

INSTITUTION OF FIRE ENGINEERS



**Examination
Syllabus**

Introduction

This booklet contains the Institution's rules and regulations and the formal appeals procedure for candidates, together with the syllabuses for the Preliminary, Intermediate, Graduateship and Membership examinations.

The syllabuses have been produced to provide a stepwise progression through the examinations and there are a number of very important and quite radical changes to the schemes presently in operation, which can be summarised as:

1. The changes will come into effect with the examinations in 2003 although candidates who are presently in the system will be able to follow the existing rules until the examinations taking place in 2005.
2. With effect from 2006 all candidates will be governed by the syllabuses and rules contained within this document.
3. The examinations at all levels will be open to any candidate at any stage
4. A candidate may take examinations at different levels and in the same year but only at the appointed examination times.
5. The examination subjects will be grouped, and then sub-divided under four general disciplines as follows

| Discipline | Sub-Division |
|---------------------------|----------------------------|
| Fire Engineering Science | |
| Fire Safety | |
| Human Resource Management | |
| Operations : | Fire Service Operations |
| | Aero Fire Studies |
| | Building Construction |
| | Fire Investigation |
| | Marine Fire Studies |
| | Petrochemical Fire Studies |
| | Communications |
| | Disaster Planning & |
| | Emergency Management |

To obtain an overall examination pass at Graduate or Member level a candidate must be successful in at least one paper from each of the four general disciplines.

6. A candidate will be expected to take the examinations, which are in keeping with his/her experience and training. A successful outcome will only demonstrate his/her academic ability and underpinning knowledge, and candidates will only be awarded a membership diploma in the appropriate grade provided they satisfy the criteria as explained in the IFE publication "*Membership Rules for Titles and Grades*".
7. A mathematics paper syllabus is included in the scheme. It will be offered within the framework and administrative structure of the Institution's examinations but will not be a part of the IFE examination system and will not count towards the IFE Membership qualification.

8. The Intermediate examination will consist of two two-hour papers – one objective test and one written test
9. The Member level examination papers will all become a three-hour written examination with a choice of six from eight questions
10. A system of moderation will be introduced to the assessment process for those individuals taking more than one paper
11. A new five-year rule is introduced and candidates wishing to obtain a membership diploma must pass all of the required examinations within that time
12. The syllabuses are presented in a more open style but with a reading list of publications for guidance towards the levels of study. By adopting this more flexible approach and by updating the reading list annually, it is envisaged that the Institution will keep abreast of any developments and changes within the field of fire studies. The knowledge of the influence and outcome of any change can then be included within the examination process.
13. The Management paper has been re-titled and now becomes Human Resource Management in keeping with the change of emphasis within this field of study and to include wider areas of study not previously included.
14. In the Membership level examinations, the Fire Protection Technology paper has now been incorporated into the Building Construction and Fire Safety papers.
15. Mobile phones and any other electronic devices that can be used for communication are not allowed within the examination room/centre.
16. Applications for all of the optional papers (including mathematics) will be asked for each year during the annual examination cycle. However, if there are insufficient candidates or interest shown in a particular paper in any particular year, then the examination will not be held.

In making these amendments to the examination system the Committee are conscious of all of the changes that have taken place within the areas of education, training, assessment and examinations and have tried to produce a system which is relevant to the needs of all of its members of whatever grade, whether in the UK or overseas.

It is hoped that these new syllabuses will test the candidates knowledge and understanding and in so doing give to the successful candidates valuable "currency" in their bank of professional qualifications. With that in mind the International Council wishes all candidates the best of luck in their future studies.

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Chairman, Syllabus Review Sub-Committee
31st March 2002

Objects of the Institution

The Institution of Fire Engineers was founded in 1918 and incorporated in 1924, chief among its objects being:-

- (a) To promote, encourage and improve the science and practice of Fire Extinction, Fire Prevention, and Fire Engineering, and all operations and expedients connected therewith, and to give an impulse to ideals likely to be useful in connection with or in relation to such science and practice to the members of the Institution and to the community at large.
- (b) To enable members to meet and to correspond, and to facilitate the interchange of ideas respecting improvements in the various branches of the said science and the publication and communication of information on such subjects.

Examination Rules and Regulations

1. General

1.1 Candidates for all examinations must be fully paid-up members of the Institution at the appropriate grade, except for members of organisations exempted from this requirement by International Council.

1.2 Application to sit the examinations must be made using the official application form provided for this purpose and obtainable from the Chief Executive Officer at the Institution's International Headquarters. Non UK candidates can obtain an application form from the Honorary Secretary of their Branch. Completed non UK application forms must be submitted through the Branch Secretary where applicable.

The closing dates for the receipt of entries are:

Non UK candidates - 31 October

UK & Republic of Ireland candidates - 30 November

The completed application form and the examination fee must be sent to the Chief Executive Officer before the closing date. Late entries will not be accepted.

1.3 Examinations are normally held on the second Thursday and Friday in March each year. Examination centres are organised throughout the world, according to demand. Each candidate will be notified as early as possible of the dates, times and place of examination.

1.4 Candidates for the Preliminary examination are required to pass the entire examination in one year.

1.5 Candidates for the Intermediate, Graduateship and Membership examinations can choose to sit individual papers. It is not compulsory to sit all papers at one examination. See sections 4. and 5.

1.6 Units used within the examination are SI Units.

Candidates may use their own calculators, provided that they conform to all the following criteria:

- (a) Non-programmable, i.e., incapable of storing information other than that provided by the manufacturers to enable the calculator to perform its normal functions.
- (b) Self-contained with own internal battery supply.
- (c) Silent in operation.

Any calculator brought into the examination room must be seen by the invigilator to be in the 'off' mode before it is switched on for use.

The use of such aids does not absolve candidates from the need to explain their working, and the steps taken to reach their answer, if they are to gain satisfactory marks.

Any stencils or templates should be commercially manufactured and should be declared to the invigilator(s) prior to the start of the examination.

The use of mobile phones or any other electronic devices is not allowed within the examination room, and all such devices must be turned off before entering the examination room and remain off during the examination period.

Examination candidates are not allowed to bring into the examination room any books, documents, articles or papers, other than proof of identity and official examination and administrative documentation received by the candidate in connection with the current examination. Any candidate who breaches this rule will have the

extraneous material confiscated by the invigilator who will make a full report of the incident and forward the confiscated item(s), together with the report to the Chief Executive Officer, as soon as the examination session has ended.

1.7 Prizes may be awarded to candidates who are successful in all papers required for a particular grade of membership and who obtain outstanding marks at the same examination. The International Council, however, reserves the right not to award prizes in any year should the standards not be sufficiently high.

1.8 The International Council of the Institution reserves the right to make any amendments to the Rules and Regulations and Syllabuses of the examinations.

1.9 All candidates will be notified, by post, of their individual result as soon as possible after the examination. Candidates in the Graduateship and Membership examination will receive gradings of their examination results for each paper taken. No correspondence will be entered into concerning individual results. The pass list will normally be published in the July issue of the Fire Engineers Journal.

1.10 The International Council has the right to exclude any candidate from any examination and reserves the right to withhold any certificate of membership of the Institution whether by examination or otherwise.

1.11 Once an examination application has been received, together with the appropriate fee, a refund will not be considered should a candidate decide to withdraw. In the event a candidate withdraws for medical or other valid reasons, then, provided they submit satisfactory evidence in support of their inability to sit the examination, their application will be deferred until the next following examination only. Applications for deferment, together with supporting evidence, and the current administration fee must be received by 31st of March of the examination year for consideration.

1.12 Any candidate wishing to take papers from different levels of the examinations in the same year may do so provided the examination timetable allows. All of the papers must be taken at the appointed examination time.

However candidates should be aware of the "5-year rule" (see regulation 1.17) when exercising this option.

1.13 The passing of an examination does not automatically confer a grade of membership upon an individual, although success in the examinations will generally satisfy the academic requirements for membership.

A successful candidate will also be required to satisfy training and experience, and in the case of corporate members, CPD criteria defined in the "Membership Rules For Titles and Grades" booklet.

It should also be recognised by candidates that for the purposes of membership grading the academic papers passed need to be compatible with, and provide proof of the level of knowledge related to their relevant experience.

1.14 Starting with the examinations in 2003, candidates who have obtained one paper previously or are taking them for the first time will be required to follow the examination regulations outlined above (see 1.13).

Those individuals who have previously obtained two or more papers will be allowed to comply with the existing regulations up to and including the examinations in 2005.

All candidates will comply with the amended regulations as from the examinations being held in 2006.

1.15 With effect from 2003 a candidate will only be allowed to register the examination passes that have been gained within a period of five consecutive examination years as evidence of the academic requirements relating to membership.

1.16 In accordance with By-Laws 3 and 5 of the Institution, the International Council will, as required, satisfy itself that an individual possesses the requisite qualifications to enter a higher category of membership.

1.17 The Education Committee will consider applications from Colleges, Universities,

training/educational establishments etc., for the accreditation and continuous validation of courses and qualifications which they wish to submit for consideration of equivalency with the Institution's examinations.

1.18 The International Council may approve such courses and qualifications and will publish annually a comprehensive list of all courses and qualifications that have been so approved. This list will be submitted by The Chairman of the Education Committee to The International Council each year.

1.19 The International Council will approve the level of fees that will be charged by the Institution for accreditation and validation. Accreditation fees will be due on submission of an application and are not refundable.

Validation fees will be due on approval of the application and thereafter on 1st January of each year.

2. Preliminary Examination

2.1 The Preliminary Examination has been designed for any individual involved in any public service, industrial or commercial organisation within the "fire industry" where an elementary qualification in fire related subjects is desirable.

2.2 The objective of the Preliminary Examination is to encourage a basic understanding of the principles of Fire Engineering.

2.3 Each candidate who passes the examination will be awarded the Institution's Preliminary Examination Certificate.

2.4 The examination will be divided into three parts:

Part 1. Fire Engineering Science

Part 2. Fire Service Operations

Part 3. Fire Safety

2.5 The examination will consist of one paper containing objective questions taken from across the entire syllabus. Computer marked answer sheets will be used and candidates must use a pencil to indicate their answers. The duration of the examination will be three hours.

No rules of moderation will apply to this paper and the normal pass mark will be 50%

2.6 Alternatively, any person who attends a course of study and/or takes an examination which has been accredited and subject to continuous validation by the Institution, and which has been prescribed in accordance with the Examination Rules and Regulations for the time being in force as having equivalency with the Preliminary Certificate, or the Preliminary Examination will be awarded with the Preliminary Examination Certificate of the Institution.

3. Intermediate Examination

3.1 The Intermediate Examination of the Institution is designed to test the development of the individual between the Preliminary and the Graduateship Examinations of the Institution. It is therefore seen as part of the preparatory examinations of the Institution (together with the Preliminary Examination) in order to provide a stepwise progression towards the Institution's main examinations.

3.2 Each candidate who passes the examination will be awarded the Institution's Intermediate Examination Certificate.

A candidate who passes each part of the examination at the same sitting will be awarded the Institution's Intermediate Examination Certificate (with Credit).

3.3 There are no other entry restrictions for candidates but as a first step, it is recommended that candidates should take the Preliminary Examination.

3.4 The examination will be divided into four sections:

1. Fire Safety
2. Operations and Equipment
3. Fire Engineering Science
4. Management and Administration

3.5 The examination will consist of two papers.

The first will contain objective questions taken from across the entire syllabus and will be of 2 hours duration. Computer marked answer sheets will be used and candidates must use a pencil to indicate their answers.

The second paper will contain questions which require a short written answer and will be of 2 hours duration. The questions will be taken from across the entire syllabus and will be printed on a returnable answer sheet. Answers can be written in either (lead pencil) or ink.

The whole examination will be of 4 hours duration.

3.6 A candidate will NOT be required to pass each part of the examination at the same sitting but must be successful within two consecutive examination years.

No rules of moderation will apply to the Intermediate Level examinations and the normal pass marks will be 60% for paper 1 (objective paper) and 40% for paper 2 (written paper).

3.7 Alternatively, any person who attends a course of study and/or takes an examination which has been accredited and continuously validated by the Institution, and which has been prescribed in accordance with the Examination Rules and Regulations for the time being in force as having equivalency with the Intermediate Examination will be awarded the Intermediate Examination Certificate of the Institution.

4. Graduateship Examination

4.1 Applications to sit a single paper or combination of papers of the Graduateship Examination will be accepted from Student members of the Institution. Applicants should however be familiar with the relevant criteria for Graduate Membership as laid down in the "Membership Rules for Titles and Grades."

4.2 In the case of wholtime members of a Fire Brigade maintained by a Fire Authority in Great Britain under the Fire Services Act 1947 or employed by the Fire Authority for Northern Ireland, reciprocal arrangements exist for successful candidates of the Graduateship and Membership Examination and the Statutory Station Officers' Examinations.

Graduates wishing to claim reciprocity with the Station Officer's qualification under this arrangement are required to have passed both parts of the statutory Sub Officers' examinations before the date of successfully passing the IFE examination and are required to pass the Fire Service Operations paper from the Operations section.

Where entrants to the United Kingdom Wholtime Fire Service are already Graduates of the Institution, they may apply to sit the Membership Examination and, if successful, then apply for reciprocity with the Statutory Station Officers' Examination, provided they have passed the Statutory Sub Officers' examination within the intermediate period.

The conditions relating to the reciprocal arrangements are contained within the Fire Services (Appointment and Promotion) Regulations, 1978, and the Fire Services (Appointment and Promotion Regulations) (Scotland) Regulations, 1978 and their various amendments.

4.3 The examination will be divided into four parts consisting of written papers in four sessions: morning and afternoon on both Thursday and Friday.

Fire Safety - Fire Safety
 Operations - Fire Service Operations
 Control and Communications
 Aero Fire Studies
 Science - Fire Engineering Science
 Management - Human Resource Management

Each paper will consist of 10 questions and 6 must be completed in the three hours that are allowed for the examination.

Individual papers may be taken (see 5.5 and 5.6 below).

4.4 To satisfy the Academic requirements of Graduate entry a candidate will be required to be successful in at least one paper from each of the four main discipline groupings.

There will be two alternative papers within the Operations discipline (ONE FOR CONTROL AND COMMUNICATIONS PERSONNEL ONLY and the other for AIRCRAFT FIREFIGHTERS). These will operate under identical conditions.

4.5 A candidate may choose to sit any paper but only at the appointed time.

4.6 In order to pass each paper at Graduate level a candidate must normally obtain a minimum of 40 per cent of the marks. However by a system of moderation described below, a candidate who fails to obtain the required 40% in ONE PAPER ONLY may pass by moderation if sufficient extra marks are obtained in the paper(s) passed.

This system only applies to papers taken in the same year.

Two papers

| | | | | | |
|---|----|----|----|--|--|
| Percentage in lowest paper | 39 | 38 | 37 | | |
| Total percentage required in two papers | 82 | 84 | 86 | | |

Three Papers

| | | | | | |
|---|-----|-----|-----|-----|-----|
| Percentage in lowest paper | 39 | 38 | 37 | 36 | 35 |
| Total percentage required in three papers | 122 | 124 | 126 | 128 | 130 |

Four Papers

| | | | | | |
|--|-----|-----|-----|-----|-----|
| Percentage in lowest paper | 39 | 38 | 37 | 36 | 35 |
| Total percentage required in four papers | 162 | 164 | 166 | 168 | 170 |

4.7 Candidates who are successful in individual papers will receive a Certificate for each successful paper following receipt by the Chief Executive Officer of such fees as are currently in force.

4.8 Candidates who have already gained a certificate in a paper or papers will not be allowed to enter for that paper or papers again until the 5-year rule has expired.

4.9 Failure to pay the appropriate fees will result in the candidate's records being deleted from the files.

4.10 A Graduate diploma will be awarded following successful completion of all four papers, providing the relevant criteria for Graduate Membership as laid down in the "Membership Rules for Titles and Grades" is satisfied, and on receipt of the payment of such fees and annual subscription currently in force to cover the financial year commencing 1 April following the examination.

A Graduate diploma (with credit) will be awarded following successful completion of all four Papers at the same examination, providing the relevant criteria for Graduate Membership as laid down in the "Membership Rules for Titles and Grades" is satisfied, and on receipt of the payment of such fees and annual subscription currently in force to cover the financial year commencing 1 April following the examination.

4.11 Prior to gaining Graduateship a student will only be allowed to gain acceptance for an examination provided that a period of no longer than 5 consecutive examination years has elapsed. (see 1.15)

5. Membership Examination

5.1 Applications to sit a single paper or combination of papers of the Membership Examination will be accepted, provided the applicant:

(a) is a fully paid up member of the Institution in the appropriate grade i.e. Student, Graduate, or Associate, and,
 (b) is engaged in the profession of Fire Engineering.

5.2 The examination will be divided into four parts consisting of written papers in four sessions: morning and afternoon on both Thursday and Friday.

A candidate may choose to sit any paper but only at the appointed time.

Each paper will consist of 8 questions and 6 must be completed in the three hours that are allowed for the examination.

Individual papers may be taken (see 5.5 and 5.7 below).

