



Studying for the Harmonised Amateur Radio Examination Certificate

Introduction

Since 2005, the Irish Radio Transmitters Society (IRTS) has been responsible for setting, organising and correcting the Harmonised Amateur Radio Examination Certificate (HAREC) examination in Ireland. Holders of the HAREC qualification are entitled to apply for an Amateur Station Licence.

Examination papers are approved by the Commission for Communications Regulation (ComReg) and the results are forwarded by IRTS to ComReg for transmission to the candidates.

Why an examination is needed

An amateur station licence entitles the holder to construct and operate radio transmitters which, depending on propagation, can send signals to the furthest points on Earth and indeed into space. Radio amateurs potentially have access to more than 20 frequency bands spanning the entire radio spectrum. When you think of the other services that use radio signals – broadcast stations, marine and air navigation / safety, satellites, GPS and mobile phones, to name but a few – you can see why radio amateurs, like all others licensed to transmit radio signals, must abide by certain rules.

Radio amateurs have greater privileges than most radio spectrum users – for example they are allowed to transmit using home-constructed equipment, they also have greater freedom to choose operating frequencies and modes than the commercial stations. However, to earn these privileges prospective radio amateurs must show that they –

- have a clear grasp of the relevant national and international regulations,
- know the accepted operational procedures used in radio transmissions, and
- have an understanding of the technical side of radio.

Examination syllabus

The Irish HAREC examination is based on a Europe-wide syllabus for the CEPT Harmonised Amateur Radio Examination Certificate (HAREC). The syllabus is designed to ensure that candidates can demonstrate proficiency in the regulations governing the amateur radio service in Ireland as well as the technical and operational aspects of amateur radio. A copy of the syllabus, along with notes for candidates, is attached.

Examination format

The examination comprises a multiple choice question paper with 60 questions and the time allowed is 2 hours. Four possible answers are shown for each question, only one of which is correct. Candidates must decide which of the options is correct and place a tick in the appropriate box on the answer sheet. There may be other possible answers to some questions; however, the choice of the correct answer from the options given is required.

The pass mark is 60% and a pass is required in each of the two main sections of the paper, Section A and Section B.

The topics covered in the paper are:

Section A - Amateur Radio Regulations and Related Topics (30 Questions)

- Licensing Conditions
- Operating Rules and Procedures
- Electromagnetic Compatibility and Transmitter Interference
- Safety

Section B – Amateur Radio Theory and Related Topics (30 Questions)

- Electrical & Electronic Principles including Components and Circuits
- Transmitters and Receivers
- Feeders and Antennas
- Propagation
- Measurements

Study material

For a start, candidates and tutors should look at the documents overleaf, which are:

1. **The exam syllabus** – essential reading! As well as outlining the topics to be covered in the exam, the syllabus includes –
 - **Notes for candidates** – designed to assist candidates and their teachers with their work in preparing for the exam by suggesting certain areas worth focusing on
 - **Four pages of Annexes** – containing key information very relevant to the exam questions
2. **Sample paper** – a useful guide to how the questions are presented in the exam
3. **Examination Reports** – these reports, published by the Examinations Board, include observations and advice that should be of assistance to anyone studying for the Licence Examination

An online **Course Guide** is available at www.irts.ie/course A zip file of this guide is available on the Downloads page at www.irts.ie/downloads for offline viewing. Also available on the downloads page is a **Document Pack** which includes some of the reference documents used in preparing the regulatory sections of the Course Guide.

We also suggest that candidates look at some of the material in the links on the IRTS **Radio Theory Links** page at www.irts.ie/theory

For those who prefer printed material, there are a number of online bookstores specialising in amateur radio material, including those run by PW Publishing and the Radio Society of Great Britain. Note, however, that as the UK amateur radio licensing system is based around three separate examinations [Foundation, Intermediate, Advanced], material on all three examinations would need to be covered by candidates studying for a full HAREC-level examination.

