Amateur radio syllabus - Full level

Full Licence Syllabus v 1.5

	Section 1 — Licensing conditions and station identification
	Nature of amateur radio, types of licence and call signs
1A2	Identify the types of UK licence and the format of all call signs in use including regional secondary locators, and all suffixes. *Note: The club, special event and contest call signs are not examined in this section.*
1A5	Recall the requirements for station identification. *Note: For the purposes of the examination this includes identifying when there is a change of:* • *frequency;* • *mode;* • *operator unless under supervision;* • *supervisor;* • *Regional Secondary Locator.*
	Operators and supervision
1B1	Understand the requirements when delegating supervisory responsibilities and the permitted uses and conditions.
1B2	Understand the meaning and identification of a Disqualified Person and the meaning of 'reasonable grounds to believe is not a Disqualified Person'. Understand the meaning of Radio Amateurs pass certificate. Understand the meaning of a recognised training course. Understand the duties of a supervisor during use by non-UK licensed persons. Understand the procedure for sending messages by non-licensed persons (greetings messages).
	Messages
1C1	Understand the requirements relating to the content of messages and who messages may be sent to. Understand the circumstances when messages, including encrypted content, may be sent. Understand the distinction between the use of codes and abbreviations and encryption. Understand that people of all ages and backgrounds participate in amateur radio and that messages must not cause offence, particularly in the context of relevant legislation including the Wireless Telegraphy (Content of Transmission) Regulations 1988 and the Communications Act (2003).
1C2	Understand the Licence requirements in respect of the receipt of messages from amateurs on non-UK frequencies. Understand the Licence requirements in respect of recorded and re-transmitted messages.

	Apparatus, inspection and closedown
1D1	Understand the requirements for clean and stable transmitters and the need to control transmitted bandwidth. Understand the need to avoid Undue Interference to other wireless telegraphy. Understand the need to conduct tests from time to time to ensure that the station is not causing Undue Interference to other radio users. Understand the need to have equipment for the reception of messages on all frequencies and modes in use for transmissions. Understand the role of Ofcom in cases of Undue Interference.
	Unattended and remote control operation
1E2	Recall that the Licensee may use any communication link for the purposes of Remote Control of the main station. Recall that if the Remote Control link is in an amateur band that the licence requirements for the link are the same as the requirements for the main station. Recall that a link in an amateur band should be above 30MHz. Recall that a link in an amateur band must not be encrypted.
	CEPT and international
1F1	Understand the requirements for operation by individual UK Licensees abroad under the CEPT Recommendation T/R 61-01 and T/R 61-02. Understand this facility does not extend to club or reciprocal licences. Understand the purpose and function of the CEPT Harmonised Amateur Radio Examination Certificate (HAREC). Recall that many countries will offer reciprocal licences to UK amateurs with a HAREC Full licence and that operation is in accordance with the host country's rules.
1F2	Understand the requirements for operation whilst Maritime Mobile and meaning of Maritime Mobile and Vessel at Sea. Understand the requirements of permission to install and operate, Radio Silence and Log Keeping. Identify the 3 ITU regions and recall that the frequencies are given in the ITU Radio Regulations.
	Licence schedule
1G1	Identify relevant information in Schedules 1 and 2 to the Full licence. *A copy of the relevant part of Schedules 1 and 2 will be available during the examination.*

1G2	Understand relevant information in Schedule 3 to the licence. • Origin of the EMF restrictions (ICNIRP); • Meaning of the term ‘general public’; • Areas in which the general public need to be protected from EMF in breach of the limits. • Records of EMF assessment; • Procedure for carrying out an EMF assessment; • Emergency situations.
	Section 2 — Technical aspects
	Fundamental theory
2A1	Understand component tolerances and the effects they may have in circuit operation.
	Power
2B1	Solve series/parallel resistor circuits to calculate currents, voltages, resistances and power given appropriate values. This may include the use of series/parallel formulae, Ohm’s Law and power. Equations include $P=V^2/R$ and $P=I^2 \times R$
	Reactive components
2D1	Understand the factors influencing the capacitance of a capacitor; area and separation of the plates, permittivity of dielectrics and formula $C=k \times A/d$. Recall that the Coulomb is the quantity of electricity, Q, given by current × time and that the charge on a capacitor is given by $Q = V \times C$.
2D2	Recall that different dielectrics are used for different purposes, e.g. air, ceramic, mica and polyester; and that with some dielectrics, losses increase with increasing frequency.
2D3	Understand that capacitors have a breakdown voltage and that they need to be used within that voltage.
2D4	Understand the term ‘self-inductance’ and recall that a ‘back EMF’ is produced as current flow changes in an inductor.
2D7	Understand the rise and fall of current in an LR circuit and that the time constant $\tau = L/R$. Understand the rise and fall of voltage in a CR circuit and that the time constant $\tau = C \times R$.

