

Foundation Radio Amateur Licence – Syllabus.



Syllabus

Assessment Objectives

1. Amateur radio

- 1a Nature of amateur radio

- 1.1 Know that the amateur licence is for self-training in radio communications and is of a non-commercial nature.

2. Licensing Conditions

- 2a Identify types of Amateur Licence

- 2.1 Know the types of Amateur Licence.
Know that more advanced classes of amateur licence exist and that they allow greater facilities and the ability to build/modify transmitting equipment

- 2b Format of Amateur callsigns

- 2.2 Know format of Foundation, Intermediate (Novice) and Full callsigns. (Know that secondary identifiers are used but be able to state only those for the foundation licence).

- 2c Licence terms and conditions. Assessable items as shown in *assessment objectives*.

- 2.3 Know the requirements for station identification.
- 2.4 Know the requirement to only send messages to other amateurs.
- 2.5 Know that secret codes are not permitted.
- 2.6 Know that broadcasting is not permitted.
- 2.7 Know that the transmission of music is not permitted.
- 2.8 Know that only the licensee personally may use the station.

Syllabus

Assessment Objectives

3. Technical Basics

- 3a Identify Units of measurement and multiple/sub-multiple prefixes.
- 3b Simple circuit theory

- 2.9 Know of the requirement to notify of change of address.
 - 2.10 Know that RA local office officials have a right of inspection.
 - 2.11 Know that RA local office officials have the right to close down or restrict operation.
 - 2.12 Know the need for a log book and the items required to be entered.
 - 2.13 Understand and use the Schedule to the licence. Recognise allowable frequencies, types & modes of transmission and power limits.
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- 3.1 Units of, and abbreviations for, Voltage, Current, Power and Resistance. Prefixes milli, kilo and Mega.
 - 3.2 Know the relationship between Voltage, Current and Power. Calculate the unknown quantity given the numerical value of the other two.
 - 3.3 Know that resistance is the opposition to current flow.
 - 3.4 Know the relationship between Voltage, Current and Resistance. Calculate the unknown quantity given the numerical value of the other two.
 - 3.5 Know that a battery provides voltage and that a circuit is needed to allow current to flow.
 - 3.6 Know that the polarity of a battery is not relevant if a filament bulb is used but that electronic circuits can be damaged by the wrong polarity.
 - 3.7 Know what is meant by the terms D.C and A.C

Syllabus

3c Frequencies used in power, audio and radio systems.

Assessment Objectives

- 3.8 Unit of frequency. Abbreviations RF and AF
Know the graphic representation of a sine wave and that sine waves are produced by oscillators
Know the frequency of the mains supply.
Know the range of frequencies for normal hearing – 100Hz- 15kHz
Know the range of frequencies for audio communication - 300Hz-3kHz.
Know the frequency bands for HF, VHF and UHF radio signals. – up to 1,000 MHz
- 3.9 Recognise that bands are allocated for particular use, e.g. broadcasting, aeronautical, maritime and amateur.
- 3.10 Recognise the relationship between frequency and wavelength. Use a graph to convert from one to the other.
Note: calculations are not required.

4. Transmitters and Receivers

4a Simple block or “concept” diagrams of a transmitters.

4b Technical requirements of radio transmitters

- 4.1 State the items in a simple transmitter block diagram:
Microphone, audio amplifier stage, frequency generation stage, modulator stage, RF power amplifier stage, feeder and antenna. Identify their interconnection.
- 4.2 Know that the frequency generation stage(s) (e.g. oscillator(s)) in a transmitter defines the frequency on which the transmitter operates. Know that incorrect setting of these stages can result in operation outside the amateur band and interference to other users.

Syllabus

Assessment Objectives

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| 4c | Simple block or “concept” diagrams of a receiver. | 4.3 | Know that the audio (or data) signal is modulated on to the radio frequency “carrier” in the modulation stage of the transmitter block diagram.

Know that modulation is by varying the amplitude or frequency of the “carrier”, resulting in AM or FM modulation modes.