Practical Experience

Experience at setting up and operating radio equipment alongside existing licensed radio amateurs – either in a club or home environment – can make the task of preparing for the licence examination a lot easier and indeed more enjoyable. Learning about topics such as band plans, permitted frequencies or modes and SWR measurements solely in a classroom environment can be difficult, it is far better to pick up this knowledge from operating under the supervision of experienced radio amateurs, using the classroom to complement the know-how picked up during these sessions. To find out the nearest club, have a look at the list of IRTS affiliated clubs and societies at www.irts.ie/clubs

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The Amateur Station Licence exam is in two sections with 30 multiple-choice questions each:

Section A - Amateur Radio Regulations and Related Topics

Section B – Amateur Radio Theory and Related Topics

The pass mark is 60% and a pass is required in both sections. Those who pass receive a **Harmonised Amateur Radio Examination Certificate** (HAREC) which is recognised in nearly all European countries and many others including Australia, Japan, New Zealand and South Africa.

Seven exam sessions were held in the two years 2016/2017, involving 76 candidates; 51 were successful, of whom 46 were sitting the exam for the first time. Many of the successful candidates achieve very high marks indeed and have clearly prepared very well for the exam; 40% of the successful candidates achieved overall marks of 80% or more.

Amateur Radio is just a hobby ... what's the problem?

Before looking at the areas that have caused problems for candidates it is worth reflecting on why getting an Amateur Station Licence entails sitting and passing an exam. Yes, amateur radio is a hobby, but a very unique one with unparalleled rights and corresponding responsibilities. Holders of an Amateur Station Licence are permitted to use more than 20 internationally agreed frequency bands right across the radio spectrum to carry out radiocommunication experiments using self-built or commercially-built equipment meeting the Technical Conditions set out in ComReg's guidelines. The same radio spectrum is occupied by countless other users for broadcasting, safety and security, geolocation, mobile phones, Internet of Things and lots more. The Amateur Station Licence give the holder far greater flexibility in terms of equipment type and permitted frequencies compared to other users. Therefore, we need to establish that we can safely operate an amateur station and in particular that we understand the regulatory framework within which radio amateurs are required to operate and the accepted operating rules and procedures. Furthermore we need to demonstrate that we have the requisite technical knowledge to carry out radiocommunication experiments.

The importance of retaining the *uniqueness* of amateur radio, including its experimental and self-training nature, cannot be over-emphasised. The bands currently available to radio amateurs were secured mainly at a time when the radio spectrum was not under the same commercial pressures as it is at present: with literally billions of devices now using radio frequencies, the competition for spectrum is intense, so amateur radio needs to continue to be seen as significant and distinctive if we are to retain what we have.

Problem areas – Section A:

Licensing Conditions. Exam candidates need to have some familiarity with key aspects of the Amateur Station Licence Guidelines published by ComReg. Unfortunately, many of the questions on permitted frequencies and power levels are being answered incorrectly. Other problem areas include the requirements for logbook keeping, the permitted content of transmissions between amateur stations and the additional constraints that apply to frequency allocations with *secondary* status.

Operating Rules and Procedures. Transmissions from an Irish amateur radio station can potentially be heard around the world, so it is essential that aspiring EI licence holders show that they are familiar with the operating rules and procedures used by radio amateurs worldwide. This is the area within Section A that the standard of answering has been the most disappointing in recent years. Knowledge of band plans is poor as is the composition of amateur radio call signs and the format of CQ calls. Candidates could benefit significantly from participating in club activities in the months leading up to an exam, or if this is not possible, some 'shortwave listening' on the amateur bands.

Electromagnetic Compatibility and Transmitter Interference. Understanding the methodology for coexisting with other users of the radio spectrum is a fundamental obligation for Amateur Station Licence holders. The exam questions for this topic include the use of filters to avoid interfering with other services or to minimise interference received from other users. Some of the answers indicate a very limited knowledge of the simple filter circuits typically used by radio amateurs, as well as how and where these filters should be deployed.