	AC theory
2E3	Understand that current lags potential difference by 90° in an inductor and that current leads by 90° in a capacitor. Understand the formulae for the reactance of a capacitor or inductor in terms of the frequency and component value. Calculate the unknown term given the other two.
2E4	Understand the use of capacitors for AC coupling (DC blocking) and decoupling AC signals (including RF bypass) to ground.
2E5	Understand the use of inductors for DC decoupling (AC blocking).
2E6	Understand that impedance is a combination of resistance and reactance and apply the formula for impedance and current in a series CR or LR circuit.
	Digital signals
2F1	Understand that analogue to digital conversion can generate a false image of the signal if frequencies are present above the frequency which is half the sampling (Nyquist) rate. Recall that these false images are known as aliases. Understand that anti-aliasing filters are used to avoid this occurring.
2F2	Recall that digital signals in the time domain can be depicted in the frequency domain by using a mathematical operation known as a Fourier Transform (FT). Recall that a Fourier Transform takes digital signals in the time domain and calculates the amplitudes and the frequencies which comprised the original signal.
	Transformers
2G1	Understand the concept of mutual inductance. Understand and apply the formulae relating transformer primary and secondary turns to primary and secondary potential differences and currents. Understand the impedance change in a transformer and apply the formula relating transformer primary and secondary terms to primary and secondary impedances. Recall that different magnetic materials used as cores for inductors and transformers perform best over different frequency ranges and affect their efficiency. Recall that losses in the material will cause heating which affects power handling and the required physical size of the core for the power concerned.
	Tuned Circuits and resonance
2H1	Apply the formula for the resonant frequency of a tuned circuit to find values of f, L or C from given data.

2H2	Recall the equivalent circuit of a crystal and that it exhibits series and parallel resonance. Recall that crystals are manufactured for either series or parallel operation and will only be stable and correct on the marked frequency when used in the intended manner.
2H4	Understand the concept of the magnification factor Q as applied to the voltages and currents in a resonant circuit. Recall that voltages and circulating currents in tuned circuits can be very high and understand the implications for component rating. Apply the formula for Q factor given circuit component values. Recall the definition of the half power point of resonance curves. Apply the equation for Q given the resonant frequency and the half power points on the resonance curve.
2H5	Understand the meaning of dynamic resistance, R_D.
	Semiconductor devices
2I1	Recall that a Zener diode will conduct when the applied reverse bias potential is above its designed value and identify its V/I characteristic curve.
2I3	Understand the basics of biasing NPN and PNP bipolar transistors and field effect transistors (FET) (including dual gate devices). *Note: Circuits shown will be an NPN transistor connected in common emitter/common source mode.*
2I4	Identify different types of small signal amplifiers (e.g. common emitter (source), emitter follower and common base) and explain their operation in terms of input and output impedances, current gain, voltage gain and phase change. Recall the characteristics and typical circuit diagrams of different classes of amplifiers (i.e. A, B, A/B and C).
2I5	Understand the feedback requirements to sustain oscillations in an oscillator.
	Cells and power supplies
2J2	Understand the function of stabilising circuits and identify different types of stabilising circuits (i.e. Zener diode/pass transistor and IC). *Note: questions on the characteristics of individual components are covered in other parts of this syllabus. This subsection is on complete circuits.*
2J3	Understand the need for rectifier diodes to have a sufficient peak inverse voltage (PIV) rating and calculate the PIV in diode/capacitor circuits.
2J4	Understand the basic principles and operation of a switch mode power supply, at block diagram level.