Know that speech can be carried by AM/SSB or FM, and data by CW or FSK. |
| 4d | Technical requirements of radio receivers | 4.4 | Recognise drawings of an r.f carrier and amplitude modulated or frequency modulated radio signals. Understand the terms carrier, audio waveform and modulated waveform. |
| | | 4.5 | Know that the power amplification of the radio signal is carried out in the final stage of the block diagram. |
| | | 4.6 | Know that the RF power amplifier output must be connected to a correctly matched antenna to work properly and that use of the wrong antenna can result in damage to the transmitter |
| | | 4.7 | Understand that excessive amplitude modulation causes distorted output and interference to adjacent channels. Understand that excessive frequency deviation will cause interference to adjacent channels. Need to ensure the microphone gain (where fitted) is correctly adjusted. |
| | | 4.8 | State the items in a simple receiver block diagram: antenna, feeder, radio tuning and RF amplification, detection, audio amplification and loudspeaker or headphones. Identify their interconnection. |
| | | 4.9 | Know that tuning of receiver is carried out in first stages of the receiver block diagram. |
| | | 4.10 | Know that detection (recovery of the original modulating signal) is carried out in the second stage of the block diagram and audio amplification is in the third stage. |

Syllabus

Assessment Objectives

5. Feeder and Antenna

5a	Feeder requirements	5.1	Know the correct cable to use for rf signals. Because of its screening qualities, Coaxial cable is most widely used
		5.2	Know that the plugs and sockets for RF should be of the correct type and that the braid of coaxial cable must be correctly connected to minimise RF signals getting into or out of the cable. The BNC and PL259 plugs should be recognised.
5b	Types of antenna	5.3	Know that the purpose of an antenna is to convert electrical signals into radio waves, and vice-versa.
		5.4	Recognise a dipole, $\lambda/4$ ground plane, yagi, end-fed wire and $5/8\lambda$ antenna. Understand that the sizes of HF and VHF antennas are different because they are related to wavelength, though they operate on the same basic principles.
5c	Antenna basics	5.5	Know that dipoles (mounted vertically), ground planes and $5/8\lambda$ antenna are omni-directional.
		5.6	Know that a yagi antenna is directional and has a gain because of its focussing ability.
		5.7	Know that e.r.p is the product of the power to the antenna and its gain.
		5.8	Know that the antenna system must be suitable for the frequency of the transmitted signal. Know that if an antenna is not correctly designed for the frequency it will not match the transmitter and will not work effectively.
		5.9	Know that at HF, where an antenna has not been designed for the particular frequency, an ATU (antenna tuning unit) makes it possible for the antenna to accept power from the transmitter.
5d	Balanced antennas	5.10	Know the difference between balanced and unbalanced antennas and that a balun should be used when feeding a H.F. dipole with coaxial cable.

Syllabus

5e Meaning of SWR

5f Use of a dummy load

6. Propagation

6a Radio propagation basics

Assessment Objectives

- 5.11 Know that an SWR meter shows whether an antenna presents the correct match to the transmitter and is reflecting minimum power back to the transmitter.
 - 5.12 Know that a high SWR (measured at the transmitter) is an indication of a fault in the antenna or feeder (and not the transmitter). (Relate this to item 4.6.)
 - 5.13 Know that a “dummy load” is a screened resistor connected instead of an antenna to allow the transmitter to be operated without radiating a signal.
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- 6.1 Know that radio waves travel in straight lines, unless diffracted or reflected.
 - 6.2 Know that radio waves get weaker as they spread out.
 - 6.3 Know that at VHF and UHF hills cause “shadows” and that waves get weaker in penetrating buildings but glass windows are more transparent to radio waves.
 - 6.4 Know that the range achieved at VHF/UHF is dependant on antenna height and a clear path and transmitter power. Know that higher antennas are preferable to higher power, as they improve both transmit and receive performance. Know that outdoor antennas will perform better than indoor antennas.
 - 6.5 Know that, at VHF/UHF, range decreases as frequency increases. In general, VHF/UHF waves have a range not much beyond “line of sight”.
 - 6.6 Know that the ionosphere comprises layers of ‘conductive gas’ at heights between 70 and 400km.