Safety. It's no surprise that the exam includes a number of questions to test a candidate's knowledge of safety. The standard of answering for this topic is generally good, however there does appear to be some confusion about the function of fuses and the selection of an appropriate current rating; other areas of weakness are around the most likely sources of RF burns from antennas, and the implications of non-ionising radiation emissions / ways of minimising such emissions.

Problem areas – Section B:

Electrical and Electronic Principles including Components and Circuits. This section provides a test of a candidate's understanding of basic electrical and electronic principles and circuits. Ohm's Law and equivalent rules for inductors and capacitors might suggest that complex mathematical calculations may be necessary to identify the correct answer, but that is not the case, as the relevant multiple-choice questions are designed in such a way that anyone with an intuitive understanding of how resistors, inductors and capacitors perform in circuits should be able to identify the correct answer without difficulty. The standard of answering for these "quasi-mathematical" questions is very good. Less well understood is the usage of other components (e.g. diodes, rectifiers, transformers) within circuits, the relationship between peak, peak-to-peak, average and RMS values, amplifier biasing or the consequences for a circuit of a high or low Q-factor.

Transmitters and Receivers. Many of the questions in this section are about the building blocks of transmitters and receivers and the nature of the output signal from CW, SSB, AM and FM transmissions. These are areas that do not seem to be well understood by candidates; also questions on why and how signals are shifted to an IF (intermediate frequency) are getting a poor response. All we can suggest is that the Course Guide, which includes numerous helpful block diagrams, should be studied.

Feeders and Antennas. This is a very practical area, most radio amateurs will spend a proportion of their time experimenting with different feeders and antennas. Some of the candidates' answering on this topic is very good, but two areas that have caused particular problems are the expected impedance of different antenna types and the impact of the velocity factor on transmission lines. We also note that more than 40% of candidates in recent years have been unable to correctly identify the length of a half-wave dipole for one of the HF bands.

Propagation. This topic is of great interest to every radio amateur as it has an enormous influence on what we can achieve in our experiments. An understanding of the characteristics and propagation implications of the different ionospheric layers is one of the core themes within this topic, however when we review the answers provided in recent exams, it is clear that many candidates have not achieved a satisfactory understanding of this fundamental aspect of propagation. Other themes, such as angle of radiation, skip distance, the sunspot cycle and the causes of fading are better understood.

Measurements. This is the smallest topic in the syllabus, with just 3 questions in the exam. It is also the topic with the lowest level of correct answers – averaging just over 60% in recent

years. Questions on measuring resonant frequency, on SWR meters, voltmeters and ammeters are being answered incorrectly. While some maths would be involved in calculating the answer from scratch for some of the measurement question, as in the case of the Ohm's Law questions referred to earlier, the multiple-choice questions in the measurements section are designed so that the correct answer should be obvious to a candidate who understands the underlying principles.

Preparing for the next exam

The next Amateur Station Licence exam is due to be held in May / June 2018. Those preparing for an exam should ideally attend a course, however we recognise that courses for the Amateur Station Licence are few and far between. Radio club attendance with participation in club activities is the next best thing. For study material, see the "Licensing" menu at www.irts.ie

We suggest that candidates and tutors obtain a copy of **Studying for the Harmonised Amateur Radio Examination Certificate**, available on www.irts.ie/downloads This document contains ...

1. The **exam syllabus** – essential reading! As well as outlining the topics to be covered in the exam, the syllabus includes –
 - o **Notes for candidates** – designed to assist candidates and their teachers with their work in preparing for the exam by suggesting certain areas worth focusing on
 - o **Four pages of Annexes** – containing key information very relevant to the exam questions
2. **Sample paper** – a useful guide to how the questions are presented in the exam
3. **Examination Reports** – four previous reports published between 2007 and 2016 are included. These reports include observations and advice that should be of assistance to anyone studying for the Amateur Station Licence

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