	Section 3 — Transmitters and receivers
	Transmitter concepts
3A2	Recall the meaning of Modulation Index and its effect on the number of FM sidebands.
	Transmitter architecture
3B1	Understand the block diagram of an SSB transmitter employing mixers to generate the final frequency. Understand the block diagram of an FM transmitter employing either frequency multipliers or mixers to generate the final frequency.
	Oscillators
3C1	Recall the effect and the importance of minimising drift.
3C3	Recall the block diagram of a Phase Locked Loop (PLL) frequency synthesiser and the functions of the stages i.e. oscillator, fixed divider, phase detector, Low Pass Filter (LPF), voltage controlled oscillator and programmable divider. Recall how sinusoidal waves may be produced by direct digital synthesis and the block diagram of a simple synthesiser. Recall that increasing the number of bits in the synthesiser will increase the purity of the signal. Recall the function of the Clock, Lookup Table, DAC and LPF in a DDS block diagram.
	Frequency multipliers
3D1	Understand that frequency multipliers use harmonics to generate frequencies above an oscillator's fundamental frequency (e.g. in a microwave transmitter).
	Microphone amplifiers and modulators
3E1	Understand the operation of AM, SSB and FM modulators. Calculate the bandwidth of such transmissions.
3E2	Identify typical sideband filter circuits and calculate relevant frequencies.
	RF power amplifiers
3F2	Understand the need for linear amplification and identify which forms of modulation require a linear amplifier. Identify simple RF transmitter PA circuits. Understand the meaning of linearity as applied to a circuit or amplifier. Understand how distortion of a single frequency signal can produce harmonics of that frequency. Understand how distortion of two (or more) frequencies can produce harmonics and intermodulation products of the input frequencies.
3F3	Recall the function of the main components of a PA circuit, i.e. collector load, bias, input circuit, output filter and matching.

3F4	Understand the implications for PA rating of different types of modulation and the effects of speech processing, with particular regard to peak to average power ratios.
3F5	Recall the function of automatic level control within the power amplifier circuit and when using an external power amplifier. Recall the function and use of a manual RF power control.
	Transmitter interference
3G1	Understand that over-modulation distorts the modulating signal resulting in harmonics of the audio which causes excessive transmitted bandwidth.
3G2	Understand that over-drive of the RF power amplifier can also result in excessive transmitted bandwidth. Understand the need to drive external power amplifiers with the minimum power required for full output and how overdriving may cause harmonics and/or spurious intermodulation products.
3G3	Understand ways to avoid generating harmonics e.g. use of push-pull amplifiers and avoiding high drive levels. Recall that transmitters may radiate unwanted mixer products and identify suitable remedies. Understand the use of low pass, band pass and band stop (notch) filters in minimising the radiation of unwanted harmonics and mixer products.
3G4	Recall that unwanted emissions may be caused by parasitic oscillation and/or self-oscillation and identify suitable remedies.
3G5	Understand how frequency synthesisers may not produce the intended frequency. Identify appropriate measures to prevent off-frequency transmissions.
	Receiver concepts
3H3	Understand that overloading a receiver causes intermodulation products and that those close to or within the wanted signal bandwidth limit the ability of the receiver to detect weak signals. Recall that the dynamic range of a receiver is the difference between the minimum discernible signal and the maximum signal without overload. Recall that dynamic range is expressed in decibels.
	Superheterodyne concepts
3I1	Understand the block diagram of superheterodyne and double superheterodyne receivers and the functions of each block.
3I2	Understand the function of a mixer, the generation of the Intermediate Frequency (IF) and other mixer products.