Syllabus

Assessment Objectives

- 6.7 Know that on HF almost all communication relies on the waves being reflected by the ionosphere.
Know that HF can provide world-wide propagation depending on how well the ionosphere bends the waves back to the earth.
Know that this varies with frequency, time of day and season.

7. EMC

7a Basics of electromagnetic compatibility

- 7.1 Know that electromagnetic compatibility (EMC) is the avoidance of interference between various pieces of electronic equipment.
- 7.2 Know that radio transmitters can cause interference to nearby electronic and radio equipment.
- 7.3 Know that radio receivers can also suffer from interference from local sources. (This is not considered specifically, but most good EMC practice applies to both conditions.)
- 7.4 Know that interference occurs through local radio transmissions being conveyed to the affected equipment through pick up in house wiring, TV antenna down-leads, telephone wiring etc., and (particularly at VHF/UHF) by direct pick-up in the internal circuits of the affected equipment itself.

7b Station design for EMC.

- 7.5 Know that EMC problems can be minimised by siting antennas as far away from houses as possible, as high as possible, and using balanced antennas at HF.
Know that, at HF, (horizontal) dipoles are less likely to be a problem and that end-fed wires present significant EMC problems.
Know that information on the avoidance of interference by the correct choice and siting of antennas and suitable operating procedures is readily available from several sources.

Syllabus

Assessment Objectives

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| 7c | Immunity of radio receiving and other devices and filtering techniques. | 7.6 | Know that the more power a station runs, the more likely it is to cause interference.

Know that some types of transmission are more likely to cause interference to TV, radio and telephones than others.

Know that SSB is the one of the poorest in this respect. FM, CW (Morse) and the some of the HF data modes (such as PSK31) are much better. |
| | | 7.7 | Know that the ability of any piece of electronic or radio equipment to function correctly in the presence of strong RF signals is known as "immunity".

Know that the immunity of most types of equipment can be increased by fitting suitable external chokes and filters in mains or TV antenna leads.

Know that the filters should be fitted as close to the affected device as possible. |
| | | 7.8 | Know that anything fitted to the mains wiring must be properly made for the purpose. Home-made items (other than ferrite rings) are potentially dangerous.

Know that information about the purchasing, making and fitting of chokes and filters is readily available from several sources. |
| | | 7.9 | Know that the function of the RF earth connection in an HF amateur station is to provide a path to ground to minimise RF currents entering the mains earth system and causing interference to other electronic equipment. |
| 7d | Social issues of Interference. | 7.10 | Know that EMC problems have the potential for causing neighbour disputes. Understand the need for diplomacy, the sources of advice available and the role of the local office of the Radiocommunications Agency (RIS). |

Syllabus

Assessment Objectives

8. Operating Practices and Procedures.

8a Operating practices and procedures

8b Operating through a repeater.

8c Band plans

8d Connecting microphones and other audio sources to the transmitter.

8e Competence in making radio contacts.

This part of the syllabus is carried out and assessed as part of a recognised training course.

8.1 Know to listen before calling and to ask if the frequency is in use.

8.2 Know how to make a CQ call.

8.3 Know to move off the calling channel (when on VHF/UHF) once contact is established.

8.4 Know the function of, and how to use, a repeater. Need for Tone or CTCSS and frequency offset. Know why a frequency offset is needed.

8.5 Know why band-plans are used. Be able to identify items on a published band-plan.

8.6 Know that connecting anything other than the supplied microphone (e.g. packet radio TNCs) to the transmitter requires correct operation of the PTT line and correct audio signal levels.

8.7 Demonstrate, using a VHF/UHF transmitter/receiver; correct tuning in to an amateur f.m voice signal and a data signal such as packet. Read the signal strength meter (where fitted).

8.8 Demonstrate correct operation of a VHF transmitter/receiver in simplex mode. Controls used shall include frequency, squelch and, audio gain (volume).