5.3 The examination papers will be divided into the four broad disciplines of Science, Fire Safety, Operations and Management. The particular papers relating to these disciplines will be

Fire Engineering Science
 Fire Safety
 Human Resource Management

Operations: Fire Service Operations
 Building Construction
 Petrochemical Fire Studies
 Marine Fire Studies
 Fire Investigation
 Aero Fire Studies
 Communications
 Disaster Planning and
 Emergency Management

To satisfy the Academic requirements of Member entry, a candidate will be required to be successful in at least one paper from each of the four main discipline groupings.

Candidates should be aware that for those wishing to precede to a Degree course or to Engineering Council registration, a Mathematics qualification will be required. A basic syllabus covering the subject areas is shown as Appendix A

5.4 In order to pass each paper at Member level a candidate must normally obtain a minimum of 40 per cent of the marks. However by a system of moderation described below, a candidate who fails to obtain the required 40% in ONE PAPER ONLY may pass by moderation if sufficient extra marks are obtained in the paper(s) passed.

This system only applies to papers taken in the same year.

Two papers

| | | | |
|---|----|----|----|
| Percentage in lowest paper | 39 | 38 | 37 |
| Total percentage required in two papers | 82 | 84 | 86 |

Three Papers

| | | | | | |
|---|-----|-----|-----|-----|-----|
| Percentage in lowest paper | 39 | 38 | 37 | 36 | 35 |
| Total percentage required in three papers | 122 | 124 | 126 | 128 | 130 |

Four Papers

| | | | | | |
|--|-----|-----|-----|-----|-----|
| Percentage in lowest paper | 39 | 38 | 37 | 36 | 35 |
| Total percentage required in four papers | 162 | 164 | 166 | 168 | 170 |

5.5 Candidates who have already gained a certificate in a paper or papers will not be allowed to enter for that paper or papers again.

5.6 A Membership Diploma will be awarded following successful completion of the appropriate papers provided that the criteria for Membership as explained in the IFE "Membership Rules for Titles and Grades" are satisfied.

A Membership Diploma (with credit) will be awarded following successful completion of all four of the appropriate papers at the same examination provided that the criteria for Membership as explained in the IFE "Membership Rules for Titles and Grades" are satisfied.

5.7 Candidates who are successful in individual papers will receive a certificate for each successful paper following receipt by the Chief Executive Officer of such fees as are currently in force.

5.8 A candidate who has gained a Membership Diploma may take as many additional papers as they wish, but only at the IFE appointed examination time.

5.9 Each candidate who successfully completes the requirements of the Membership examination will be required to pay such fees and annual subscriptions currently in force for the financial year commencing on the 1 April following the examinations. On receipt of all monies due, a Diploma will be issued.

5.10 Failure to pay the appropriate fees may result in the candidate's records being deleted from the examination files.

5.11 There is no restriction on the maximum number of optional papers and certificates a candidate may hold.

5.12 Prior to gaining Membership a student will only be allowed to gain acceptance for an examination paper provided that a period of no longer than 5 consecutive examination years has elapsed. (see 1.15)

6 Election or Transfer to the Grades of Graduate and Member

This is contained within the "Membership Rules for Titles and Grades" which must be read in conjunction with the "Rules, Regulations and Syllabuses for the Institutions Examinations"

Examination Preparation Technique

Despite the large volume of material available which advises candidates on the sitting of examinations, many students who have assimilated the necessary knowledge fail to gain a pass mark through simple mistakes in the examination room.

Some, of course, are made extremely nervous by the stress of the examination itself and this can have an unfortunate effect on performance. It is rather akin to getting tongue-tied at an interview - you could kick yourself afterwards, but the damage has already been done. Others just do not follow the instructions, or else misjudge the time available to them.

There is another group who fail - those who do not understand the amount of preparation they must undertake if they are to pass the Institution's examinations.

To pass an examination you need knowledge, technique and confidence.

Preparation for the Examination

Everyone has different study patterns. Some work best last thing at night, whilst others do better early in the morning. Candidate A will gain the most from long periods of study whereas Candidate B will be far more effective working in short bursts. What suits one will not necessarily suit another.

Whichever method you eventually decide suits you, be consistent. You cannot tinker with study; it has to be a wholehearted commitment despite the distractions of everyday life, which inevitably intrude from time to time.

The first step must be to register with the Institution at Headquarters in Leicester UK, and obtain a copy of the syllabus of the examination. Ideally this will be done about 18 months before the anticipated examination date as this will give you time to become attuned to what you are undertaking and prepare a study plan of say, 12 months duration which includes a period for revision at the end. You may need less time, or perhaps more, although starting too far in advance of the examination might prove to be counter productive if staleness sets in.

Your study plan should allocate subjects to various weeks and should allow for:

- (a) time to study each subject at least twice;
- (b) a two week period of general revision; and
- (c) a final week of intensive revision when essential facts and information are memorised.

Only in this way will the size of the task before you register, and bring home the fact that any reduction in the frequency of study will make it difficult to catch up on at a later date.

If you are being assisted in your studies by a correspondence course or college instruction, the work schedule will, to some extent, be planned for you.

In the Examination Room

Always plan to arrive at the examination centre at least

30 minutes before the examination is due to start. You need time to get over your journey and make yourself comfortable. It also provides the chance to check your writing implements etc. At the very least, you need two pens, pencils and sharpener, eraser, three coloured pencils, a ruler and a protractor.

Note in particular that those candidates taking the Preliminary and Intermediate Examination must only use a pencil to complete their answer sheet.

Remember to ensure that you do not take into the examination room any article not permitted. If you have any doubt seek the advice of the invigilator.

The other advantage of planning to arrive early is that it gives you some allowance for a hitch in your travelling arrangements. It would be unfortunate to waste a year's study through a last minute delay.

You will be allocated a place at which to sit (determined by your examination number), and the appropriate question paper and answer sheet; will be placed before you with only the cover sheet showing. This is when the chief invigilator will give you important instructions about the examinations. You must clear your mind of all the technical information tumbling through your head and listen to the invigilator. **WHAT THE INVIGILATOR HAS TO SAY IS IMPORTANT AND MOST OF IT WILL BE REPEATED IN WRITING ON THE COVER SHEET.** In particular, make a note of the maximum number of questions you must answer and from which sections. If it says six, it means six and not seven. The examiners are quite ruthless about this and will simply cross out your last answer, or answers that exceed the stated number.

Now is the time to note the duration of your examination, deduct ten minutes (for final checking of your answers) and then divide the remainder by the number of questions you hope to answer. It is sound advice not to exceed the resultant time per question when you start writing. Most of the marks you score in any question generally result from your first fifteen minutes of writing and spending more time on one favourite question may only result in one or two extra marks at the expense of many more if you fail to complete the paper. The chances are that a later answer can be appropriately answered in under the time and you can then come back to an unfinished script. If you think that is going to happen, leave space at the end of your incomplete answer to come back to it before starting the next question.

It is good practice to make 'rough notes' in pencil in your answer book prior to starting to produce each final written answer. These rough notes can be crossed through and marked over by the words 'rough notes' or 'cancel' but they help to order your thoughts before you start to write. They may also be used as a 'prompt' to you as you write your answer so that you do not forget an important point you may have thought of.

Finally, if you fail to finish your answer, or you lose your way in the answer, the rough notes may help the examiner in determining whether your answer was correct or not and marks may be awarded accordingly.

APPEALS PROCEDURE FOR INDIVIDUAL EXAMINATION CANDIDATES

1. Any candidate who wishes to appeal against the result they have been given must register that appeal in writing within 28 days from that date that the results were posted by IFE Head Office.
2. Any candidate who writes to the Chief Executive Officer and appeals against the result they have been given will not have a review of papers if he has gained a pass in that paper.
3. A candidate who appeals against a fail decision shall be asked by the Chief Executive Officer to submit in writing the grounds for the appeal. The grounds for appeal should be received within 28 days of the request of the Chief Executive Officer. The candidate will be charged the equivalent of a single paper fee to have the script re-marked. The Chief Executive Officer will forward the appeal to the Chairman of the Education Committee, on receipt of the appropriate monies, who will then consider the grounds for the appeal and arrange a re-mark of the script.
4. Final Appeal

A candidate who continues to be aggrieved at being failed, may appeal further. In this instance:

 - a) The Chief Executive Officer should ask the candidate to submit the further grounds for an appeal. If these are no different from the first appeal, the further appeal will fail and the Chief Executive Officer will inform the candidate no further correspondence will be entered into. Any further grounds for appeal must be received within 28 days of the request by the Chief Executive Officer.
 - b) Where a candidate produces further submissions to the appeal, the Chairman of the Education Committee, on receipt of a further fee, will cause the original script(s) to be marked by an independent examiner.
 - c) Once the independent marker's full report has been received, the Chief Executive Officer will arrange for the Chairmen of two committees (other than Education) to review and make a decision based on that report, together with the further evidence submitted by the candidate. The appeal may be upheld or denied and the Chief Executive Officer will write and inform the candidate accordingly. This will be the final appeal and no further correspondence will be entered into. Should this appeal be upheld then the fee for re-marking will be returned.

Preliminary Syllabus

This syllabus has been constructed as a series of well-defined objectives with the intention that students can acquaint themselves satisfactorily with the required subject matter.

The study material required for this examination is contained in the Preliminary Examination Handbook published by the Institution and The Home Office Manuals of Firemanship. Other sources of information may be used provided they cover the subject matter adequately.

This syllabus is a guide to your study plan. You should be aware that questions might be included from time to time, which reflect current thinking and new developments in Fire Engineering.

Fire Engineering Science

Aim: To demonstrate a basic knowledge of fire engineering science and principles

1. Mathematics

- 1.1 Carry out mathematical processes involving:-
 - a) Measurement of areas and volumes
 - b) Identify and calculate the areas of rectangles, triangles and circles
 - c) Estimate the area of irregular shapes
 - d) Calculate the volumes of rectangular and circular tanks
 - e) Calculate the capacity of hose and pipelines

2. Physical properties of matter

- 2.1 Define and understand the terms:-
 - a) Density
 - b) Vapour density
 - c) Liquids of different density
 - d) Gases of different density
 - e) Matter and energy
 - f) Melting point, boiling point and evaporation

3. Mechanics

- 3.1 Demonstrate an understanding of:-
 - a) Motion
 - b) Momentum and force
 - c) Work, energy and power
 - d) Friction

4. Heat

- 4.1 Define heat and temperature and describe their relationship
- 4.2 Demonstrate an understanding of how temperature is measured by:-
 - a) Liquid thermometers
 - b) The air or gas thermometer
 - c) Using solids to measure temperature
 - d) Thermocouples
 - e) Electrical resistance
 - f) Thermistors
 - g) Comparison by brightness
 - h) Infra red
 - i) Thermometric scales
 - j) The Celsius or Centigrade scale
 - k) The Fahrenheit scale
 - l) The Kelvin scale
- 4.3 Understand the various units of heat:-
 - a) The Joule
 - b) The calorie
- 4.4 Demonstrate a knowledge of:-
 - a) Specific heat
 - b) Change of state and latent heat
 - c) Latent heat of vaporisation
 - d) The effect of a change of pressure on the boiling point and latent heat
 - e) Latent heat of fusion
 - f) Cooling by evaporation
- 4.5 Describe the processes of:-
 - a) Conduction
 - b) Convection
 - c) Radiation

5. Thermal expansion

- 5.1 Understand the principles involved with:-
 - a) The thermal expansion of solids
 - b) The coefficient of linear expansion
 - c) Thermostats
 - d) The coefficient of superficial and cubical expansion of solids
 - e) Thermal expansion of liquids

- f) Cubical expansion
- g) The effect of expansion on density
- h) The expansion of gases
- i) Temperature, pressure, volume
- 5.2 Define and understand the Gas Laws i.e.
 - a) Boyle's Law
 - b) Charles' Law
 - c) The Law of Pressures
 - d) The General Gas Law
- 5.3 Understand the basic principles involved with:-
 - a) The liquefaction of gases
 - b) Critical temperature and pressure
 - c) Liquefied gases in cylinders
 - d) Sublimation
6. **Hydraulics**
- 6.1 Know the properties of water
- 6.2 Understand:-
 - a) The principle characteristics of pressure
 - b) The relationship between pressure and head of water
 - c) The loss of pressure due to friction
 - d) That energy changes in water streams

7. Chemistry

- 7.1 Understand basic chemistry including:-
 - a) Atoms and molecules
 - b) Compounds and mixtures
 - c) Basic elements and their symbols
 - d) The use of symbols to write formulae
 - e) Simple radicals and their symbols
 - f) Atomic mass
 - g) Molecular mass
 - h) Valency
 - i) Nomenclature
 - j) Simple equations
 - k) The triangle of fire (Fire Triangle)
 - l) Heat of reaction and calorific values
 - m) Flashpoint, firepoint and sustained fires
 - n) Ignition
 - o) Spontaneous ignition temperatures
 - p) Self-heating and spontaneous combustion
- 7.2 Explain how fires are extinguished by:-
 - a) Starvation
 - b) Smothering
 - c) Cooling
- 7.3 Explain the action of the following fire extinguishing media/methods, i.e.
 - a) Water
 - b) Inert gas
 - c) Foam
 - d) Vapourising liquids
 - e) Carbon Dioxide and inert gases
 - f) Dry chemical powders
 - g) Blanketing
 - h) Beating

8. Electricity

- 8.1 Define the terms:-
 - a) Volts
 - b) Ampères
 - c) Ohms
 - d) Watts
 - e) Joule
- 8.2 Define and understand Ohms Law
- 8.3 Explain the significance of conductors and insulators
- 8.4 Explain the reasons for providing earth connections and other protective devices to electrical circuits

Operations

Aim: to demonstrate a basic understanding of operational firefighting and rescue procedures.

1. Incident command

- 1.1 The impact of health and safety on the incident ground
- 1.2 Initial stages of incident
- 1.3 Development stage of incident
- 1.4 The closing stage of incident
- 1.5 Definitions relating to incident command
- 1.6 Incident command structure

- 1.7 Lines of command
- 1.8 Span of control
- 1.9 Shared responsibility and authority - roles in the incident command system
- 1.10 Sectorisation of incidents
- 1.11 The use of Compressed Air Breathing Apparatus (CABA) at an incident:-
 - a) Demonstrate a knowledge of the precautions to be taken when donning CABA
 - b) Demonstrate a knowledge of CABA entry control procedures
 - c) Know the basic procedural rules to be followed by CABA wearers
 - d) Describe the principles involved in searching in CABA
 - e) Know the CABA line signals

2. Rescue

- 2.1 Understand the basic principles involved in evacuating and searching for casualties
- 2.2 Understand basic methods of rescue

3. Firefighting

- 3.1 Demonstrate a basic knowledge of how to tackle:-
 - a) chimney fires
 - b) one room fires
 - c) duct fires
 - d) roof fires
 - e) basement and underground fires
 - f) high rise building fires
- 3.2 Understand the advantages and limitations of using hose reels
- 3.3 Demonstrate the principles of operating with hose lines at any level, including the use of breechings and variable branches

4. Ventilation and salvage

- 4.1 Understand the value of ventilation
- 4.2 Know when and how to ventilate
- 4.3 Understand the benefits of damage limitation at an incident
- 4.4 Demonstrate a knowledge of various methods of limiting damage to a building on fire and in neighbouring premises

5. Appliances and equipment

- 5.1 In relation to pumping appliances:-
 - a) Understand the advantages and disadvantages of the various pump mounting positions
 - b) Understand the general principles involved in getting pumping appliances to work
- 5.2 In relation to pumps and primers:-
 - a) Describe the three categories of pumps
 - b) Describe five types of pump, i.e.
 - force
 - lift
 - bucket and plunger
 - rotary
 - centrifugal(N.B. a detailed knowledge of pump characteristics is not required)
 - c) Describe the operation of the following
 - primers
 - pistons
 - exhaust gas ejector
 - rotary - water ring
 - d) Describe how to get a pump to work from a hydrant
 - e) Describe how to get a pump to work from open water
 - f) Identify and rectify pump faults
- 5.3 In relation to delivery hose:-
 - a) Explain the construction and characteristics of hose
 - b) Know how to take care of hose
 - c) Know the causes of damage to hose
- 5.4 In relation to branches and nozzles:-
 - a) Understand the design and operation of various hand held branches, controlled and uncontrolled
- 5.5 In relation to ropes and lines:-
 - a) Understand the differences between natural and man made fibre ropes
 - b) Describe the lay of a rope
 - c) Know the causes of deterioration in rope

- 5.6 In relation to fire extinguishers, demonstrate a knowledge of the method of operation and appropriate use of the following:-
- Water type - gas cartridge
 - Water type - stored pressure
 - Foam type - stored pressure
 - Dry powder type - stored pressure
 - Dry powder type - gas cartridge
 - Carbon dioxide type
- 5.7 In relation to firefighting foams:-
- Describe the classification of foam
 - Describe the properties of foam in relation to its expansion
 - Explain the uses of protein, fluoro chemical and alcohol resistant foam
- 5.8 In relation to foam making equipment:-
- Describe the principles of operation of a low expansion foam branchpipe
 - Explain the principles of operation of a low expansion foam generator
 - Explain the principles of operation of a high expansion foam generator
- 5.9 In relation to Compressed Air Breathing Apparatus (CABA):
- Describe the composition of air before inhalation and after exhalation
 - Describe the circuit flow of Compressed Air Breathing Apparatus (CABA)
 - Calculate the working duration of CABA
 - Describe the use of a personal line and a guide line for use with CABA
- 5.10 In relation to ladders:-
- Describe the construction of a 10.5 m ladder
 - Describe the construction of a 13.5 m ladder

- Demonstrate a knowledge of pitching and working from 10.5m and 13.5 m ladders

Fire Safety

Aim: to demonstrate a basic understanding of building construction and fire safety

1. Elements of construction

- Explain the graphical symbols used for fire protection drawings
- Outline the use to which the following building materials are put and comment on their behaviour in fire:-
 - Timber
 - Stone
 - Brick
 - Cement
 - Concrete (reinforced and pre-stressed)
 - Metals
 - Glass
 - Building boards and slabs
 - Insulating materials
 - Paint
 - Plastics
- Recognise the following elements of structure, state their function and comment on their fire resistance:-
 - Columns
 - Beams
 - Walls
 - Floors
 - Roofs
 - Non-load bearing walls and partitions
 - Stairways
 - Doors
 - Windows

- Roof lights
- Ceilings

2. Fire safety practice

- Outline the basic principles of means of escape in case of fire.
 - Outline the principles of the provision of access for fire appliances to buildings for firefighting purposes
 - Outline the main causes of fire in the home
 - Describe two common types of behaviour that lead to fires starting in the home
 - Describe the two main functions of a domestic smoke alarm
 - Outline the main points to bear in mind when installing a domestic smoke alarm
 - Describe the actions to be included in an escape plan for the home
 - Describe, the advice that should be given about tackling a fire in the home, and two types of fire extinguisher that may safely be used.
 - Outline the advantages of domestic sprinkler systems compared with smoke alarms
- ### 3. Fixed installations
- Outline the basic design features, use and operation of the following types of fixed installations:-
 - Sprinkler systems
 - Drencher and water spray projector systems
 - Rising mains
 - Hose reels
 - Foam systems
 - Gas/vapour systems
 - Dry powder systems

Intermediate Syllabus

The syllabus has been prepared in a series of well defined objectives with the intention that students can acquaint themselves satisfactorily with the required subject matter.