3I3	Understand the advantages and disadvantages of high and low intermediate frequencies and the rationale for the double and triple superhet. Understand that for given RF and IF frequencies, there is a choice of two possible local oscillator (LO) frequencies. Understand the reasons for the choice and calculate the frequencies. Understand the origin of the image frequency and calculate the frequency from given parameters.
3I4	Understand the operation of an IF amplifier and the IF transformer. Understand the concept of two LC tuned circuits utilising transformer coupling. Identify critical and over-coupled response curves. Understand how the gain of an IF amplifier can be varied, how this may cause distortion and how the effects of the distortion are avoided.
3I5	Recall the source and effects of phase noise. Recall the unit of measurement is dBc/Hz.
	RF amplifiers and external pre-amplifiers
3J1	Recall the operation of the RF amplifier. Understand that external RF preamplifiers do not always improve overall performance and will reduce the dynamic range. Understand why, at HF, this loss can be as much as the gain of the preamp but that at VHF and above a low noise pre-amp is beneficial. Understand why most benefit is gained by locating the pre-amp at the antenna.
	Demodulation
3K1	Understand the operation of basic analogue AM, CW, SSB and FM demodulator circuits and the function of the limiter for FM.
	Automatic gain control (AGC)
3L1	Understand the source and use of an AGC voltage. Recall that the speed of the AGC response can be adjusted on both attack and decay.
	SDR transmitters and receivers
3M1	Recall that analogue and digital signals are transmitted by some form of amplitude and/or frequency/phase modulation. Recall that amplitude and frequency/phase modulation can be portrayed on a phasor diagram. Understand that to fully capture the information contained in the amplitude and phase of the signal that the position of the phasors must be resolved as the values on two axes at right angles.

3M2	Recall that mixing the RF or IF signal with two local oscillator signals 90 degrees different in phase will produce an in-phase (I) and quadrature (Q) component which can be digitised allowing all forms of modulation to be demodulated entirely by mathematical processes in a PC or using dedicated hardware. Recall that this technique is the basis of SDR (software defined radio) receivers. Recall that these techniques can also be used to create complex modulations for use in transmitters. Recall that if sampling is carried out directly on the RF signal the extraction of I and Q components and subsequent demodulation may be carried out entirely by mathematical processes.
	Transceivers
3N1	Understand that transceivers normally share oscillators between the transmitter and receiver circuits; and they may use common IF filters to limit both the transmitter and receiver bandwidths and that they also use common changeover circuits. Recall the function and use of the RIT control.
3N2	Understand that using a transverter enables operation on frequency bands not covered by the primary transceiver equipment. Calculate appropriate frequencies used in transverter operation. Recall that transverters generally require low power drive. Understand the need for extra care to avoid transmitting out of band when using a transverter. Recall that transverters require the correct interfacing with the primary equipment to control sequencing and prevent hot switching. Understand the techniques of RF sensing and PTT (push-to-talk) transmit receive switching.
	Section 4 – Feeders and antennas
	Feeders
4A3	Understand that the velocity factor of a feeder is the ratio of the velocity of radio waves in the feeder to that in free space and that the velocity factor is always less than unity. Recall that the velocity factor for coaxial feeder with a solid polythene dielectric is approximately 0.67 or 2/3. Perform calculations involving velocity factor, physical length, electrical length and frequency.
	Baluns
4B1	Recall the construction and use of transformer, sleeve and choke type baluns. Identify the circuits of 1:1 and 4:1 transformer baluns.

	Types of antenna
4D1	Recall the equation for calculating wavelengths and apply an end factor correction when calculating the approximate physical lengths of simple dipoles and end fed antennas.
4D2	Recall the current and voltage distribution on the centre fed dipole and $\lambda/4$ ground plane antennas. Recall the feed point impedances of centre fed half-wave dipoles, quarter-wave and loaded 5/8 λ verticals, folded dipoles, full-wave loops and end feed $\lambda/4$ and $\lambda/2$ antennas. Recall the effect of passive antenna elements on feed point impedance and the use of folded dipoles in Yagi antennas.
	Standing waves
4E1	Understand that the standing wave ratio (SWR) is a measure of the signal travelling back down the feeder expressed in terms of the standing waves caused by the reflected signal voltage (or current).
4E2	Recall that return loss is the ratio of the forward signal power to the return signal power; normally expressed in dB. Understand that a low SWR equates to a high return loss and a high SWR equates to a low return loss.
4E3	Understand that the loss in the feeder will reduce the SWR and increase the return loss as measured at the transmitter and that the SWR at the antenna is unaffected. Recall that Return Loss at transmitter = Return Loss at antenna + 2x (feeder loss).
	Antenna matching units
4F1	Understand that Antenna Matching Units (AMUs) can cancel reactive components of the antenna system feed point impedance (before or after the feeder) and can transform impedances to an acceptable resistive value. Identify typical AMU circuits i.e. T, Pi and L circuits.
4F2	Understand that a quarter-wave length of feeder can be used as an impedance transformer. Apply simple examples of the formula $Z_o^2 = Z_{in} \times Z_{out}$
	Section 5 – Propagation
	Radio propagation: key concepts
5A1	Recall that under free space conditions e-m waves spread out according to an inverse square law of power flux density and that the electric field strength, measured in volts/metre, drops linearly with distance. *Note: Numerical calculations required at item 6E1 only*

