - (iv) need to inhibit radiation, shielding
  
- (j) mobile antennas - method of construction, efficiency, bandwidth, impedance and methods of feeding;
  - (i) base loaded whips;
  - (ii) centre loaded whips;
  - (iii) distributed loading whips (helical) ;
  - (iv) 1/4 and 5/8 wavelength (VHF/UHF) ;

- (k) impedance matching methods ;
  - (i) baluns and stubs ;
  - (ii) transformer matching
  - (iii) folded dipoles ;
  - (iv) gamma matching ;
  - (v) antenna tuning units (ATU), configurations, advantages and uses -

## 10.2 Transmission lines :

- (a) reasons for use ;
- (b) coaxial and balanced transmission lines ;
  - (i) characteristic impedance ( $Z_0$ ) ;
  - (ii) dielectrics ;
  - (iii) losses, attenuation ;
  - (iv) velocity factor ;
- (c) standing waves on a transmission line for the following conditions of termination (amplitude of current and voltage variations along a line) ;
  - (i) open circuit ;
  - (ii) resistance greater than  $Z_0$  ;
  - (iii) resistance less than  $Z_0$  ;
  - (iv) correctly terminated ;
  - (v) short circuit ;
- (d) voltage standing wave ratio (VSWR) ;
  - (i) reflected power ;
  - (ii) tolerable VSWR ;
  - (iii) effect of high VSWR ;
  - (iv) relationship between VSWR/load/ $Z_0$  ;
  - (v) measurement

## 11. PROPAGATION

### 11.1 Characteristics of radio waves :

- (a) electromagnetic radiation ;
  - (i) propagation ;
  - (ii) free-space velocity-formul, calculations ;
  - (iii) reflection, refraction and diffraction ;
  
- (b) polarisation ;
  - (i) electric and magnetic fields ;
  - (ii) vertical polarisation ;
  - (iii) horizontal polarisation ;
  
- (c) types of propagation ;
  - (i) ionospheric waves ;
  - (ii) tropospheric waves ;
  - (iii) ground waves ;
  - (iv) VHF/UHF/SHF considerations ;
  
- (b) ionospheric propagation ;
  - (i) properties of the ionosphere ; ionisation; refraction; absorption;
  - (ii) definitions; skip distance; skip zone; virtual height; ALF; MUF; optimum working frequency (OWF) ;
  - (iii) variations in ionisation densities at different heights (D, E and F regions) ; typical height ; thickness; diurnal and seasonal variations ; effect of frequency ;
  - (iv) multiple hop propagation;
  - (v) reflection losses ;
  - (vi) long and short path ;
  - (vii) radiation angle ;
  - (viii) the sun, solar radiations that influence the ionosphere (short and long term) ; solar cycle, sunspots (effect on propagation) ; solar rotation (27 days) ;
  
- (e) tropospheric propagation ;
  - (i) causes of tropospheric bending and ducting ;
  - (ii) effect on VHF/UHF
  
- (f) ground wave propagation;
  - (i) characteristics ;
  - (ii) distance versus frequency ;
  
- (g) fading - types and causes (all frequencies)

## 12. TEST EQUIPMENT & MEASUREMENTS

### 12.1 Permanent magnet moving coil (PMMC) meter;

- (a) principle of operation ;
- (b) applications and methods of use as :
  - (i) DC voltmeter ;
  - (ii) DC ammeter ;
  - (iii) Ohm meter ;
  - (iv) AC voltmeter ;

(c) sensitivity, accuracy and loading effects when used as a voltmeter

### 12.2 Electronic voltmeter (digital and analogue) - advantages, applications and comparison of uses

### 12.3 Cathode ray oscilloscope (CRO) :

- (a) applications and limitations (including SSB power measurement) ;
- (b) interpretation of basic display;
  - (i) X axis - time ;
  - (ii) Y axis - amplitude ;
- (c) interpretation of wave shapes ;
  - (i) DC;
  - (ii) sine wave AC;
  - (iii) Lissajous patterns;
  - (iv) envelope and trapezoidal display of AM modulation percentage ;
  - (v) SSB speech patterns;
  - (vi) keying waveforms

### 12.4 Basic test instruments:

- (a) A knowledge of the principles of operation, applications and limitations of the following instruments:
  - (i) RF probe (RF voltmeter);
  - (ii) absorption wavemeter (tunable and untuned types);
  - (iii) field strength meter;
  - (iv) dip oscillator;
  - (v) reflectometer (SWR meter);
  - (vi) RF wattmeter ;
  - (vii) 2 tone audio test oscillator (SSB power measurements)