A guide to suitable material will be found by reference to the IFE Examinations - Reading list.

This syllabus is a guide to your study plan. You should be aware that questions may be included from time to time which reflect current thinking and new developments in Fire Engineering.

Note: The examination syllabus is a progressive syllabus and candidates are reminded that the Intermediate Examination will have regard to the level of knowledge gained in the Preliminary Examination.

Fire Engineering Science

1. Mathematics

- Carry out mathematical processes involving:-
 - Transposition and transformation of formulae
 - Use of the standard form of numbers
 - Simple trigonometry

2. Mechanics

- Define and be able to carry out basic calculations involving the following terms:-
 - Force
 - Momentum
 - Mass
 - Weight
 - Pressure
 - Velocity
 - Acceleration
 - Power
 - Energy
 - Work
- Define and carry out simple calculations involving centres of gravity

3. Heat

- Define heat and temperature and describe their relationship
- Define and be able to carry out simple calculations involving Boyle's Law, Charles' Law, the Law of Pressures and the General Gas Law
- Define the terms "critical temperature" and "critical pressure"

4. Hydraulics

- Define the following and be able to carry out simple calculations involving these terms:-
 - Density
 - Relative Density
 - Specific Gravity
 - Pressure in fluids
- Define atmospheric pressure and describe methods of measuring it
- Calculate the capacity of spherical and cylindrical containers
- Calculate the capacity of irregularly shaped open water supplies
- Calculate the velocity and quantity of flow of water in hose and pipelines of differing internal surfaces and diameters
- Explain the relationship between pressure, nozzle diameter and discharge from a branch
- Define the term jet reaction and be able to calculate jet reaction forces
- Explain the conditions required to enable water to flow in hose or pipes
- Know that the quantity of water flowing is found by applying the formula

$$Q = V \times A$$
 (where:- Q = quantity in cubic metres per second
 V = velocity in metres per second
 A = cross sectional area of the pipe in square metres)
- Know that the velocity of water can be calculated using

$$V = \frac{20L}{d^2}$$
 and carry out simple calculations using the formula
 (where:- V = Velocity in metres per second
 L = flow in litres/mins and
 d = diameter of hose or pipe in mm)
 Be able to transpose the above formula to make L the subject and carry out simple calculations for flow rate
- Know that the discharge of water can be found using:-

$$L = \frac{\sqrt{d^2}}{20} \text{ litres / min}$$
 (where: V = Velocity in metres per second

L = flow in litres/mins and
 d = diameter of hose or pipe in mm)

and carry out simple calculations using this formula

- Calculate the discharge through nozzles using the formula:-

$$L = \frac{2d^2 \sqrt{P}}{3}$$

(where:- L = discharge in litres/min
 d = the nozzle diameter in mm
 P = pressure at the nozzle in bars)

- Understand the practical considerations of high nozzle pressures.
- Understand the significance of the difference in specific gravities between liquids such as petrol and water
- Explain the qualifying factors to be overcome when lifting from open water
- Explain the working of a siphon
- Explain the terms brake power and water power
- Demonstrate that $W.P. = \frac{100 \times L \times P}{60}$

(where:- W.P. = water power
 L = flow litres/min
 P = pressure in bars)

- Calculate pump efficiency percentage using the formula:-

$$E = \frac{WP \times 100}{BP}$$

where:- WP = water power (in watts)
 BP = break power (in watts)

5. Chemistry

- Define the terms: atom, element, compound, mixture, solution, solubility and suspension.
- Outline the construction of an atom and show how the electron shell configuration has an effect on reactivity
- Explain the construction of a simple chemical equation
- Appreciate that a flame is a particular type of chemical reaction
- Explain the term "flammable" with respect to a fuel/oxygen mixture
- Define "flash point" and "fire point" and explain their difference

- 5.7 Define "spontaneous ignition temperature"
- 5.8 Describe the four classes of fire and name the extinguishing media appropriate to each class.
- 6. Electricity**
- 6.1 Define the terms:-
- Volts
 - Amperes
 - Ohms
 - Watts
 - Joules
- 6.2 Solve simple problems involving electrical energy and power
- 6.3 Define and solve simple problems involving Ohms Law
- 6.4 Identify various types of cable e.g. PVC, other plastic sheathed, mineral-insulated copper sheathed
- 6.5 Explain the need for circuit protection
- 6.6 Recognise potentially dangerous domestic loading conditions

Operations

- 1. Pre-planning**
- 1.1 The value of preplanning for incidents and in particular, demonstrate an understanding of the significance of topography, safety, the nature of premises and processes, water supplies and liaison with site personnel
- 2. Command and control**
- 2.1 Understand:-
- Command and Control procedures
 - Risk assessment methodology
 - Principles of operational command and tactics
 - Fire Service responsibilities at fire situations
 - Use of Control Units, Forward Controls on the fireground and relationship to Brigade Control Centres
- 3. Fireground operations**
- 3.1 Understand:-
- The first actions on arrival at an incident
 - How to assess assistance needs
 - The use of breathing apparatus at all stages in an incident, including safety, emergency and relief procedures
 - The indications of dangerous conditions eg building collapse
 - Various methods of salvage and ventilation
 - Various methods of reaching and attacking the seat of fire
- 4. Rescue techniques**
- 4.1 Understand various:-
- Methods of entry into building and vehicles
 - Methods of searching for trapped persons including using communication lines and breathing apparatus
 - Methods of rescue of trapped persons
- 5. Fireground procedures**
- 5.1 Describe in relation to specific risks, methods of attack, hazards to the firefighters and others, the environment and the appropriate procedures when attending incidents involving:-
- Occupied buildings and structures, including domestic and high rise property
 - Basements and tunnels
 - Shopping complexes
 - Atrium buildings
 - Historic buildings and premises containing valuable artefacts including museums and galleries
 - Premises used to supply gas (natural and manufactured), electricity and fuel for power
 - Premises used for petrochemical purposes including fuel storage and refining of hydrocarbons
 - Refrigeration plant
 - Laboratories having the risk of chemical spillage
 - Railway premises and rolling stock
 - Road transport and roadways including motorways
 - Explosives, stores and ordinance factories
 - Premises likely to contain dust explosion hazards

- Forests, heaths, bush and crops
- 5.2 Describe in relation to incidents which do not necessarily involve fires, the principal hazards, methods of protection and the procedures to deal effectively with the following types of incidents:-
- Lift accidents
 - Underground accidents
 - Rescues from cliffs
 - Rescues from collapsed buildings
 - Extraction of persons from machinery
 - Hazardous loads including methods of protection and decontamination of equipment and personnel
 - Rescues at motor vehicle accidents
 - Water related rescues
- 6. Water supplies**
- 6.1 Describe a typical water distribution system
- 6.2 Explain the term ring main and name the salient features
- 6.3 Explain the causes of poor flow in mains
- 6.4 Describe a hydrant installation and its principal components

- 7. Mobilisation and communications**
- 7.1 Outline methods of transmitting calls from the public to a Fire Brigade Control Room
- 7.2 Outline methods of summoning personnel and transmitting call information and instructions to:
- Fire stations
 - Mobile fire appliances
 - Individuals at locations other than fire stations

Equipment

- 1. Pumps and primers**
- 1.1 State the four types of positive displacement pumps
- 1.2 State the operating principles of centrifugal and peripheral pumps, including high pressure pumps and state their advantages and disadvantages
- 1.3 State the operating principles and application of ejector pumps, together with their advantages and disadvantages
- 1.4 Name the common primers in use and describe their principles of operation
- 1.5 Describe direct and indirect cooling systems
- 1.6 Describe in detail the correct method of using suction hose in various conditions
- 1.7 Name the gauges to be found on a typical pump and state their purpose
- 1.8 Outline potential faults and other symptoms that may arise when working from a pressure-fed supply or open water
- 2. Hose**
- 2.1 List the main characteristics essential for good delivery and suction hose
- 2.2 Identify the causes and methods of avoiding deterioration in such hose
- 2.3 State the appropriate methods of testing delivery and suction hose
- 2.4 Describe the principles of design and operation of the various types of coupling for delivery and suction hose
- 3. Branches etc.**
- 3.1 Describe the basic use and design of:-
- Hand held branches, controlled and uncontrolled
 - Dividing & collecting breechings
 - Ground monitors

- 4. Foam and foam making equipment**
- 4.1 Define the categories of fire and firefighting foams
- 4.2 Outline the operational use of foam
- 4.3 Describe the principal performance characteristics of a:-
- low expansion branchpipe or generator
 - medium expansion branchpipe or generator
 - high expansion generator

- 5. Ropes**
- 5.1 Compare natural and man made ropes
- 5.2 Outline the construction of such ropes
- 5.3 Identify the causes and methods of avoiding deterioration of such ropes

- 6. Ladders**
- 6.1 Outline the safety precautions to be observed when handling, pitching and climbing ladders
- 6.2 Understand the general principles of working with ladders and be able to identify safe and unsafe working angles
- 7. Lighting**
- 7.1 Describe various types of portable lighting equipment
- 8. Chemical protection**
- 8.1 Describe various types of chemical protective clothing
- 8.2 Describe the designs of clothing that provides total environmental protection by being "gas tight" or limited protection against splashing by harmful chemicals
- 9. Radiation equipment**
- 9.1 Identify and describe basic radiation detection equipment

Fire Safety

- 1. Building construction, character and use of building materials**
- 1.1 Elements of structure:-
- State the function of a column
 - State the 6 principal materials used for the construction of columns, i.e. timber, brick, stone, reinforced and pre-stressed concrete, cast iron and steel
 - Identify means of increasing the fire resistance of columns
 - Describe the construction of a common type of cast iron column
 - Explain the various methods of constructing steel columns
 - Explain the major disadvantages of steel in building construction as its inability to withstand high temperatures
 - Identify the primary function of a structural beam
 - Identify and describe a continuous beam
 - Describe the reaction of an applied load upon a beam
 - Identify the means of increasing the fire resistance of beams
 - Understand the effect of charring on timber beams
 - Understand the need to reinforce concrete when used in the manufacture of beams
 - Understand why reinforcement is undertaken in the lower section of concrete beams
 - Explain that, in modern methods of construction, walls which comprise elements of structure are named according to the function they perform, viz external wall, separating wall, compartment wall, load-bearing wall or load-bearing part of a wall
 - Explain the principal types of load bearing wall construction
 - Explain the general principles of brick wall construction
 - Understand what part of a cavity wall carries the weight of upper floors
 - Identify the more common types of floor construction, e.g. timber joisted, compressed board panels, solid reinforced concrete and hollow block
 - Explain the factors which affect the performance of floors when involved in fire
 - Identify the methods of supporting floor joists in or on walls
- 1.2 Other elements of structure:-
- Describe the construction and identify the component parts of a flat roof
 - Describe the construction and identify the component parts of a pitched roof
 - Recognise and describe the component parts of a staircase
 - Recognise and describe the construction and operating principles of the following doors:-
 - hinged
 - swing
 - revolving
 - sliding

- 4.7 Outline the possible causes of ignition and problems from the misuse and malfunction of heating, cooking and lighting equipment.
- 4.8 Explain the characteristics of fires with different origins, i.e.
- slow fires
 - rapidly developing fires
 - accidental fires from different causes
- 4.9 Outline the reasons for suspecting arson from the general characteristics of a fire and at or after the scene of investigation.

Paper 2A - Operations, Vehicles and Equipment (Optional)

1. Firefighting techniques

In relation to general operations:

- 1.1 Command and Control
- Discuss the purpose of pre planning for any specified emergency.
 - Explain the value of specific command references for officers, including Sector Command procedures
 - Detail all types of fireground communications systems
 - Describe principles for general control, fireground tactics and fireground strategy
 - Explain the need for evacuation at fires
 - Outline the strategy and tactics involved in rescue work
 - Explain the objectives of ventilation at fires
 - Describe the aims and principles of salvage/damage control
- 1.2 Fire development and extinguishment, including:
- Methods of identifying differing types of burning materials
 - Various ways in which fire can spread within buildings and between buildings
 - Explain in detail the principles, application and benefits of ventilation, including Positive Pressure Ventilation
- 1.3 Fireground Safety
- Discuss the value of safety organisation at incidents including the duties that might be assigned to Safety Officers.
- Describe in detail, in relation to specific risks, the various methods of attack, hazards to the environment and persons present, and appropriate practical procedures when attending incidents involving:
- 1.4 Domestic and other life risk accommodation, including houses in multiple occupations
- 1.5 All types of Transportation Premises and Systems including underground and vernicular rail systems
- 1.6 Specific Risk Premises and Materials including special risks:
- Radioactive materials in premises or vehicles
 - Agriculture and rural buildings and silos
- 1.7 Industrial Premises:
- Plant using metals and metallic powders
 - Plant using/evolving toxic gases, including ammonia and chlorine
 - Plant producing and using chemicals
- 1.8 Describe in detail, in relation to incidents which do not necessarily involve fires (often referred to as Special Services) the principal hazards, methods of protecting persons and the environment and practical procedures to return effectively to a safe situation at all incidents including those involving:
- Natural disasters resulting in flooding or building collapse
 - Underground pipelines conveying hazardous substances
2. Mobilisation and communication
- 2.1 Detail methods of summoning personnel and transmitting call information and instructions to:
- Fire stations
 - Individuals at locations other than fire stations
 - Mobile fire appliances
- 2.2 Describe equipment used and operating principles of brigade control rooms including the use of computer aided mobilising systems.
- 2.3 Describe the radio systems using VHF and UHF workings and discuss their use both on and off the fireground.

3. Pumps and primers

- 3.1 Describe in detail centrifugal and peripheral pumps including high-pressure pumps and state their advantages and disadvantages.
- 3.2 Describe ejector pumps and state their areas of application within the Fire Service, together with their advantages and disadvantages.
- 3.3 Define the terms:
- Duty point
 - Volute
 - Multi stage
 - Guide vanes
 - Cavitation
- 3.4 State the purpose and operation of anti-surge devices on high pressure hose reel tubing.
- 3.5 Explain in detail direct and indirect cooling systems and state the advantages and disadvantages of both systems.
- 3.6 Describe a typical hose reel system with the main pump feeding the hose reels at high or low pressure.
- 3.7 Describe in detail the symptoms of faults that may occur:
- when working from pressure-fed supply
 - when working from open water
- 3.8 State the principles to be observed when controlling pump output where branchmen are involved. And the benefits and disadvantages of automatic pump controls
- 3.9 Describe the maintenance and servicing of pumps that should occur on returning from fire.