5A3	Recall that an e-m wave comprises E and H fields in phase, at right angles and at right-angles to the direction of travel and the power flux density (watts / Metre squared) is given by the product of E and H. Recall that in circular polarisation, the polarisation of the wave rotates as it propagates, with either a right-handed (clockwise from behind) or left-handed polarisation. Recall that this is often used for satellite communication where the orientation of the satellite is indeterminate. Recall that the transmit and receive antennas should have the same polarisation.
	Ionosphere
5B1	Understand the effects of Solar flares and sun spots on propagation.
5B2	Recall that the highest frequency that will be refracted back to the transmitter is known as the Critical Frequency of Vertical Incidence (critical frequency). Recall that the maximum usable frequency (MUF) will be higher than the critical frequency. Recall, in general terms how the MUF varies over the 24 hour cycle and the variation in MUF from summer to winter.
5B3	Recall that propagation where the signals are reflected vertically back from the ionosphere is known as Near Vertical Incidence Sky wave (NVIS). Recall that NVIS is a technique employed on some low frequency bands (e.g. 5MHz) to make contacts over relatively short distances.
5B4	Recall that the ionosphere can change the polarisation of a radio wave.
	VHF and above
5C3	Recall that contacts at VHF and above can be made by reflecting signals off the lunar surface and that this is known as Earth-Moon-Earth (EME) propagation. Understand that as the moon is a poor reflector of radio frequency signals and is a long way from earth, EME contacts generally need high power and high gain antennas accurately pointed at the moon and very sensitive, low noise receivers or the use of special low-signal strength modes to overcome the path loss. Recall that it is possible to make contacts on the VHF bands by reflecting signals off the ionised gases created during an Aurora and that this occurs at high Northerly and Southerly latitudes and that this is known as Auroral propagation. Recall that auroral ionised curtains form vertically in the ionosphere and that movement of these curtains cause rapid flutter on the signals.
	Other features
5D1	Recall the Galactic Noise is random noise originating outside the earth’s atmosphere.

5D2	Recall the factors affecting a link budget; transmitter power, feeder losses, antenna gains and path loss. Recall that path loss includes spreading loss and obstruction losses.
	Section 6 – Electro magnetic compatibility (EMC)
	EMC concepts
6A2	Understand that the immunity of a device is affected by the nature of its installation and that poor installation of an otherwise good item of equipment can compromise its safe and compliant operation.
6A4	Recall that radio amateurs are not required to demonstrate compliance with EMC standards for equipment they put into service but remain responsible for complying with licence requirements regarding interference.
	Sources of interference and their effects
6B1	Recall that some imported or home constructed electronic equipment may not meet relevant EMC standards. Recall that items containing radio communication facilities such as cordless and mobile telephones and information technology communication equipment may produce sufficiently strong signals to cause short range interference but are otherwise generally satisfactory. Recall that imported devices and toys may not be compliant with the relevant regulations.
6B2	Understand that Blocking (or desensitisation) is an effect in a radio receiver where a strong, constant level interfering signal e.g. FM either swamps the wanted signal or drives the affected circuits out of their normal operating range such that the received audio or data is severely attenuated or muted. Understand that Cross-modulation is an effect in a radio receiver where the interfering signal is varying in strength e.g. AM or SSB such that the modulation on the interfering signal is added to the modulation on the wanted signal such that both may be heard with varying clarity.
6B3	Recall that passive intermodulation products can be caused by corrosion in any metallic junctions in metalwork, including transmitting and receiving antennas, supports and guttering.
	Routes of entry
6C1	Recall that amateur transmissions can enter audio stages via long speaker leads or other interconnections. Understand that any semiconductor or diode junction within an electronic device can rectify unwanted RF.
6C2	Understand that many TV mast-head amplifiers are wide band devices and can suffer from cross-modulation and overload causing intermodulation and blocking and may also overload the TV.