Know the meaning of signal reports exchanged during a contact.

Make a simplex radio contact and exchange signal reports.

8.9 Demonstrate, using an H.F. transmitter/receiver, correct tuning in to an amateur s.s.b voice signal and a Morse signal. Read the signal strength meter.

Syllabus

Assessment Objectives

8f Connecting a transmitter/receiver.

This part of the syllabus is carried out and assessed as part of a recognised training course.

9. Safety

9a Sources of danger: mains, power supplies and high current batteries.

8.10 Demonstrate correct operation of an HF. Transmitter/receiver in an s.s.b contact. Controls used shall include frequency, the r.i.t (clarifier), audio gain (volume), r.f, microphone gain and antenna tuner (ATU).
Make an H.F. s.s.b voice contact and exchange signal reports.

8.11 Demonstrate a CQ call on VHF/UHF, making a contact and initiating a change of frequency (QSY) off the calling channel.

8.12 Demonstrate connecting a transmitter/receiver to a power supply, antenna and feeder.

8.13 Demonstrate, using a $\lambda/2$ dipole antenna with adjustable elements, that the SWR varies as the length of the elements are varied. Set up the dipole for minimum SWR. *Note: The elements are not to be adjusted whilst transmitting. Correct procedure for a radiating test shall be demonstrated.*

9.1 Know that high voltages carry a risk of electrocution and high currents carry a risk of overheating and fire.

9.2 Know why mains powered equipment should have a safety earth.
Know that special care is needed with earthing arrangements if your house has PME. Know that details of PME earthing can be obtained from the local electricity supply company and are covered in a separate leaflet.

9.3 Know that a correct fuse must be fitted to all electrical equipment.

9.4 Know only to work inside equipment which is disconnected from the mains.

9.5 Know the correct way to wire a 3-pin mains plug.

9.6 Know the need for a clearly marked switch to turn off all station equipment in case of emergency.

Syllabus

8b Actions to be taken and avoided in the event of an accident.

8c Station layout and tidiness

8d Safe use of headphones

Assessment Objectives

9.7 Know that, in the event of an accident involving electricity, the first action is to switch off the power.

Know that the casualty must not be touched unless the power has been switched off.

9.8 Know not to have wires trailing across the floor. Trip hazard and the risk of frayed insulation.

9.9 Know that elevated wires and antennas must be suitably located and secured.

9.10 Know that antennas and feeders should not be sited close to overhead power cables.

9.11 Know that antenna erection is potentially hazardous and that it is advisable to have someone to help you. At least one adult should be present.

9.12 Know that antenna elements should not be touched whilst transmitting and should be mounted to avoid accidental contact.

Note: this does not apply to low powered devices such as hand-held equipment.

9.13 Know that particularly high antennas may need special protection against lightning.

9.14 Know that excessive volume when wearing headphones can cause damage to hearing.

Morse Code.

The ITU Radio Regulations places an obligation on national Administrations to require candidates to demonstrate that he/she is able to send correctly by hand and to receive correctly by ear, texts in Morse code signals. The requirement is waived for access to frequencies above 30MHz. It is expected that this requirement will be removed at the next world radio conference, WRC2003. It is then open to administrations to consult their amateurs as to whether the requirement should be retained as a national arrangement.

Until the requirement is removed, the following section forms a part of the syllabus. This section may be taken at any time in relation to the training course but prior to the exam.

– See Note 1.

10. Morse Code

Note Italic text under discussion

10a Send and Receive Morse Code

10.1 Demonstrate that he/she is able to send correctly by hand and to receive correctly by ear, texts in Morse code signals.

Notes:

1. The Foundation Licence permits access to both h.f and v.h.f amateur bands. There is no concept of an “A” or “B” licence as currently in force for the Novice (Intermediate) and full licence classes.
2. Tutors are advised to read ”Foundation Training Course – A Guide to Tutors” produced by the Radiocommunications Agency. The Guide also has a glossary explaining some of the terms used and sources of further reading.