4. Fire service vehicles

- Demonstrate an understanding of the principal components, operations and functions of vehicles used by the fire brigade for fire fighting or special incident work undertaken by fire brigades. Be able to specify the features of all types of fire and rescue vehicles, including the following:
- NOTE:** 'Vehicles' includes container style vehicles (PODS) which may have one prime mover, but a number of containers.
- 4.1 A pumping appliance having an integral pump working from a power take off driven by the road engine and designed to carry a crew of personnel, with additional equipment including ladders, a water tank and hose reels.
- 4.2 Aerial apparatus including turntable ladders and hydraulic platforms.
- 4.3 Emergency tenders designed to carry a comprehensive range of rescue equipment and special appliances for rough terrain.
- 4.4 Rapid intervention vehicles used at airfields and within brigades for fire fighting and rescue.
- 4.5 Vehicles used to convey water and foam concentrate in bulk to the fireground.
- 4.6 Vehicles used at chemical incidents including those used to decontaminate personnel.
- 4.7 Vehicles used to assist in fireground control and command.
- 4.8 Vehicles used to convey salvage equipment.
- 4.9 Vehicles used to lay hose to incidents whilst the vehicle is being driven.
- 4.10 Recovery vehicles designed to help recover other vehicles that may have broken down or be unable to move.

5. Equipment

5.1 Hose

- 5.1.1 Describe in detail the performance requirements and the construction of the various types of hose.

5.2 Ropes

- 5.2.1 (a) Discuss in detail the comparisons between natural, man made and wire ropes.
- (b) Describe in detail the construction of such ropes.
- (c) Describe a turntable rescue line, a lowering line, a long line and a short line and explain the usage's of these.
- (d) Describe methods of obtaining mechanical advantage when using lines with blocks and tackle.

5.3 Foam and foam making equipment

- 5.3.1 Detail the different properties of the various foams and foam concentrates.
- 5.3.2 Classify problems by expansion and by constituents (low medium high).
- 5.3.3 State the conditions under which foam concentrates 'should be stored.

- 5.3.4 Name the types of equipment required to produce foam.
- 5.3.5 Specify the care and maintenance of foam making equipment
- 5.3.6 Describe the application rates of foam and factors to be taken into account when using foam to extinguish a fire.
- 5.3.7 State what is meant by 'pressurised foam supply'.

5.4 Ladders

- 5.4.1 Describe the safety precautions to be observed when handling - pitching - climbing ladders.
- 5.4.2 Detail in depth the principles of working with ladders

5.5 Breathing apparatus & associated equipment.

- 5.5.1 Describe the principal component parts and the passage of air from the cylinder at high pressure to the wearer in a specific type of compressed air apparatus.
- 5.5.2 Describe one type of Breathing Apparatus communications equipment.
- 5.5.3 Describe a safety procedure used to control the use of BA by up to 12 wearers.
- 5.5.4 Describe methods of testing a specific type of apparatus.
- 5.5.5 Describe in detail a typical hand operated resuscitation apparatus and typical automatic resuscitator.

5.6 Hydraulic rescue equipment, cutting gear and other rescue apparatus

- 5.6.1 Describe the construction and operating principles of compressed air power tools, electric power tools and flame cutting equipment.
- 5.6.2 Name the items in a typical hydraulic rescue kit and state the operating instructions and general maintenance applicable to the equipment.
- 5.6.3 Describe the operation of hauling and lifting equipment.

5.7 Lighting equipment

- 5.7.1 Explain in detail the term 'Intrinsically Safe.'

5.8 Chemical protective clothing

- 5.8.1 Describe the principles of clothing designed to give total environmental protection by being 'gas tight', or limited protection against splashing by harmful chemicals. Show an understanding of the testing and maintenance procedures to be adopted for such items.

5.9 Radiation equipment

- 5.9.1 Describe in detail the type of equipment used in relation to radiation incidents.

6. Water supplies

- 6.1 State the precautions to be observed when using a high pressure hydrant.

7. Risk assessment

- 7.1 Discuss the principles of a 'Risk Assessment' based approach to planning operational fire cover.

Paper 2B - Communications (Control & Communications Personnel only) (Optional)

1. Theory

- 1.1 Outline the principles of wave motion and understand the relationship between amplitude, wavelength and frequency.
- 1.2 Understand the nature and uses of electromagnetic waves, including the relative wavelength, frequencies and uses of electromagnetic waves of different wavelengths.
- 1.3 Under the principles of sound wave motion.
- 1.4 Describe sound waves with reference to:
- loudness
 - pitch
 - quality
 - noise
 - notes
- 1.5 Explain the sound responses of the human ear.
- 1.6 Explain how intensity varies with distance and describe methods used to measure sound intensity.
2. Radio theory
- 2.1 List the component modules of a basic radio system and detail their interaction.
- 2.2 Compare conventional radio systems with trunked systems.

- 2.3 Show an understanding of the different methods of modulation.
- 2.4 List the applications of 'simplex', 'duplex', 'single frequency working' and 'double frequency working'.
- 2.5 Describe the use of microwave links used as part of a wide area radio scheme.
- 2.6 Outline the main features of digital and analogue radio systems for both conventional and trunked formats.
- 2.7 Explain the requirement for a radio control system.
- 2.8 List the techniques to overcome interaction distortion between transmitters in an audio phasing, quasi synchronous phasing and best signal selection.
- 2.9 Show an understanding of the correct aerial types for mobiles, radio links, and main broadcast transmitters and receivers including the correct length and positioning.
- 2.10 List the methods of establishing wide area coverage for communication with mobiles.
- 2.11 Outline how the range of communications between hand portable equipment may be improved.
- 3. Control**
- 3.1 Understand the planning, design and operation of control centres.
- 3.2 List the ergonomic factors to be considered when designing a control room layout.
- 3.3 Outline the environmental factors that influence the choice and positioning of equipment.
- 3.4 Outline the process involved in the preparation of a specification for a control centre.
- 3.5 List the methods by which new equipment is evaluated against the specification.
- 3.6 Outline the requirements of maintenance agreements for mobilising and radio equipment.
- 3.7 Outline the 'core' and 'non core' activities undertaken by fire service control rooms.
- 4. Communications**
- 4.1 Detail the methods by which calls from the public and other sources are passed to the fire service.
- 4.2 Describe the use of computer aided mobilising systems.
- 4.3 Outline the principles of cellular telephone networks and their application to the fire service.
- 4.4 Discuss data transmission methods to mobile resources.
- 4.5 Outline the operational considerations of AVLS (automatic vehicle data location systems) for the fire service.
- 4.6 Describe the operational procedures associated with using radio equipment in hazardous environments.
- 4.7 Understand the factors affecting the installation of radio equipment in fire service vehicles.
- 4.8 Describe the use of CCTV (closed circuit television) at fire service incidents.
- 4.9 Define the term telemetry and its application to the fire service.
- 4.10 Describe the facilities available as part of the mobilising system that may be provided on fire stations.
- 5. Information technology**
- 5.1 Describe the use of computer networks in the fire service.
- 5.2 Understand the principles and methods of providing information held on fire service databases to both control rooms and mobile resources.
- 5.3 Explain the fire service use of GIS (graphical information systems).
- 5.4 Discuss software applications available for personnel computers for use in the fire service.

Paper 2C - Aero Fire Studies (Optional)

- 1. Provision for fire-fighting and rescue facilities at airports and airfields.**
- 1.1 Discuss the categorisation of airports in relation to the fire fighting protection to be provided.
- 1.2 Detail the provision of principal and complementary extinguishing media and describe their characteristics.

- 1.3 Outline the discharge rates for extinguishing agents
- 1.4 Discuss the provision of rescue and fire-fighting vehicles and detail their response times and specifications.
- 1.5 Explain in detail the concepts of critical area concept.
- 1.6 Discuss the provision of water supplies at airports and airfields.
- 2. Fire protection of airport buildings.**
- 2.1 Describe the use, construction features and classification of aircraft hangars
- 2.2 Describe the principles of hangar separation.
- 2.3 Detail the fire protection measures that should be recommended for different groups of hangars.
- 2.4 Explain the basic layout of airport terminal buildings.
- 2.5 Discuss the fire protection measures that should be recommended for airport terminal buildings.
- 3. Aircraft construction**
- 3.1 Detail the materials normally used in aircraft construction.
- 3.2 Outline the features of aircraft construction
- 3.3 Describe the features of power systems and services
- 3.4 Describe the features of internal fixtures and fittings
- 3.5 Discuss in detail the aircraft access and evacuation systems
- 3.6 Classify passenger emergency exits in terms of type, size and location and be able to determine the number and type of exits to be provided for each side of an aircraft according to passenger carrying capacity
- 3.7 Discuss the provision of fixed fire protection systems in aircraft
- 3.8 Describe the various engines used in aircraft and outline their hazards
- 3.9 Discuss the types of aviation fuels that are used and outline their characteristics
- 3.10 Describe the construction details of rotary wing aircraft
- 3.11 Categorise types of helicopters
- 3.12 Discuss access and escape routes provided in rotary wing aircraft
- 3.13 Describe the position of engines and the general features of rotor blades
- 3.14 Describe the provision of fuel tanks in military aircraft
- 3.15 Discuss the types of fuel used in military aircraft
- 3.16 Describe the access and exits from military aircraft including cockpit canopies, break-in points and emergency hatches
- 3.17 Outline the types of power systems and services that may be found in military systems
- 3.18 Outline the three type of storage of armaments and pyrotechnics found on board military aircraft.
- 4. Emergency planning and procedures**
- 4.1 Explain the use of grid maps, rendezvous points, standby points and the use of other interested organisations in pre-planning
- 4.2 Detail the categorisation of emergencies at airports and define the terms.
- a) Aircraft accident
- b) Full emergency
- c) Local standby
- d) Bomb alert/bomb suspected
- e) Domestic fire
- 4.3 Discuss the pre-determined attendance and the role of the local authority fire services
- 4.4 Discuss the following features that are useful for planning procedures.
- a) Observation and watching duties
- b) Determining the best position for standby for emergency vehicles.
- 5. Aircraft fire-fighting procedures and techniques**
- 5.1 Discuss in detail the types and causes of aircraft ground incidents and fires that can be encountered and the methods of dealing with them including:
- a) Fuselage and passenger cabin fires
- b) Wheel fires and hot brakes
- c) Engine fires
- d) Running fuel fires
- e) Metal fires
- 5.2 Discuss the methods of dealing with aircraft fuel spillage both with or without fire

- 5.3 Discuss the fire tactics and techniques that need to be adopted for attending incidents at airports for the following:
- a) Approaching the incident
- b) Appliance positioning
- c) Application of extinguishing agents
- d) Use of additional water supplies and extinguishing agents
- e) Locating the incident
- f) Casualty handling
- 5.4 Define the terms "high speed and low speed" accident and discuss in general terms the actions of the rescue and fire service at these types of incidents
- 5.5 Detail the procedure for foaming runways for emergency landings
- 5.6 Describe the methods used to foam runways
- 5.7 Discuss the advantages of foaming runways and outline the problems associated with this procedure
- 6. Rescue from aircraft**
- 6.1 Describe the methods used to evacuate an aircraft by the flight crew
- 6.2 Describe the methods used to evacuate an aircraft by the fire service and rescue personnel
- 6.3 Detail the methods of entry that can be used to gain access to an aircraft
- 6.4 Discuss the principles of rescue procedures for rescue from civil aircraft
- 6.5 Detail the methods of entry used to gain access to military aircraft including access via cockpit canopies
- 6.6 Outline the dangers presented by ejection seats and the principles of making them safe
- 6.7 Describe the methods of release and rescue of aircrew.
- 7. Post accident procedures**
- 7.1 Discuss the movement of wreckage and the practice of de-fuelling.
- 7.2 Discuss the need to decontaminate personnel and equipment
- 7.3 Describe methods of dealing with ignition sources and the evacuation of the surrounding area.
- 7.4 Discuss the removal and collation of personal belongings
- 7.5 Discuss the removal and moving of bodies including the recording of positions and locations.
- 8. Heliports**
- 8.1 Discuss the main factors that need to be considered in choosing a heliport site
- 8.2 Outline the points that need to be considered when determining the size of a heliport including the final approach and take-off areas
- 8.3 Discuss the levels of fire protection required for heliports
- 8.4 Outline the categorisation of heliports in relation to the provisions of fire protection facilities to be provided
- 8.5 Discuss response times for fire and rescue personnel at both surface and elevated heliports

Paper 3 - Fire Engineering Science (Compulsory)

- 1. Analysis and interpretation of data**
- 1.1 Extract and tabulate given data and express that data in the form of:
- a) Graphs
- b) Histograms and bar charts
- c) Circular diagrams (pie charts)
- 1.2 Obtain median, mean and norm values from given data.
- 1.3 Extend graphs to
- a) project values from given data (extrapolate)
- b) deduce values from missing data (interpolate).
- 2. Mechanics**
- 2.1 Define the SI system of units in terms of basic and derived units.
- 2.2 Describe and carry out simple calculations involving the equations of motion
- 2.3 Describe Newton's Laws of Motion
- 2.4 Use vector quantities to find resultant values.
- 2.5 Apply vector methods to force and motion problems.
- 2.6 Calculate moments around a fulcrum, including

- the use of levers and parallel forces.
- 2.7 Carry out calculations involving centres of gravity and buoyancy.
- 2.8 Define stress strain and Hooke's Law and carry out calculations involving these terms.
- 2.9 Apply the calculations of work, power, density efficiency to practical examples.
- 2.10 Describe and calculate the friction force between two surfaces in contact.
- 3. Hydraulics**
- 3.1 Define the terms:
a) Density
b) Specific gravity
c) Pressure in fluids
and demonstrate the relationship between the three.
- 3.2 Solve problems involving the terms referred to in 3.1.
- 3.3 Define "streamline flow".
- 3.4 Show how the principle of atmospheric pressure is used in pumping systems either as an aid to flow or as a means of measuring flow.
- 3.5 Use the laws of friction to calculate energy losses in piped water supplies.
- 3.6 In relation to pumps, define water power, brake power and efficiency. Carry out basic calculations involving these terms.
- 3.7 Explain the relationship between velocity and discharge of water through hose of differing diameters.
- 3.8 Discuss the purpose and design of branches and nozzles.
- 3.9 Calculate both theoretical and effective height of a jet.
- 4. Electricity**
- 4.1 Describe electric current as a flow of electrons.
- 4.2 Describe how electrical energy is generated and distributed.
- 4.3 Explain the characteristics of alternating and direct current.
- 4.4 Describe the operation and characteristics of a step-up and step-down transformer
- 4.5 Explain Ohms Law, Calculate the relationship between resistance, amperage and voltage in simple circuits, both parallel and series.
- 4.6 Use Ohms Law to solve problems.
- 4.7 Explain the magnetic and chemical effects of electrical currents and show how these phenomena are applied in:
a) Electric motors
b) Primary and secondary electric cells
- 4.8 Describe the function and method of operation of fuses and circuit breakers.
- 4.9 Define and solve problems involving resistance variation with temperature and resistivity.
- 4.10 Apply the concept of power to electrical circuits.
- 5. Heat**
- 5.1 Define and calculate:
a) Specific heat capacity
b) Latent heat of vapourisation
- 5.2 Apply the use of 5.1 to calculations involving the transfer of heat.
- 5.3 Calculate linear, superficial and volumetric expansion using the relevant coefficients.
- 5.4 Apply the Gas Laws to calculations involving changing conditions of heat.
- 6. Radioactivity**
- 6.1 Describe the principles of radioactivity.
- 6.2 Explain the construction of alpha and beta particles and gamma radiation and compare their penetrating powers.
- 6.3 Define the terms decay and half life.
- 6.4 Describe the biological effects of radiation and precautions to be adopted for safety from the effects of radiation.
- 7. Chemistry**
- 7.1 Describe the construction of an atom and show how the electron shell configuration has an effect on reactivity.
- 7.2 Explain the concept of valency and the relevance of the periodic classification of the elements.
- 7.3 Apply the concept of valency to the formation of chemical compounds.
- 7.4 Balance simple chemical equations and define stoichiometric conditions.
- 7.5 Calculate relative molecular masses and vapour densities from given relative atomic masses.
- 7.6 Use "balanced" chemical reactions for the calculation of the masses, and the volumes, of reactants in chemical reactions.
- 7.7 Demonstrates an understanding of the classification of the chemical elements and the main hazards associated with each grouping.
- 7.8 Demonstrate a knowledge of the properties, reactions and hazards associated with elements defined as
a) Metals
b) Non-metals
- 7.9 Describe the main properties of the following compounds and elements:
Acids (Inorganic and Organic)
Ammonia
Ammonium hydroxide
Calcium oxide
Alkalis
Carbon monoxide
Carbon dioxide
Chlorine
Hydrogen
Oxygen
Sodium
Sulphur
Phosgene
- 7.10 Define hydrocarbons.
- 7.11 Describe the structure and main properties of the first four members of the alkane family.
- 7.12 Define the terms flashpoint, fire point and spontaneous ignition temperatures.
- 7.13 Describe the principles involved in the extinction of fire by smothering, cooling and oxygen starvation.
- 7.14 Outline the principles of the fire "tetrahedron" and inhibition of combustion chains involving a "free radical" mechanism.
- Paper 4 - Human Resource Management Practice (Compulsory)**
- 1. Planning, control & review**
- 1.1 Identify the responsibilities of a team leader in connection with the needs of customers and suppliers both internal and external to the organisation.
- 1.2 Discuss the responsibilities of employee and employer in relation to health and safety at work.
- 1.3 Describe planning methods for achieving productive results
- 1.4 Discuss leadership of individuals and team members and understand the different styles of command.
- 2. Introduction to quality management**
- 2.1 Outline the basic processes for the maintenance of quality assurance and control.
- 2.2 Identify the team leaders role in meeting organisation objectives and implementing policy.
- 2.3 Understand the need for effective recording systems, staff reporting and simple budgetary control.
- 2.4 Detail employee training and development systems.
- 3. Use and control of resources**
- 3.1 Describe the role of the team leader when using resources efficiently.
- 3.2 Outline the concept of effective resource management.
- 3.3 Describe the process of motivation
- 3.4 Discuss typical problems associated with delegation.
- 3.5 Identify the human relationship between environment, personality and behaviour.
- 3.6 Examine communication systems in resource control.
- 4. Management and Self Development**
- 4.1 Identify the need to manage personal and professional development, and to build effective working relationships.
- 4.2 Assess the effect of personal performance and style of working, taking into account the views of other relevant people.
- 4.3 Draw up a specific, measurable and achievable action plan for self-development, which takes into account known priorities and personal resources.
- 4.4 Examine individual jobs and set out a plan for effective time management.
- 4.5 State the principles of good communications.
- 4.6 Describe methods of maintaining confidentiality.
- 4.7 Examine personal relationships with line managers, colleagues and team members.
- 4.8 Describe a system for informing people of expected standards of work and behaviour.
- 4.9 Describe formal and informal systems for handling conflict in organisation
- 5. Recruitment**
- 5.1 Discuss the process of recruitment of people within the role of the team leader.
- 5.2 Describe the legal requirements for recruiting and employing personnel.
- 5.3 Identify a typical organisational system for identifying personnel requirements.
- 5.4 Prepare a job description and personnel specification from given information.
- 5.5 State the principles to be followed when recording information on all candidates involved in the selection process.
- 6. Individual and team development**
- 6.1 Describe how to make a significant contribution to development of teams and individuals, to ensure the best use of Human Resources in achieving team and organisational objectives.
- 6.2 Identify different development needs.
- 6.3 Outline how to influence peoples response to identified needs.
- 6.4 Discuss how to contribute to the planning of developmental activities.
- 6.5 Explain how to monitor, review and provide feedback on individuals development activities.
- 6.6 Explain the ways in which work can be assessed. List the information that is needed to carry out the assessment.
- 6.7 Outline how to produce a realistic and achievable work plan and communicate it to a team.
- 6.8 Explain how to involve staff in the assessment process.
- 7. Improving team performance**
- 7.1 Identify typical problems likely to lead to poor work performance.
- 7.2 Describe the range of support services available to a team member with a problem, which is affecting work performance.
- 7.3 Outline the need for respect for a team member with whom poor work performance is being discussed.
- 7.4 Detail the main steps which a disciplinary procedure should incorporate.
- 7.5 Explain how to maintain confidentiality when dealing with a grievance.
- 7. Information collection and analysis**
- 8.1 Describe the need for a sound knowledge of managing information efficiently within the role of a team leader:
- 8.2 Discuss information collection and use to organisational effectiveness.
- 8.3 Explain how to carry out an investigation requiring the collection and validation of information and takes account of resource availability.
- 8.4 Explain the principles of confidentiality.
- 8.5 Explain how feedback is used to check understanding.
- 8.6 Evaluate the use of a meeting.
- 8.7 Plan a meeting for a small group of people including:
a) its purpose and objective
b) preparation required
c) length and timing
d) post meeting requirements