6C3	Understand that amateur transmissions can be picked up by the intermediate frequency stages of TV and radio receivers. Understand the potential for image frequency interference to analogue and digital radio. Understand that television receivers and most broadcast radio receivers employ superheterodyne circuits and recall some typical frequencies used in radio and television receivers. • Medium Wave radio broadcast 526 - 1606kHz • VHF FM radio broadcast 87.5 - 108MHz • VHF DAB radio broadcast 174 - 230MHz • TV broadcast 470 - 694MHz • Radio IFs typically 455 - 500kHz and 10.7MHz. Note: Current design digital TV receivers use a variety of Intermediate frequencies between 4 and 39MHz.
	Filtering and remedial measures
6D1	Understand the use of high, low, band pass and band stop (notch) filters of L, T and π configuration including coaxial stubs as notch filters or traps, in improving the immunity of affected devices. Recall the use of ferrite beads or rings in internal and external filtering.
6D2	Understand the construction and use of a typical mains filter. Identify a typical circuit of a braid breaking filter and a combined high pass/ braid breaking filter. Understand their use. Understand why a ferrite ring will attenuate common-mode currents without affecting the differential-mode wanted signal.
	Station design and antenna placement/general principles
6E1	Recall that reducing field strength to the minimum required for effective communication is good radio housekeeping. Apply the formula for the field strength surrounding an antenna given the ERP and distance from it.
6E2	Understand good RF grounding and bonding techniques. Understand the effects of inadequate RF grounding and bonding.
6E3	Recall that balanced antenna systems tend to cause fewer EMC problems than unbalanced antennas. Recall that balanced and unbalanced feeders should leave the antenna at right-angles to minimise coupling.
	Station design and antenna placement/mobile installations
6F1	Recall that advice on mobile installations is the Federation of Communication Services UK Code of Practice for the installation of mobile radio and related ancillary equipment in land based vehicles.

6F2	Understand how to minimise the likelihood of stray RF currents entering the vehicle wiring and electronics.
	Social aspects and testing
6G1	Recall the correct procedures for dealing with complaints of electromagnetic disturbance caused by amateur transmissions.
	Section 7 – Operating practices and procedures
	Good operating practices and procedures
7A1	Understand the reasons why some stations may use split Tx and Rx frequencies within a frequency band.
	Band plans
7B1	Identify items on a typical band-plan (e.g. centre of activity, band width and recommended modes). *Note: Questions will be limited to the 5MHz (60m) and 472kHz (600m) bands.* *A copy of the relevant band plans will be available during the examination but may not be ones in current use.* *Reference Booklets containing examination band plans are available on the RSGB web site.*
7B2	Recall that band plans in other countries and IARU regions may not align with the UK band plan.
	Special events
7H1	Recall the purpose of special event stations and the format of their call signs. Recall the process for obtaining a special event call sign.
	Section 8 – Safety
	Electricity
8A1	Recall that lethal voltages can exist in equipment and that live circuits may be exposed as soon as the equipment case is removed.
8A2	Recall that in PME systems the main earth terminal is connected to the neutral of the electricity service at the consumers' premises. Recall that under severe fault conditions PME systems have the potential to cause fatal electric shocks and/or fires in amateur radio stations. Recall that the RF earth in an amateur station should be connected to the PME bonding point in accordance with the Local Authority building department's requirements or the IET Wiring Regulations to maintain safety under fault conditions.