### 12.5 Advanced test instruments :

- (a) Appreciation of the use and limitations of the following instruments :
  - (i) digital frequency meter (DFM) ;
  - (ii) RF signal generator ;
  - (iii) antenna noise bridge

## 13. INTERFERENCE

### 13.1 Transmitter defects :

- (a) definitions, causes, effects, location and suppression of interference caused by :
  - (i) parasitic oscillations ;
  - (ii) harmonic radiation;
  - (iii) self oscillation (instability) ;
  - (iv) spurious outputs and overdriving (splatter) ;
  - (v) inter modulation products ;
  - (vi) key clicks

### 13.2 Interference to broadcast and TV reception (BCI and TVI) and other domestic equipment:

- (a) causes :
  - (i) front end overload (including blocking) ;
  - (ii) fundamental overload (AF/RF) ;
  - (iii) cross modulation ;
- (b) remedies :
  - (i) stubs;
  - (ii) filters (including toroids) ;
  - (iii) ferrite beads, chokes and bypass capacitors ;
- (c) recognition of symptoms and precautions to avoid the various interference problems, including those which can be generated by ancillary devices (e. g SCR or Triacs) ;
- (d) interference due to re-radiation-external cross modulation causes-effects-cures



### 13.3 Filters and their applications :

- (a) high-pass ;
- (b) low-pass ;
- (c) band-pass ;
- (d) co-axial (all types including cavity resonator);
- (e) strip line

## 14. ADVANCED MODES OF TRANSMISSION AND RECEPTION

### 14.1 A basic appreciation of the use and applications and interference potential of the following modes of transmission and the bandwidths involved :

- (a) high definition television (ATV) ;
- (b) slow scan television (SSTV) ;
- (c) radio teletype (RTTY) ;
- (d) repeaters (FM & ATV) ;
- (e) satellite translators and transponders ;
- (f) beacons ;
- (g) transmission techniques involving bandwidth compression (e.g narrow band voice modulation - NBVM) ;
- (h) computer controlled communication systems (AMTOR, packet radio etc.)

## 15. SAFETY

### 15.1 The human body :

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

### 15.2 Safety with high voltages :

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

- 15.3 Mains wiring
- (a) Mains power point configuration ;
  - (b) Colour code for active, neutral and earth ;
  - (c) Difference between active, neutral and earth ;
  - (d) Basic principle of earth connection ;
  - (e) Fuses and circuit breakers ;
    - (i) principle of operation ;
    - (ii) importance of use of appropriate rating
- 15.4 Lightning :
- (a) danger of lightning strikes ;
  - (b) paths of entry ;
  - (c) lightning arrestors and other precautions
- 15.5 Safety in use of high RF energy levels (including precautions at microwave frequencies)
- 15.6 Safety in use of hazardous materials or equipment (e.g. high voltage power suppliers; batteries - electrolyte, ventilation, charge/ discharge rate. Beryllium encapsulated solid state devices)
- 15.7 Safety in mobile station operation - awareness of hazards

(ii) LICENCING CONDITIONS, OPERATING PRACTICES  
AND PROCEDURES

(WRITTEN PAPER - SYLLABUS)

1. Definitions of Amateur Stations, Amateur Service and General terms in usage with Amateur Radio Service.
2. Qualification 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 equipment
  - Authorised Radio Frequency Bands
  - Types of Emissions
  - Stability of Emissions
  - Automatic Radio Telegraph System
  - Data & Facsimile Transmissions
  - Television Experiments
  - Inspection of stations
  - Avoidance of interference
  - Quality of transmission
  - Transmitter power
  - Antenna gain
  - Use of satellites and repeaters; accessing a repeater
4. General provisions :
  - Use of stations in the Amateur Service
  - Prohibited Traffic
  - Licensee Responsible for operation of station
  - Secrecy of Communications
  - Log Keeping
  - Change of address of Amateur Station
  - Mobile Operations (Land, Maritime & Aeronautical)
  - Emergency Amateur Networks
  - Call Signs or Identifications
  - Liability for breaches of Law
  - Offences against regulations/rules
  - Licensee to Receive Distress Signals
  - Recording and Replaying Transmissions
  - Relaying of Transmissions

## 5. Operating Procedures :

Call and Tests

Calling Procedure

Call and reply

Mobile stations and stations operating at locations other than the authorised Fixed Locations.

Distress Procedure

Distress Call & Message

Distress Traffic, obligations

Urgency signal

Emergency position indicating Radio Beacons

## 6. Miscellaneous :

Abbreviations and signals

Phonoetic Alphabet

Morse Code

Q - code

## 7. Regulations / Rules :

Local Radio Regulations and Rules

ITU Radio Regulations

Terms and conditions of the licence