Membership Syllabus

The Syllabus has been prepared in a series of objectives with the intention that the students can acquaint themselves satisfactorily with the required subject matter.

The guide to the study material required for this examination is contained in the reading list which is available from IFE Headquarters.

This syllabus is a guide to your study plan. You should be aware that questions may be included from time to time which reflect current thinking and new developments in Fire Engineering.

Note: The examination syllabus is a progressive syllabus and candidates are reminded that the Membership Examination will have regard to the knowledge contained within the Preliminary, Intermediate and Graduate level syllabuses.

However candidates must equally ensure they are well prepared by reading widely since study only of the material outlined above will not be sufficient for this particular examination.

PAPER 1 - Fire Engineering Science (Compulsory)

1. Hydraulics

- 1.1 Write and explain Bernoulli's theorem.
- 1.2 Carry out calculations based on the Bernoulli's equation.
- 1.3 Describe the Venturi effect
- 1.4 Explain how Venturi meters, Pitot tubes and vee notch weirs are used to evaluate flow rates, pressures and pressure drops.
- 1.5 Carry out calculations for flow rate using the Venturi meter.
- 1.6 Calculate the flow of water through open channels.
- 1.7 Calculate forces exerted by a jet hitting a flat or inclined surface.

2. Combustion

- 2.1 Describe a flame or combustion in terms of chemical reactions and discuss the factors which influence the speed of the reaction.
- 2.2 Describe the combustion process as a chain mechanism including the effects of temperature and pressure on rate of reaction.
- 2.3 Describe the ignition processes which initiate the combustion reaction.
- 2.4 Describe the combustion of solids, liquids, gases, transient dust and vapour phases as a process.
- 2.5 Describe how the combustion process can be terminated.
- 2.6 Define the following terms in relation to the chemical reactions:
 - a) Limits of Flammability
 - b) Diffusion flames
 - c) Premixed flames
 - d) Cold flames
 - e) Limits of flammability
 - f) Self ignition temperature
 - g) Flash over
 - h) Flash back
 - i) Backdraft
- 2.7 Describe how the necessary fuel/air mixture ratio may be achieved by diffusion.
- 2.8 Describe how the necessary fuel/air mixture ratio may be achieved by pre-mixing.
- 2.9 Explain how dust and spray explosions can occur..

3. Special combustion processes

- 3.1 Define the terms:
 - a) Spontaneous heating
 - b) Spontaneous ignition
 - c) Spontaneous combustion
- 3.2 Describe the term oxidation and give examples of high temperature oxidation.
- 3.3 Discuss the hazards of flammable materials that contain their own means of oxidation.
- 3.4 Differentiate between high and low explosives and explain the classification of explosives as follows:
 - a) Detonators
 - b) Propellants
 - c) Initiators
 - d) Deflagrators

4. Fire dynamics

- 4.1 Describe the Incubation and Ignition stages of a Fire.
Materials properties, Thermal Inertia, Radiative heat transfer to fuel surfaces.
- 4.2 Early Growth
Surface Spread of Flame (wind aided/wind opposed), floors/walls/stairs/trench effect, fuel array geometry and thermoplastic spread.
- 4.3 Heat release rate/ square metre of material/item/whole fire, fire calorimetry.
- 4.4 Flame and Smoke plumes
Flame height vs heat release, plume height, cold air entrainment, basic smoke movement, ceiling layer formation, layer temperature vs radiant flux from it.
- 4.5 Ventilation
Bi-directional flow through an opening, ventilation control of fires in compartments, layer formation, smoke outflow through an opening
- 4.6 Flashover
The effects of fire position (centre of room/near wall/in corner), ceiling height, thermal properties of wall and ceiling materials. Heat release for flashover, time to flashover.
- 4.7 Fire Growth rates.
Time squared fires slow/medium/fast/ultrafast, factors affecting.
- 4.8 Steady State Phase.
Duration of burning and fire load (Laws law)
- 4.9 Decay Phase
Effect of fuel or air depletion. Automatic/manual extinction.
- 4.10 Preparing a quantitative fire growth curve based on all previous sections.

5. Effects of heat

- 5.1 Explain the production of heat by the following processes:
 - a) Friction
 - b) Combustion of gases
 - c) Passages of electric current
 - d) Chemical reactions
- 5.2 Describe how the effect of heat changes the strength of materials.
- 5.3 Describe the effects of fire on the following structural materials:
 - a) Timber
 - b) Brick
 - c) Stone
 - d) Reinforced concrete
 - e) Cast iron
 - f) Steel
 - g) Aluminium
 - h) Glass
- 5.4 Describe the principles of the laboratory tests which may be used to assess the flammability and fire resisting properties of materials and elements of structure.
- 5.5 Discuss the factors which influence the severity of a fire within a room or building.
- 5.6 Define the terms Fire Load and Fire Load Density and, using calorific values, carry out simple calculations.

6. Principles of heat and combustion sensitive detection devices

- 6.1 Describe in detail the operating principles of:
 - a) Ionisation detectors
 - b) Optical detectors
 - c) Heat detectors
 - d) Combustion detectors
 - e) Radiation detectors
 - f) Flame detectors
- 6.2 Demonstrates a knowledge of the use and effectiveness of the detectors listed in 6.1 according to the risk to be covered and their reliability.
- 6.3 Describe the operating principles of thermocouples and thermistors.

7. Electricity

- 7.1 Describe in detail the principles of generation, transmission, distribution, and utilisation, of electrical energy.

- 7.2 Define the terms earthing and bonding and explain why these terms are important with regard to electricity.
 - 7.3 Describe the principle of protective measures utilised to safe guard individuals and equipment in conjunction with electrical energy.
 - 7.4 Detail protective arrangements for the use of electricity in atmospheres that are flammable or contain explosive dusts.
 - 7.5 Describe static electricity, its generation, storage discharge.
 - 7.6 Detail the precautions necessary to minimise the generation, accumulation and discharge of static electricity particularly in flammable atmospheres.
- ### 8. Special hazards
- 8.1 Detail the methods of internal and external storage of hazardous substances which are flammable, toxic, corrosive, radioactive or a combination of such hazards.
 - 8.2 Show an understanding and knowledge of the physiological effects of hazardous substances with particular reference to their toxicity
 - 8.3 Describe measures of toxicity and distinguish between poisoning by inhalation and skin absorption.
 - 8.4 Describe the nature, properties, industrial processes, the precautions to be taken in handling and storage, the signs and symptoms of poisoning, the flammability of the substances used in the process, the correct medical treatment to be applied, their reaction to fire fighting media and to other substances and hazards of the following substances:
 - a) Fats and Waxes
 - b) Paints and varnishes
 - c) Coal and coke
 - d) Petroleum spirit and fuel oils
 - e) Liquefied petroleum gases
 - f) Cellulose materials
 - g) Plastics
 - h) Metals
 - i) Animal and vegetable oils
 - j) Radioactive materials
 - k) Cryogenic substances
 - l) Explosives
 - m) Organic Solvents
 - 8.5 Outline the hazards associated with:
 - a) Coal gas and natural gas installations
 - b) Petroleum and oil installations
 - c) Chemical plants
 - d) Liquefied petroleum gas installations
 - e) Pipelines conveying flammable gas or liquids.

Paper 2 - Fire Safety (Compulsory)

1. Fire safety practice

- 1.1 Identify the principal requirements for the prevention of fire in the following classes of premises and places:
 - a) Multi-storey car parks
 - b) Shopping precincts and malls
 - c) High rise tower blocks
 - d) Hospitals
 - e) Residential care establishments for the elderly, young or disabled
 - f) Schools and universities
 - g) Sports stadia
 - h) Petroleum installations and chemical plants
 - i) Residences of multiple occupation
 - j) Flats or maisonettes (apartments)
 - k) Historic buildings
 - l) High bay storage warehouses and other warehousing with large storage areas
 - m) Farm buildings
 - n) Tank farms
 - o) Temporary buildings and structures
 - p) Buildings being build, altered or demolished
- ### 2. Principles of means of escape from fire
- 2.1 Define the principles of means of escape (egress) from fires and apply them in particular to:

- a) Residential premises
 - b) Places of public entertainment
 - c) Industrial and commercial premises
 - d) Large city centre complexes and shopping malls
- 2.2 Outline special arrangements that may be needed for means of escape for the young, the old and the disabled.
- 3. Installation using extinguishing media**
- 3.1 Describe in detail the design features, installation, maintenance and operation of the following:
- a) Sprinkler Systems
 - b) Drenchers
 - c) Water spray projectors and water mist systems
 - d) Rising mains
 - e) Foam systems
 - f) Gas/vapour systems
 - g) Dry powder systems
- 3.2 Discuss the particular risks for which the systems listed in 1.1 above would be appropriate.
- 4. Fire detection systems**
- 4.1 Describe in detail the design features, installation, maintenance and operation of the following:
- a) Heat detectors
 - b) Smoke and combustion product detectors
 - c) Flame detectors
 - d) Flammable vapour and other vapour detection systems
- 4.2 Discuss the particular risks for which the systems listed in 4.1 above would be most appropriate.
- 5. Explosion detection and control systems**
- 5.1 Describe in detail the design features, installation, maintenance and operation of the following:
- a) Explosion detection systems
 - b) Explosion venting systems
 - c) Explosion suppression systems
- 6. Fire alarm systems**
- 6.1 Describe in detail the design features, installation, maintenance and operation of Automatic Fire Detection Systems and include:
- a) Types of System
 - b) Definitions of a Detector
 - c) Classifications of Detectors
 - d) Success or failure of operation
 - e) Automatic Fire Detectors - Radio Systems
 - f) Automatic Fire Detection - Detector Circuits
 - g) Control and indicating equipment
 - h) Detector position
 - i) Manually Operated Fire Alarms
- 6.2 Discuss the particular risks that the systems in 6.1 would be appropriate for.
- 7. Installations – general**
- 7.1 Describe the procedures for the commissioning of fixed installations.
- 7.2 Outline the procedures for the testing, maintenance and regular inspection of fixed installations.
- 8. General fire safety**
- 8.1 Discuss the physiological, behavioural and psychological effects of people presented with a fire situation.
- 8.2 List emergency procedures for the safe evacuation of people from a fire situation.
- 8.3 Show a knowledge of how the behavioural aspects of people in fire can be used to plan means of escape and evacuation procedures.
- 8.4 Show a knowledge of the behaviour of people in a fire and demonstrate how this can adversely affect evacuation and means of escape.
- 8.5 Discuss detailed procedures for training staff in fire safety.
- 8.6 Discuss methods of improving fire safety in the community and increasing public awareness and perception of general fire safety matters.
- 9. Legislation and codes of practice**
- 9.1 Explain the principal requirements of fire safety, fire precautionary and fire prevention legislation and their attendant Codes of Practice, rules, regulations and recommendations which operate in their own Country and which apply to the list of premises and places in 1.1 above.

Paper 4 - Building Construction (Optional)

- 1. Fire loading**
- 1.1 Estimate the fire loading in buildings.
- 1.2 Discuss the consequences of differing fire loading in buildings.
- 2. Fire containment**
- 2.1 Define “elements of structures” and discuss in detail their fire resisting properties.
- 2.2 Discuss ways in which design standards are set and can be achieved for both materials and elements of structure.
- 2.3 Describe the methods by which materials and elements of structure are fire-tested, evaluated and reported upon.
- 2.4 Discuss the relationship between the fire testing of materials and a system of building control.
- 3. Protection of beams and columns from fire**
- 3.1 Describe the methods of protecting columns and beams of steel used in buildings.
- 4. Building design for fire safety**
- 4.1 Discuss the concept of compartmentation.
- 4.2 Describe methods of fire stopping and protection in the following:
- a) Ducting
 - b) Service voids
 - c) Suspended ceiling spaces
 - d) Cavities
 - e) Raised floors
 - f) Lofts and roof spaces
 - g) Shafts
 - h) Stair-wells
 - i) Conveyor openings
 - j) Doorways and other openings
 - k) Roof and wall junctions and other functions formed by elements of structure.
 - l) Atriums
- 4.3 Define conditions when openings may be permitted to allow services to pass through elements of structure.
- 4.4 Discuss the spread of fire both vertically and horizontally and the concept of space separation.
- 4.5 Discuss given examples of buildings and building techniques and their relationship with fire safety design.
- 5. Smoke and combustion products control and ventilation**
- 5.1 Discuss the flow of smoke and gases within buildings of differing designs and describe the mechanisms available, both natural and mechanical, for controlling this flow.
- 5.2 Describe the design criteria and operation of roof and wall vents and discuss the effect these have on control and venting of smoke and gases.
- 5.3 Discuss the design and operation of screens, curtains and other devices used for the control of smoke and gases.
- 5.4 Describe the use of pressurisation as a means of controlling the flow of smoke and gases.
- 5.5 Discuss in detail the relative merits of control, dispersal and venting systems used to control smoke and combustion products.
- 6. Access for firefighting vehicles**
- 6.1 Discuss in detail the need to provide adequate access to buildings for firefighting vehicles with particular reference to:
- a) Differing sizes of buildings
 - b) Road widths and loadings
 - c) Vehicle turning circles
 - d) Approach distances to building entrances
 - e) Amount of perimeter access
 - f) Affect of fixed installations in buildings on access
 - g) Proximity of buildings
- 7. Services in buildings**
- 7.1 Describe in detail methods used to extract vapour and fumes.
- 7.2 Describe in detail the methods used for supplying buildings with compressed air and other piped gases.
- 7.3 Discuss the installation and use of fire lifts in a building.
- 7.4 Discuss the installation and use of conveyors, shutters and refuse disposal systems in a building.