8A6	Understand that no work should be undertaken on live equipment unless it is not practicable to do otherwise. Understand that suitable precautions must be taken to avoid electric shock.
	Working with RF
8D1	Recall that the International Commission for Non Ionising Radiation Protection (ICNIRP) produces guidance for exposure to Radio Frequency fields. Understand it is not advisable to exceed the recommended safe exposure levels and that this is particularly applicable at locations open to the public.
	Lightning
8E1	Recall that thunderstorms carry heavy static charges. Understand that the static charge from thunderclouds can ionise the air to form a low resistance path to ground, enabling a very high current to flow as a lightning stroke. Understand the risks to human life, domestic property and electronic equipment associated with a direct strike and/or the build-up of static charges. Understand that there is little that can be done to protect an amateur station from a direct lightning strike, but that good static discharge systems can prevent dangerous static charges building up on antenna systems during thunderstorms. Understand that disconnecting antenna feeders from radio equipment also reduces the risks.
	Working mobile and portable
8F4	Understand that operating in temporary premises and/or outdoors can introduce new hazards i.e. overhead power lines, inadequate electrical supplies, trailing cables, damp ground and excessive field strengths. Recall the additional safety precautions that should be taken whilst operating in temporary premises and/or outdoors i.e. • site survey/risk assessment, • cable routing/protection, • correct fusing, • use of Residual Current Devices (RCD's, RCBO's) • no adjustments or repairs to live equipment. Recall that mains supplies in other countries may be of a different voltage or frequency; utilise different plugs and sockets and that UK specified equipment may not be suitable or hazardous if connected and used.
8F5	Understand that operating when mobile or maritime mobile can introduce new hazards i.e. insecure equipment, long/flexible antennas, accidental shorts to earth, lack of attention to driving. Recall the additional safety precautions that should be taken whilst operating mobile and/or maritime mobile i.e. secure equipment, cable routing/ protection, correct fusing, use of hands-free equipment, attention to good radio housekeeping.

8F6	Understand that a risk assessment should be performed when an activity could present a hazard to yourself or others. Understand that risk assessment involves identification of hazards and the measures to mitigate the risk. Recall a risk assessment needs to consider the likelihood of harm and the severity of that harm. Recall that the significant findings of risk assessments need to be recorded. Recall that risk assessment records are important in law and for insurance purposes. Recall that risks should be expressed in understandable terms. Recall that appropriate insurances should be obtained for all amateur radio activities but in particular where the public could be involved.
8F7	Understand the risks associated with the use of electrical generators, earthing, fuel stowage, refilling.
	Section 9 – measurements and construction
	Measurements
9A1	Understand the use of series multiplier resistors in analogue voltmeters and shunts in ammeters. Understand the effect of the test meter on the circuit under test.
9A3	Understand the effect of measurement tolerance, calibration accuracy and time related drift on frequency measurements and the allowances to be made for transmission bandwidths.
9A4	Understand that signal generators and similar devices will have a source impedance and the effect on the signal level of attaching different load impedances. Recall that not all measuring equipment will have a 50Ω input impedance. Understand that the choice of measuring equipment may have an effect on the on the measurement result and on the object under test.
9A5	Understand that steady RF power may be determined by measuring the RF potential difference across a dummy load and that a steady audio signal, e.g. from an audio oscillator, will be required for AM and SSB measurements. Understand the meaning of peak envelope power (PEP) of an SSB transmission and that it may be determined using a peak reading power meter or an oscilloscope and dummy load.
9A6	Recall the uses and limitations of crystal calibrators, digital frequency counters and standard frequency transmissions.
9A7	Identify the circuit of an SWR meter using either a sense wire between the inner and outer conductors of a coaxial line or a current transformer and capacitive voltage tap. Understand in simple terms how this leads to an SWR reading on devices using a single meter, twin meters or cross-needle twin meter.

9A8	Understand the purpose and basic operation of an oscilloscope. Calculate the frequency and voltage of a waveform from given data.
9A9	Understand the purpose and basic operation of a spectrum analyser. Identify the fundamental and harmonics on a typical spectrum analyser display.
	Decibels
9B1	Use the equations for decibel power, dB, dBW, dBm and voltage ratios dBV.
	Components
9C1	Recall that temperature has an effect on the value of components. Those with negative coefficients will reduce in value as temperature rises whereas those with positive coefficients will increase in value. Understand the effect this will have on tuned circuits and remedial measures. *Questions may include simple calculations.*

Note: See combined syllabus for the Introduction and Examination Material parts of the specification.