- 7.5 Outline the methods of providing fixed fire equipment in a building.

Paper 5 - Human Resource Management (Compulsory)

- 1. Planning, control & review**
- 1.1 Detail the responsibilities of the manager in connection with the needs of customers and suppliers, external and internal to the organisation:
- 1.2 Describe how planning methods can be adopted to achieve productive results.
- 1.3 Explain how the keeping of records relating to work methods and health & safety, can provide a basis for continuous improvement.
- 1.4 Describe how leadership of individuals and team members can influence control.
- 2. Quality management**
- 2.1 Identify the role of the manager in providing quality satisfactions.
- 2.2 Describe how to implement planning systems and procedures, which seek to achieve quality outcomes.
- 2.3 Explain how to monitor and control quality and take necessary steps to improve it.
- 2.4 Discuss how leadership support of individuals and team can be provided.
- 3. Use and control of resources**
- 3.1 Describe the role of the manager to use resources efficiently:
- a) The concept of effective resource management.
 - b) How poor resources can affect performance.
 - c) Information and communication systems in relationship to resource control.
 - d) Analysis techniques using past data to predict future resource requirements.
 - e) Typical resource problems and how they might be overcome.
- 4. Development of personal management style**
- 4.1 Identify the support you would require implementing an action plan for self-development.
- 4.2 Describe why work is delegated, how to delegate and how to monitor performance.
- 4.3 Discuss how to assess available information to ensure effective decision taking.
- 4.4 Recognise negative forms of behaviour that are likely to occur if team members are not kept well informed.
- 4.5 Draw up a chart for an organisation management structure and lines of command.
- 4.6 Define the responsibilities and accountabilities of one of those to whom they report.
- 5. Recruitment and selection**
Within the role of a manager.
- 5.1 Specify the information required to write a job description and person specification for a specified job.
- 5.2 Identify the factors, which should be, considered in establishing personnel requirements, with whom and how they should be discussed.
- 5.3 Discuss candidate feedback into the process, with provision for further development and reviews and improvement of the selection process.
- 6. Planning and controlling the work of teams and individuals**
- 6.1 Explain the importance of equal opportunities in Human Resource Management.
- 6.2 Detail a work plan, which is consistent with organisational objectives and policies.
- 6.3 Describe a system, which encourages team members to become involved in work allocation.
- 6.4 Identify a method of minimising the impact of cost and time in changes to work situation.
- 7. Managing the performance of teams and individuals**
- 7.1 Review a disciplinary and grievance procedure, which includes recording mechanisms and comment on the authority and responsibilities of the manager within the procedure.
- 7.2 Discuss a specific incident in which a team member had a problem which was causing poor work performance and describe how well it was handled.

8. Meetings and decision making

- 8.1 Detail the functions and limitations of meetings; decision making within the role of a first line manager.
- 8.2 Discuss the information required in respect of major decisions made by managers, commencing on the importance of accuracy, relevance and sufficiency of that information.
- 8.3 Analyse a given information system and make recommendations to improve it.
- 8.4 Describe different types of meeting explaining the purpose of each and identifying typical objectives for each type.
- 8.5 Explain different styles of leadership, and describe typical scenarios encountered in meetings, where they could be used.
- 8.6 Describe decisions, which are best, made during a meeting of managers and explain why.

9. Human Resources

- 9.1 Describe in detail the manager's role in relation to:
- Job analysis
 - Job evaluation
 - Employee relations
 - Training and Employee development
 - Morale
 - Health, Safety and Welfare

Paper 6 - Fire Service Operations (Optional)

1. Command and Control

- 1.1 Discuss in detail the purpose of pre planning and demonstrate an ability to produce a pre plan for any specified emergency.
- 1.2 Describe in detail and discuss the principles for general control, fireground tactics and fireground strategy.
- 1.3 Explain in detail the need for evacuation at fires, emergency incidents and major disasters and discuss how this can be achieved.
- 1.4 Detail the strategy and tactics involved in rescue work and discuss how they are used in practise to effect efficient rescues.
- 1.5 Describe in detail and discuss procedures for ensuring the safety of both personnel and public.
- 1.6 Explain the objectives of ventilation at fires and describe in detail the principles involved.
- 1.7 Discuss the aims of salvage/damage control operations and describe in detail the principles and technicalities involved.
- 1.8 Discuss the techniques of fire investigation into the cause, and damage that is inflicted by fire, emergency incident or major disaster.
- 1.9 Show an understanding of the indirect socio-economic consequences of fires, other emergency incidents and major disasters.
- 1.10 Describe the inter relationship of logistics operations and technical support incidents.
- 1.11 Discuss in detail environmental effects and control measures in relation to fires
- 1.12 Describe in detail the different types of firefighting media and equipment.
- 1.13 Discuss in detail the firefighting procedures and tactics in fires involving hazardous materials.

2. Firefighting Vehicles and Appliances

- 2.1 Discuss the design, construction and operation of any vehicle to be used for fire and rescue purposes.
- 2.2 Demonstrate an understanding of how a specification for an emergency vehicle or appliance is produced.
- 2.3 Discuss the design, construction and operation of fire boats and other water-borne appliances.
- 2.4 Discuss the use of other modes of transport that may be utilised for emergency or firefighting purposes.
- 2.5 Demonstrate an ability to produce outline research proposals for the investigation of problems that may be encountered in the design, construction and operation of appliances, the equipment they carry and the incidents they may attend.
- 2.6 Demonstrate an ability to programme an equipment design and evaluation system and to implement the introduction of successful equipment.

3. Incidents Involving All Sorts of Transport; Road, Rail (including underground and vernicular) Shipping and Air.

- 3.1 Discuss in detail firefighting and emergency procedures for transport incidents including:

- Incidents at stations, interchanges, docks and airports
 - Incidents in populated areas
 - Incidents in rural or remote areas
 - Rescue
 - Special hazards which may be encountered
- 3.2 Describe the design and construction of the following types of ships:
- General cargo
 - Container
 - Chemical and gas carriers
 - Bulk carriers
 - Passenger vessels including liners
 - Warships
- 3.3 Explain the measures incorporated into ships to provide fire detection and protection.
- 3.4 Demonstrate an understanding of the concept of stability and outline the procedures for ensuring stability during firefighting operations.
- 3.5 Outline the factors relevant to ship firefighting both in ports and at sea.
- 3.6 Describe the general features of railways.
- 3.7 Describe the types, design and construction of trains and rolling stock.
- 3.8 Discuss in detail firefighting and emergency procedures for railway incidents.

4. Communications

- 4.1 Discuss in detail the importance of good communications for both emergency and non-emergency purposes within the modern fire service
- 4.2 Discuss the planning, design, operation and functions of control centres suitable for emergency services.
- 4.3 Discuss the methods by which stations can be alerted from a control centre.
- 4.4 Describe the various types of radio schemes and systems for fire service general and fireground use.
- 4.5 Discuss the use of computer aided mobilising systems
- 4.6 Discuss possible future developments in the use of technologically advanced systems for mobilisation and communications.

Paper 7 - Aero Studies (Optional)

1. Provision for fire-fighting and rescue facilities at airports and airfields.

- 1.1 Explain in detail the concepts of critical areas and control
- 1.2 Outline the training requirements of rescue and fire-fighting personnel
- 1.3 Outline the features to be taken into account when designing and providing airport fire stations
- 1.4 Explain in detail the specifications & considerations to be taken into account when designing and providing new airport fire appliances

2. Fire protection of airport buildings.

- 2.1 Explain the determination of the size of an airport terminal building and its facilities
- 2.2 Discuss the design features of air freight and cargo terminals
- 2.3 Explain the classifications and protection of aircraft hangers

3. Emergency planning and procedures

- 3.1 Explain the purpose of pre-planning for emergencies
- 3.2 Outline the need for emergency planning within the immediate community
- 3.3 Detail the role of each emergency service at the scene of an aircraft accident
- 3.4 Discuss the problems of command and control in the early stages of a major civilian aircraft accident
- 3.5 Detail the principles of good site management at the scene of a major aircraft accident
- 3.6 Explain the strategic, tactical and operational levels of command and control, giving examples of each

4. Post accident procedures

- 4.1 Discuss the need for post accident counselling for rescue personnel
- 4.2 Show an understanding of the need to preserve the site and evidence and the gathering of other evidence

- 4.3 Discuss the removal and collation of personal effects and papers
- 4.3 Discuss the removal and moving of bodies including the recording of positions and locations
- 4.4 Detail the factors to be taken into account in setting up a temporary morgue
- 4.5 Describe the hazards of handling human remains at the site of a major aircraft accident and at the temporary morgue
- 4.6 Describe the health and safety legal considerations to be taken into account when planning and establishing a temporary morgue
- 4.7 Describe Critical Incident stress in the context of rescue workers and ways in which the effects can be minimised.

5. Training

- 5.1 Discuss how the lessons learned from aviation disasters in a country can be disseminated
- Nationally
 - Internationally
- 5.2 Describe the various methods of training available to test contingency and pre-determined emergency plans and how they can be improved
- 5.3 Discuss the salient points of organising a large scale exercise involving all responding emergency services to major aircraft disasters

6. Media

- 6.1 Discuss the role of a media centre at a major incident and the liaison agreements with the emergency services
- 6.2 Discuss liaison with the media before, during and after a major incident
- 6.3 Detail the factors to be considered in running a press conference during a major disaster

7. Environmental awareness

- 7.1 Discuss the prevention of pollution of water courses and rivers by collection and impounding of fire-fighting run-off water.
- 7.2 Discuss the environmental hazards associated with fire-fighting foams
- 7.3 Detail the hazards of vapour cloud /toxic gas cloud off site during and after fire or other operations.

8. Heliports

- 8.1 Define and show an understanding of the terms "obstacle limitation surfaces" and "Transitional surfaces"
- 8.2 Detail the main features to be considered in the designing of off -shore heliports
- 8.3 Explain in detail the concept of critical area as applied to helicopters.
- 8.4 Discuss response times for fire-fighting and rescue personnel at both surface level and elevated heliports

Paper 8 - Fire Investigation (Optional)

1. Effects of structures and their contents

- 1.1 Discuss the effects that the contents of a building has on fire, including:
- traditional furniture
 - modern furnishings
 - carpets and rugs
- 1.2 Discuss the concept of fire load density.
- 1.3 Describe the principles of Heat Release.
- 1.4 Define Law's law and express it as a mathematical formula.
- 1.5 Apply Law's law to practical situations.
- 1.6 Describe how ventilation in a building may affect a fire.
- 1.7 Describe the effect that the structure of a building has on fire.

2. Effects of occupancy and firefighting

- 2.1 Discuss the effects that the occupancy can have on a building involved in fire and in particular uses such as:
- factories
 - chemical works
 - hospitals and residential homes
 - schools
 - ships
- 2.2 Outline the effects of firefighting on the structure and contents of a building involved in fire.

- 3. Management of fire investigation**
- 3.1 Describe the communication pathways that are appropriate in the management of fire investigation.
- 3.2 Discuss the organisational aspects of fire investigation and produce a diagram of alternative fire investigation procedures.
- 3.3 Discuss the training of fire investigation officers and the contents and design of suitable courses.
- 3.4 Detail the personal safety factors that fire investigation officers need to take account of when carrying out fire investigations.
- 4. Collection of information**
- 4.1 Detail the type of information that is required by the following parties:
- Fire service
 - Police
 - Coroner
 - Insurance
- 4.2 Outline the ways and methods used to collect information and describe the advantages and disadvantages of each method.
- 4.3 Describe the recording of information relating to the positions of moveable objects and fire seat location.
- 4.4 Define the terms 'lay witness' and 'expert witness'.
- 4.5 Discuss the effective interviewing of a witness.
- 5. Locating the seats of fire**
- 5.1 Discuss the following factors that affect the accuracy in determining the location of a seat of fire:
- size of fire
 - flashover
 - smouldering
 - fire fighting procedures
 - localised fuel load
 - backdraught
- 5.2 Describe in detail the physical signs that can illustrate the general locality of a seat of fire and discuss their relative merits with particular reference to:
- low level burning
 - high level burning
 - smoke spread
 - wall patterning
 - glass fracture, melting, discolouration or staining.
 - melting and distortion of metals
 - melting and degradation of plastics
 - burning effects of timber
 - the arrow theory
- 5.3 Describe and discuss the value of the instrumental aids that are available to the fire investigator to detect hydrocarbons.
- 5.4 Describe in detail the indirect methods of locating the seat of fire with particular reference to:
- witnesses' observations
 - reversal of fire fighting
 - points of entry and exits
 - position of bodies
 - knowledge of materials present
- 5.6 Discuss the term 'apparent seats of fire' and be able to group them under specific headings.
- 5.7 Explain the need for excavation of the site.
- 5.8 Outline the need to reconstruct the site.
- 5.9 Describe the study of pre-fire events.
- 5.10 Explain the term 'Radius of error'.
- 5.11 Describe the approach to the excavation of the fire seat with particular reference to:
- extraneous items and materials
 - fire accelerants
 - liquid burn patterns
 - solid fire accelerants
- 5.12 Describe the approach to general excavation of the site.
- 6. Deductive evidence at the scene of fire**
- 6.1 Discuss how glass can provide evidence to assist in the investigation of a fire.
- 6.2 Discuss how smoke records can provide evidence to assist in the investigation of fire.
- 6.3 Describe how evidence can be gained from instrument marks, footwear impressions, and tyre marks (in cases of vehicle evidence).
- 6.4 Discuss the use of trace evidence found at fire scenes including directional evidence.
- 7. Fires involving fatalities**
- 7.1 Explain the fundamental features of an investigation when a person dies as a result of fire.
- 7.2 Describe the ways in which the deceased may be identified.
- 7.3 Discuss the evidence that needs to be collected to establish the location of death and when and how the deceased died.
- 7.4 Show an understanding of how people behave in fires.
- 7.5 Discuss the factors which would lead an investigator to recognise a death in fire as murder or suicide.
- 7.6 Display an understanding of basic medical terminology that may be encountered during an investigation and subsequent post-mortem.
- 7.7 Describe the points to consider when removing bodies at fire scenes.
- 8. Explosives and explosions**
- 8.1 Explain the types of explosions that may occur.
- 8.2 Describe the term 'High Explosives'.
- 8.3 Explain the term 'Condensed Phase Deflagration.'
- 8.4 Explain the term 'pyrotechnics'.
- 8.5 Describe the term 'dispersed explosion.'
- 8.6 Explain the term 'ventilation induced flashover'.
- 8.7 Describe container explosions.
- 8.8 Discuss the investigation of explosions.
- 8.9 Outline the materials that can be involved in explosions.
- 8.10 Explain the preservation of evidence of an explosion and outline a procedure for searching for a high explosive device.
- 9. Vehicle fires**
- 9.1 Discuss in detail car fires and their causes with particular reference to:
- moving car fires
 - accident induced car fires
 - stationary car fires
 - location of the seat of fire
- 9.2 Describe the examination of the vehicle for evidence.
- 9.3 Discuss in detail lorry fires and their causes with particular reference to:
- moving vehicle fire
 - accident induced fires
 - fires in stationary lorries
- 10. Heating, cooking and lighting**
- 10.1 Discuss the possible causes of ignition from the following:
- open fires
 - fixed gas fires
 - LPG cabinet heaters
 - paraffin heaters
 - radiant heaters
 - electric reflector and fan heaters
 - night storage heaters
- 10.2 Discuss the causes and recognition of fires in cooking appliances.
- 10.3 Discuss the possible causes of ignition in electrical lighting systems and lighting systems that involve naked flames.
- 11. Recognition of types of fire**
- 11.1 Describe the characteristics of fires with different origins.
- 11.2 Explain the reasons for suspecting arson as a cause of fire from the general circumstances.
- 11.3 Explain the reasons for suspecting arson at or after the investigation of the scene of fire.
- 11.4 Discuss the types of persons who set fires and explain the classification of them into certain groups.
- 12. Physical processes in fire**
- 12.1 Describe the physical processes involved in a fire with particular reference to:
- heat, temperature and the states of matter
 - heat transfer
 - flame height
 - upper layer temperature
 - radiative feed back
- 13. Electricity**
- 13.1 Show an understanding of the ways in which heat can be achieved in a circuit.
- 13.2 Explain how static electricity can become a possible source of ignition.
- 13.3 Discuss the recognition of electrical causes of fire
- 14. Chemistry of fire and flammable materials**
- 14.1 Outline the chemistry of fire and define the following terms:
- stoichiometric mixture
 - flammability limits
 - flash point and fire point
 - radiation induced flashover
 - flames
 - smouldering combustion
 - spontaneous combustion
 - spontaneous ignition temperature
 - autoignition temperature
- 14.2 Outline the properties of the following common flammable materials:
- methane, propane and butane
 - acetylene (ethyne)
 - hydrogen
 - petroleum products
 - paraffin
 - white spirit
 - diesel oil
 - ethanol (alcohol), methylated spirit, methanol (methyl alcohol) and isopropanol (2-propanol)
 - plastics and chemicals that are used in plastic manufacturing industries.
 - rubbers (natural and synthetic)
 - carbohydrates
 - cellulose
 - proteins
 - fats
 - wood
- 14.3 Show a detailed knowledge of the principles of estimation of temperatures attained.
- 15. Laboratory examinations**
- 15.1 Describe the taking and examination of fire debris samples with specific reference to
- the chain of continuity for law
 - avoidance of contamination.
- 15.2 Discuss the levels of involvement of the laboratory with regard to incendiary devices.
- 15.3 Explain the principles of laboratory examination of the following:
- containers
 - clocks and watches
 - hair and clothing
 - paint
 - other articles and evidence that may be found at a fire scene
- 16. Matches**
- 16.1 Describe in detail the main aspects of interest in the study of matches and show a knowledge of their physical and chemical properties in relation to establishing the causes of some fires.
- 17. Laboratory analysis**
- 17.1 Explain the principle of laboratory analysis of material and samples collected at the scene of fire with particular reference to:
- fuels and fire accelerants - hydrocarbons
 - fuels and fire accelerants - non-hydrocarbons
 - toxic combustion products
- 18. The expert witness**
- 18.1 Define the term expert witness.
- 18.2 Explain the division of evidence into functional parts.
- 18.3 Explain the rules against hearsay and the use of other persons evidence.
- 18.4 Describe how expert evidence is disclosed in criminal and civil court proceedings.

Paper 9 - Marine Fire Studies (Optional)

- 1. The law and fire on ships**
- 1.1 Outline the development of SOLAS rules from the Titanic through various agreements to present day.
- 1.2 Detail the role of classification societies in formulating Class Rules, national and international law.
- 1.3 Describe the responsibility for control on a vessel during firefighting, both at sea and in port.
- 1.4 Outline the role of a Port Authority.

- 1.5 Describe the Law of Salvage and the Liability for Loss, in relation to fires at sea.
- 1.6 Outline the implications of International Maritime Agreements.
- 1.7 Discuss the responsibilities of the International Maritime Organisation (I.M.O.) and the General Council for British Shipping (G.B.C.S.).
- 2. Provision for firefighting and fire protective measures aboard ships**
- 2.1 Outline the legislative requirements on board ships for fire pumps, fire mains, fixed firefighting systems and hoses.
- 2.2 Describe the legislative requirements for firefighters outfits and other protective equipment.
- 2.3 Discuss the provision of special firefighting and fire protection requirements for oil carriers, gas carriers, chemships, bulkers and hatchcoverless vessels.
- 2.4 Outline the discharge rates for foam systems, deck spray systems and powder systems.
- 2.5 Describe the features of the various fixed installations including the required concentrations for gaseous systems.
- 2.6 Discuss the requirements of SOLAS for 'A' and 'B' class fire resisting construction.
- 2.7 Describe the deployment of fire resisting divisions in cargo carriers and passenger vessels.
- 2.8 Detail the fire detection and fire alarm requirements on various vessels.
- 2.9 Detail the different ventilation systems and duct construction.
- 2.10 Discuss the need to arrange risks in cargo spaces and machinery spaces.
- 2.11 Explain the need for emergency power and the measures taken for its provision.
- 2.12 Describe the training requirements for ships personnel identified in the International Maritime Organisation Musters and Drill Regulations.
- 3. Ship construction**
- 3.1 Detail the materials normally used in ship construction.
- 3.2 Outline the variety in types of ships and briefly describe each.
- 3.3 Describe the features of hull structure.
- 3.4 Describe the requirements for accommodation fittings.
- 3.5 Discuss tanker construction (single hull, double hull).
- 3.6 Outline and explain the purpose of essential features such as cofferdams, double bottom tanks, deep tanks and holds.
- 3.7 Show a complete knowledge of the theory of stability and its importance in design.
- 3.9 Describe the various engines and machinery used on ships and outline their hazards.
- 3.10 Discuss the types of fuels used on ships and outline their characteristics.
- 3.11 Describe the legal requirements for permanent markings on each side of the hull.
- 4. Port/harbour facilities and emergency planning**
- 4.1 Discuss the difficulties presented by tidal ranges and dock facilities with lock entry.
- 4.2 Outline the provision of water mains and hydrants in typical ports.
- 4.3 Describe the firefighting capabilities of tugs and other harbour craft.
- 4.4 Explain the difficulties in access to quayside and wharf facilities.
- 4.5 Discuss the importance of liaison during firefighting with Port Authorities and the importance of prior crew familiarisation with port facilities.
- 4.6 Describe the dockside cargo handling facilities and their use during fire operations.
- 4.7 Describe the contents of general arrangement plans exhibited on vessels.
- 4.8 Explain the need to establish clear procedures for fighting fires on ships in ports/harbours.
- 4.9 Detail the principles of an emergency plan for fighting fires on ships in ports/harbours.
- 4.10 Describe the particular problems of dealing with incidents on vessels lying offshore.
- 4.11 Discuss access through entry ports and accommodation doors and the problems created by the height of the hull.
- 4.12 Discuss the use of ships derricks in bringing equipment on board ship.
- 4.13 Discuss the use of helicopters for transporting personnel and equipment.
- 4.14 Describe the special training needs of firefighters when, working with helicopters.
- 4.15 Describe the IMDG: Codes for Dangerous Goods and the emergency schedules produced for various substances.
- 4.16 Discuss the training requirements to enable personnel to have knowledge of stowage requirements to carry various classes of goods.
- 4.17 Discuss the need for pre-determined attendances to vary according to the type of incident and type of vessel.
- 4.18 Discuss the feasibility of using tugs and other small craft as a means of transportation of personnel and equipment.
- 4.19 Discuss the importance of the provision of a detailed fire plan, the ships fire wallet and the need for incident pre-planning.
- 4.20 Discuss the training, operational and financial implications facing a fire authority when adopting an airborne approach to ship fires.
- 5. Firefighting procedures and techniques**
- 5.1 Discuss the need for effective liaison with ships officers.
- 5.2 Discuss the need to assess stability of the vessel and the dangerous effects of free surface water.
- 5.3 Describe the hazards of fire spread in vessels and the need for effective boundary cooling.
- 5.4 Describe in detail the hazards and procedures associated with engine room fires.
- 5.5 Describe in detail the hazards and procedures associated with fires in accommodation spaces.
- 5.6 Describe in detail the hazards and procedures associated with fires in holds.
- 5.7 Describe in detail the hazards and procedures associated with fires on tankers.
- 5.8 Describe in detail the hazards and procedures associated with fires in containers.
- 5.9 Describe the benefits of utilising on board extinguishing systems to prevent the spread of fire.
- 5.10 Discuss the problems of ventilation on ships.
- 5.11 Discuss the use of breathing apparatus and airline equipment and the adoption of effective search and rescue procedures.
- 5.12 Outline the problems in recognising the dangerous goods and implementing an appropriate response.
- 5.13 Explain the duties of a Ship Stability Officer and the need for a dedicated crew. Outline the duties of a ship stability crew.
- 5.14 Discuss the problems that arise in maintaining stability when injecting water into ships.
- 5.15 Discuss the methods that can be employed for injecting and removing water from holds and compartments.
- 5.16 Detail the information required to clearly record the ships stability status during firefighting operations.
- 5.17 Discuss the advantages and disadvantages of utilising high expansion foam as an extinguishing media for fires in engine rooms and holds.
- 5.18 Describe the functions of a fireboat, the equipment carried and the value of utilising fireboats whilst firefighting.
- 5.19 Show an understanding of how to carry out an investigation into the causes of fire on board indicating the liaison required with other authorities and agencies.
- 5.20 Outline the methods of fire investigation on board and identify any variations from land based investigations.
- 5.21 Discuss the operational and logistic implications of firefighters being exposed to high temperatures when ship firefighting.
- 5.22 Show an understanding of the effect of high temperatures on the efficient and safe management of a large scale incident.
- 6. Naval vessels**
- 6.1 Outline the variety of special types of naval vessels including Fleet Auxiliaries.
- 6.2 Discuss the problems associated with the carriage of ammunition and weaponry.
- 6.3 Discuss the problems associated with nuclear power plants.
- 6.4 Describe the responsibility of the fire brigade officer with respect to incidents on RN ships in ports.
- 6.6 Outline the priorities of naval firefighting, its aims and techniques and how they differ from the fire brigades.
- 6.7 Explain the role of the Navy during an incident on a naval ship and compare with that of the Fire Brigade.
- 6.8 Outline a typical incident on a naval ship and the structure at various points employed for effective incident command and control.
- 7. Offshore Platforms**
- 7.1 Outline the different types of platforms in use including fixed, mobile and semi-submersibles.
- 7.2 Explain the construction of platforms in use.
- 7.3 Describe the arrangements of production facilities on both oil and gas platforms.
- 7.4 Describe the arrangements of accommodation structures and the safety features built into their design.
- 7.5 Outline the anchoring and ballasting systems employed on the various platforms.
- 7.6 Discuss the pump and firemain requirements for platforms.
- 7.7 Outline the fixed installations employed on platforms together with firefighting equipment.
- 7.8 Describe the special fire protective provisions found on helidecks.
- 7.9 Discuss the fire resisting compartmentation and risk separation structures found on platforms.
- 7.10 Describe arrangements for assisting companies in the event of a fire offshore, specifically regarding any legal obligations.
- 7.11 Outline the legal obligations placed on operators to ensure personnel are effectively trained in firefighting techniques.

Paper 10 - Petrochemical Fire Studies (Optional)

- 1. Petrochemical processes**
- 1.1 Describe one distillation/separation process, one cracking or reforming process, one extraction process and one polymerisation process. Candidates to be able to give an outline of the chemical and physical processes involved, typical temperatures and pressures used, the feedstocks used and the output products.
- 1.2 Show an understanding of the range of products made by refinery and petrochemical plants, and give examples of how they are used as fuels, to make plastics/fibres, and in the manufacture of other chemicals.
- 1.3 Explain the term catalyst, and give an example of how they are used in refinery or petrochemical plants, and explain why they might influence the fire/explosion risks associated with such plants.
- 2. Formation and characteristics of flammable gas/air mixtures**
- 2.1 Describe how the vapour pressure of a flammable liquid varies with the temperature, and relate this to the flash point of a liquid.
- 2.2 Describe how the flammable limits of a flammable liquid vary as the temperature changes.
- 2.3 Describe the effect of mixing liquids of different boiling points on the vapour pressure, and relate this to what happens when such a mixture is spilt.
- 2.4 Give examples of the use of inert gases for making safe process or storage plant, and describe the range of gases that are commonly used in petrochemical plants.
- 2.5 Describe methods used for the determination of flash point of a liquid, and how these are used in setting regulations for international transport
- 2.6 Describe what happens when a petrochemical normally stored as a liquid under pressure is suddenly released.
- 2.7 Describe how products may be compared, either by a minimum ignition temperature, or by minimum (spark) ignition energy.
- 3. Sources of ignition and mechanisms of ignition of petrochemical gases and vapours**
- 3.1 Describe the range of ignition sources that may exist on a chemical plant. Give examples of the precautions that are used to control these sources of ignition

- 3.2 Explain the dangers associated with lagging soaked in spilt product, products released as a mist or spray, and furnaces or other equipment for controlled combustion.
- 3.3 Distinguish between ignition sources controlled by good selection of equipment, and those controlled in other ways.
- 4. Fire safety in refineries and petrochemical plants**
- 4.1 State the principles of:
- The safe storage of feedstocks and products including consideration of the safe layout, design and operation of tank farms.
 - The safe filling and loading of products including consideration of the safe layout, design and operation of loading facilities for the loading of road and rail tankers with liquid, liquified and gaseous products.
 - The safe operation of refinery flare stacks under both normal and abnormal plant conditions.
- 5. Safe methods of work**
- 5.1 State the principles of:
- Permits to work and hot work permits.
 - Safe maintenance of refinery plant.
 - The safe draining, purging and maintenance of tanks and storage vessels, including tanks containing solid residues.
 - The safe control of outside contractors working on site.
- 6. Electrical safety**
- 6.1 Describe the principles of hazardous area classification of refinery plants, and explain the terms zone 0, 1 and 2.
- 6.2 Describe the purpose of a hazardous area classification, and how it may be used; for the selection of fixed electrical equipment, for the control of vehicle movements, and during maintenance activities.
- 6.3 Give examples of the ways in which electrical equipment may be made safe for use in a hazardous area, and the factors that need to be considered in making a selection of equipment for a particular location
- 6.4 Describe the marking of electrical equipment for use in hazardous areas
- 6.5 Be able to discuss the selection of electrical equipment to be installed in the open air, or that may be exposed to dusty atmospheres. Show an understanding of the marking scheme for such equipment.
- 6.6 Describe ways in which static electricity may build up and form a hazard, and the precautions needed to control this risk, in particular during pumping of liquids, splash filling of tanks, during steam cleaning, and during pneumatic transfer of polymer powders or granules.
- 6.7 Discuss the hazards of lightning strikes and the methods available for the protection of plant.
- 6.8 Describe the safe maintenance of electrical equipment in petrochemical plants.
- 7. Firefighting in petrochemical plants**
- 7.1 Organisation and training of refinery fire brigades.
- 7.2 First Aid Fire Fighting:
- Selection and siting of first aid fire fighting equipment
 - Training of operatives in the use of first aid fire fighting equipment.
- 7.3 Water supplies:
- Quantities of water required
 - Fixed fire pumps, location and sizing
 - Water mains and hydrant systems
- 7.4 Fixed fire fighting systems
- Water systems
- Foam systems
- Foam concentrates - types, characteristics, uses and choice
 - Foam making systems
 - Foam delivery systems - Description and uses, advantages and disadvantages
- Fixed pourers
- Mobile monitors
- Portable foam towers
- Fixed sub-surface systems
- Dry powder systems
- Gas/vapour systems
- 7.5 Special fire fighting problems
- Floating roof tanks

- Marine tanker loading/unloading jetties
- 8. Major disaster planning both on site and off site**
- 8.1 Be able to outline any local legislation relating to major disasters; or describe the risks associated with 3 of the following,
- the failure of an LPG pressure storage tank exposed to fire
 - the rollover of refrigerated gas storage
 - the boil over of a tank during fire fighting operations
 - a release of a large volume of toxic gas
 - the release of a large cloud of flammable gas/vapour
 - the ignition of a flammable mixture inside a pipeline.
- 8.2 Be able to discuss ways in which good preplanning may be able to reduce the consequences of a major incident.
- 8.3 Describe the causes and consequences of a major incident involving refinery or petrochemical plant.
- 9. Environmental aspects of petrochemical firefighting**
- 9.1 Discuss the problems associated with firefighting on refinery sites, in particular showing an understanding of the problems caused by the use of very large quantities of water, problems caused by products which may float on or dissolve in water or block drains, the pollution of rivers and the sea by large quantities of material which may damage the environment, and discuss ways of minimising these problems.

Paper 11 - Civil Emergency and Disaster Management (Optional)

- 1. Local authority contingency planning**
- 1.1 Describe the role of Local Authorities and Government in civil emergencies and the need for liaison.
- 1.2 Describe the functions of an Emergency Planning Officer (or equivalent).
- 1.3 Detail the legal obligations of the Local Authority in dealing with major civil emergencies.
- 1.4 Discuss the planning principles involved in mitigating the effects of civil emergencies.
- 1.5 Describe what is meant by an Integrated Approach to emergency management and discuss its practicalities.
- 1.6 Detail the responsibilities of Local Authorities and the processing industry with regard to large scale chemical emergencies.
- 1.7 Explain the term 'Combined Response' and list the principles in establishing effective 'Call-Out' arrangements.
- 1.8 Produce a model for a co-ordinated approach to Disaster Management and outline Key accountabilities.
- 1.9 Discuss the parameters of major civil emergencies and disasters and whether a definition should be prescribed.
- 1.10 Detail the main differences in planning for wartime and peacetime contingencies.
- 1.11 Discuss the merits of computer modelling in contingency planning for a large processing plant.
- 1.12 Define 'Emergency Planning' and highlight the core aspects.
- 1.13 Discuss the 'Core' aspects of a contingency plan for a local authority in dealing with a major civil disaster.
- 1.14 Discuss the attributes of planning against other forms of preparedness.
- 1.15 Describe the role of a Civil Emergencies advisor.
- 1.16 Discuss whether there should be a statutory duty for local authorities to undertake Civil Emergency planning. Describe the advantages and disadvantages of such a duty.
- 1.17 Detail other Government departments or agencies which should or could be involved in the response to:
- Rail accident
 - Aircraft accident
 - Chemical accident
 - Coastal or Inland waterways pollution incident
 - Severe storms
- and describe their role.
- 2. Disaster management**
- 2.1 Detail the role of the Police, and other emergency services at the scene of a major incident.
- 2.2 Discuss the problems of command and control in the early stages of a major civil disaster.
- 2.3 Detail the principles of good site management at the scene of a major civil disaster.
- 2.4 Explain the strategic, tactical and operational levels of command and control and give an example of each.
- 2.5 Describe the relevance of risk assessment in managing major civil emergencies and highlight the significant factors involved.
- 2.6 Discuss the principles of co-ordination between local authorities and the statutory emergency services at a civil disaster.
- 2.7 Describe the 'Lead Department' approach to disaster management as applied by government and detail the function of Regional Emergency Committees (REC's).
- 2.8 Discuss the role of government in responding to an international disaster overseas.
- 2.9 Describe the operational difficulties that emerge in the early stages of disaster response where an act of terrorism is suspected.
- 2.10 Discuss the sub-cultures associated with disasters.
- 2.11 Define the term 'Disaster'.
- 2.12 Detail the phases of disaster and explain the interaction of agencies involved in each.
- 2.13 Describe the various communications options available in a major disaster/civil emergency and the means for ensuring their availability.
- 3. Training**
- 3.1 Discuss how the lessons learned from disasters in a country can be disseminated (i) nationally and (ii) internationally
- 3.2 Describe the various methods of training available to test contingency plans and how these may be improved.
- 3.3 Describe the key training topics which should form the core of successful planning objectives in disaster preparedness.
- 3.4 Describe the factors that need to be considered when undertaking a Cost Benefit Analysis of a large scale exercise compared to other forms of training.
- 3.5 Detail the methods of training for the strategic, tactical and operational levels of command and comment on their suitability.
- 3.6 Discuss the salient points of organising a large scale exercise involving a local authority and other agencies in responding to a major aircraft disaster.
- 3.7 Detail the safety considerations to be given to the management of a major incident and the implications for training.
- 4. Voluntary assistance**
- 4.1 Detail the role of the voluntary organisations in the primary response to major civil emergencies.
- 4.2 Discuss how the contribution of volunteers can be maximised during the various phases of disaster.
- 4.3 Detail the principles of good site management at the scene of a major civil disaster in co-ordinating the activities of voluntary and other support agencies.
- 4.4 Show by schematic means the core aspects in which organised volunteers can assist the statutory authorities involved in disaster response.
- 4.5 Describe how the voluntary agencies can optimise their skills and resources in dealing with a civil emergency lasting several weeks.
- 5. Support for Victims and Rescuers**
- 5.1 Discuss the social impact of disasters and discuss the means of control and mitigation.
- 5.2 Describe the effects of disasters on communities and how this can be ameliorated.
- 5.3 Detail how communities can be helped in the recurring phase of disasters and whether Local Authorities should take the lead role.
- 5.4 Discuss how rescuers can be affected by disasters.
- 5.5 Explain the difficulties in dealing with the victims of a major civil disaster remote from the centre of population.
- 5.6 Describe the function of the Police Casualty Bureau and identify any overlap of function which could take place.
- 5.7 Explain Post Traumatic Stress Disorder and the reasons for both public and rescuers becoming affected.

- 5.8 Describe Critical Incident Stress in the context of rescue workers and ways in which the effects can be minimised.
- 5.9 Explain the 'Bellwin' scheme in relation to the financial recovery of communities.
- 5.10 Describe the difficulties that can emerge in establishing a Disaster Fund.
- 5.11 Describe the direct and indirect losses to the community that can occur following a major civil emergency.
- 6 Information and the media**
- 6.1 Describe the role of the media at major disasters and the methods you would use to optimise their use.
- 6.2 Discuss liaison with the media before, during and after a major disaster.
- 6.3 Describe the role of the Media Centre at a major incident and the liaison arrangements with the emergency services.
- 6.4 Describe the role of the Press Officer within the local authority and how best to optimise this as a resource.
- 6.5 Detail the role of the Central Office of Information (COI) in supporting local press liaison officers.
- 6.6 Describe the operational logistics of the mass media at a major incident and appropriate control of their attendance.
- 6.7 Explain the means of self regulating the media to minimise the effects on a traumatised community.
- 6.8 Detail the immediate needs of the media in the early stages of civil disasters.
- 6.9 Detail the factors to be considered in running a Press Conference during a major disaster.
- 7 Victim identification and recovery**
- 7.1 Describe the methods used to identify dead bodies. Discuss the relative merits associated with each.
- 7.2 Describe the role of the Forensic Scientist in the identification of bodies.
- 7.3 Detail the factors to be taken into account in setting up a temporary mortuary.
- 7.4 Describe the role of the Coroner or relevant legal system in disaster work and the legal powers in preserving evidence.
- 7.5 Describe the hazards of handling human remains at the site of a disaster and at the temporary mortuary.
- 7.6 Detail the role of the embalmer/funeral director in a mass disaster.
- 7.7 Discuss the advantages and disadvantages of relatives viewing the remains of victims of a mass disaster.
- 7.8 Describe the role of the pathologist in a disaster.
- 7.9 Discuss the importance of understanding religion, race and culture when discussing death with relatives of disaster victims.
- 7.10 Discuss the work of Forensic Odontology at a major disaster and describe the problems that severely dismembered bodies present in identification.
- 7.11 Describe the health and safety legal considerations to be taken into account when planning and establishing a temporary mortuary.
- 1.5 Draw the circuit for a simple potential divider network and:
a) calculate the output voltage.
b) calculate the effects of loading the potential divider.
c) describe methods of overcoming the loading problem.
- 1.6 Recognise the difference between AC (alternating current) and DC (direct current) wave forms and select from a list those effects of DC and AC appropriate to a coil.
- 1.7 Select a simple phase diagram representing the resultant phase difference between current and voltage for circuits with inductive and/or capacitive loads. Recognise a correct statement relating the true power in an AC circuit to its power factor.
- 1.8 Calculate:
a) the losses in electrical conductors due to resistance.
b) the power losses in electrical conductors due to resistance.
- 1.9 Appreciate the need for a logarithmic scale of measurement when dealing with large attenuation, quoting dB values against the ratio of input and output.
- 1.10 Recognise typical dB values associated with typical communication applications.
- 2. Radio theory**
- 2.1 Describe the characteristics of HF (high frequency), VHF (very high frequency) and SHF (super high frequency) propagation, including the variation of radio coverage, reception of foreign stations and adjacent channel interference.
- 2.2 Select appropriate frequency bands for wide area communications and person to person communications.
- 2.3 Discuss the component modules of a basic radio system and describe their interaction. Compare conventional radio systems with trunked radio systems. Discuss and compare methods of modulation.
- 2.4 Distinguish between and list the applications of 'simplex', 'duplex', 'single frequency working' and 'double frequency working'.
- 2.5 Describe and compare the methods by which central sites may be linked to remote radio sites.
- 2.6 Describe the main features of digital and analogue radio systems for both conventional and trunked formats.
- 2.7 Describe:
a) the need for a radio control system.
b) the techniques used to overcome interaction and distortion between transmitters in audio phasing, quasi-synchronous phasing and best signal selection.
- 2.8 Define the correct aerial type for mobiles, fixed sites, radio links and portable equipment, showing an understanding of the requirement for correct length and positioning of the aerial.
- 2.9 Sketch the appropriate polar diagrams for various aerial types.
- 2.10 Discuss the methods of establishing wide area coverage for communication with mobiles. Discuss local coverage techniques and how the range of hand portable equipment may be improved by increasing the power, gaining height to improve signal path and the use of repeaters.
- 2.11 Identify the stages used to convert an analogue to digital signal. Identify the bit rate for a telephony circuit, to PDH (plesiochronous digital hierarchy) line systems and SDH (synchronous digital hierarchy).
- 2.12 Discuss the constraints imposed on radio system design and operation imposed by national and international legislation.
- 3. Command and control**
- 3.1 Discuss the planning, design, operation and function of a fire service control centre.
- 3.2 Describe the ergonomic factors to be considered when designing a control room layout.
- 3.3 Describe the environmental factors that influence the choice and positioning of equipment, including legislation and health and safety implications.
- 3.4 Explain how a specification for a control centre is produced.
- 3.5 Detail a method by which an equipment design and evaluation system is produced for the provision of new equipment.
- 3.6 Describe the methods used to specify and evaluate maintenance arrangements.
- 3.7 Explain the 'core' activities undertaken by fire service control centres and discuss other 'non core' activities which may be carried out.
- 3.8 Discuss in detail:
a) risk areas
b) pre-determined attendance
c) special attendance
d) special operational measures produced as part of incident pre-planning
- 3.9 Discuss the arrangements for providing alternative control room facilities for use in the event of evacuating the main control centre.
- 3.10 Discuss the implications for control centres to earn income for fire authorities.
- 3.11 Discuss the design, operation and facilities of a mobile control unit.
- 4. Communications**
- 4.1 Describe the methods by which calls from the public and other sources are passed to a control centre.
- 4.2 Discuss the methods by which a fire station can be alerted from a control centre.
- 4.3 Describe the concepts of cellular telephone networks and their application to emergency service use.
- 4.4 Describe the principles and methods by which data may be exchanged with mobile resources.
- 4.5 Discuss the implications and use of AVLS (automatic vehicle location systems).
- 4.6 Outline the philosophy and features of a common protocol used by central sites to communicate with remote locations.
- 4.7 Describe the principles, standards and criteria for using radio and data equipment in hazardous environments.
- 4.8 Discuss the factors affecting the installation of radio and data equipment in fire service vehicles.
- 4.9 Discuss the application of CCTV (closed circuit television) in operational emergency situations.
- 4.10 Explain the application of telemetry to fire service operations.
- 4.11 Describe the equipment, on fire stations, available as part of the mobilising system.
- 5. Information technology**
- 5.1 Discuss the use of computer aided mobilising systems.
- 5.2 Discuss the architecture of computer networks including their relationship to each other.
- 5.3 Discuss the principles and methods of providing information held on fire service databases to control centres and mobile resources.
- 5.4 Explain the fire service use of GIS (graphical information systems).
- 5.5 Discuss the use of computer software to meet fire service needs.
- 5.6 Discuss the use of client/server applications within the fire service.
- 5.7 Discuss the possible future developments in the use of technological advances in mobilising systems and equipment.

Paper 12 - Communications (Optional)

1. Theory

- 1.1 Describe:
a) the properties of sound waves with reference to loudness, pitch, quality, noise and notes.
b) the sound response of the human ear.
c) how intensity varies with distance.
d) the method used to measure sound intensity.
- 1.2 Describe:
a) the principles of wave motion including the relationship between amplitude, wavelength and frequency.
b) the nature and uses of electromagnetic waves including the relative wavelength, frequencies and uses of electromagnetic waves of different wavelengths.
- 1.3 Show an understanding of the principles of electrical circuits and the units associated with basic electrical quantities.
- 1.4 Select and apply formulae to the relationship between voltage, current and resistance and voltage, current and power.

Mathematics

The syllabus for the mathematics 'package' has been included to provide a base for Members who wish to transfer onto the first year of a university Fire Engineering degree course and to satisfy some of the requirements of the Engineering Council Division.

In the past students have been disadvantaged by their lack of mathematic skills at degree entry level, and the Engineering Council does specify that universities should only accept students onto their courses, and therefore into their grades of membership, who have reached a specified level in mathematical competency.

As a consequence of this, the Institution's Education Committee, together with the Syllabus Review Sub Committee, have decided to include in its new draft syllabus for examinations from 2003 onwards, a mathematics paper. This paper has been designed as a single independent unit within the Membership examinations syllabus.

This means that the paper will not count towards the Membership qualification but will be offered within the framework and administrative structure of the Institutions examinations. There will be no pre-qualifications required for taking the examination, and it is strongly recommended that it is only for those who are already full Members of the Institution and are about to embark on a university course.

Candidates are also reminded that universities may also ask for other standards for entry and prospective degree students should always check on the entry qualifications required.

The mathematics paper, as described above, is only one way of satisfying entry criteria to any degree course and universities may also accept a range of qualifications which will be equally acceptable i.e. 'A' level or higher mathematics, BTEC Mathematics units at the appropriate level, distance learning mathematics foundation level courses (Open University style), pre-entry level courses etc.

Applicants to take the examination will be asked for each year during the annual examination cycle and if there are sufficient candidates, an examination will be planned. Dependant upon the number of applicants each year, an examination may or may not be set and it might only be possible to have either one or a few centres nominated for candidates to attend for the examination. In the case of non-UK candidates, the Institution will endeavour to integrate the examinations into the usual examination centres used in any particular country. However, if there are insufficient candidates or interest shown in any particular year, then the examination will not be held.

It is predicted that there will only be a small take up of this particular examination and because of this, the Institution and its Education Committee will exercise judgement whilst using flexibility in the delivery of the examination.

The guide to the study material required for this examination is contained in the reading list which is available from IFE Headquarters.

Mathematics Paper

1. Arithmetic

- 1.1 Classify numbers
- 1.2 Explain the BODMAS rule for adding, subtracting, multiplying and dividing arithmetical expressions
- 1.3 Show how to write a number to a given number of significant figures
- 1.4 Show how to write a number to a given number of decimal places
- 1.5 Explain the terms 'highest common factor' and 'lowest common multiple'

2. Fractions

- 2.1 Explain how to add, subtract, multiply and divide fractions
- 2.2 Define the terms "improper fraction", "proper fraction" and "mixed fraction"

3. Percentage and ratio

- 3.1 Explain the terms 'percentage' and 'ratio'
- 3.2 Show how to perform calculations using percentages and ratios

4. Algebra

- 4.1 Explain what is meant by 'algebra'
- 4.2 Introduce important algebraic notations

- 4.3 Explain what is meant by a 'power' or 'index'
- 4.4 Explain what is meant by a 'formula'

5. Indices

- 5.1 State the three laws of manipulating indices
- 5.2 Show how expressions involving indices can be simplified using the three laws
- 5.3 Explain square roots, cube roots and fractional powers
- 5.4 Explain "scientific notation" for representing very large and very small numbers concisely

6. Simplifying algebraic expressions

- 6.1 Describe a number of ways in which complicated algebraic expressions can be simplified

7. Factorisation

- 7.1 Explain what is meant by the 'factors' of an algebraic expression
- 7.2 Show how an algebraic expression can be factorised

8. Algebraic fractions

- 8.1 Explain how to simplify algebraic fractions by cancelling common factors
- 8.2 Explain how algebraic fractions can be multiplied and divided
- 8.3 Explain how algebraic fractions can be added and subtracted

9. Transposing formulae

- 9.1 Explain how formulae can be rearranged or transposed

10. Solving equations

- 10.1 Explain what is meant by an equation and its solution
- 10.2 Show how to solve linear, simultaneous and quadratic equations

11. Functions

- 11.1 Explain what is meant by a function
- 11.2 Describe the notation used to write functions
- 11.3 Explain the terms 'independent variable' and 'dependent variable'
- 11.4 Explain what is meant by the inverse of a function

12. Graphs of functions

- 12.1 Show how to draw a graph of a function
- 12.2 Explain what is meant by the domain and range of a function
- 12.3 Explain how to use the graph of a function to solve equations

13. The straight line

- 13.1 Describe some special properties of straight-line graphs
- 13.2 Explain the equation $y = mx + c$
- 13.3 Explain the terms 'vertical intercept' and 'gradient'

14. The exponential function

- 14.1 Show how to simplify exponential expressions
- 14.2 Describe the form of the exponential function
- 14.3 Illustrate graphs of exponential functions
- 14.4 List the properties of the exponential function
- 14.5 Show how to solve equations with exponential terms using a graphical technique

15. The logarithm function

- 15.1 Explain the term 'base of a logarithm'
- 15.2 Show how to calculate the logarithm of a number to any base
- 15.3 State the laws of logarithms and uses them to simplify expressions
- 15.4 Show how to solve exponential and logarithmic equations
- 15.5 Define the logarithm function
- 15.6 Illustrate graphically the logarithm function

16. Angles

- 16.1 Explain the units 'degree' and 'radian'
- 16.2 Show how to convert from degrees to radians and from radians to degrees
- 16.3 Show how to calculate the length of a circular arc
- 16.4 Show how to calculate the area of a sector

17. Trigonometry

- 17.1 Define the trigonometrical ratios sine, cosine and tangent
- 17.2 Illustrate the graphs of the trigonometrical functions
- 17.3 Explain the inverse of the trigonometrical functions
- 17.4 Show how to solve trigonometrical equations

18. Solution of triangles

- 18.1 Explain the terms 'scalene', 'isosceles', 'equilateral' and 'right-angled' as applied to triangles
- 18.2 State Pythagoras's theorem and shows how it can be used in the solution of right-angled triangles
- 18.3 State the sine rule and the cosine rule and shows how they are used to solve triangles

19. Matrices

- 19.1 Explain what is meant by a matrix
- 19.2 Show how matrices can be added, subtracted and multiplied
- 19.3 Explain what is meant by the determinant of a matrix
- 19.4 Show how to find the inverse of a matrix
- 19.5 Show how matrices can be used to solve simultaneous equations

20. Measurement

- 20.1 Revise common units of length and conversions between them
- 20.2 Revise the concepts of area and volume
- 20.3 Provide a summary of important formulas needed for calculating common shapes and volume of common solids
- 20.4 Revise common units of mass and conversions between them

21. Gradients of curves

- 21.1 Introduce a technique called differentiation for calculating the gradient of a curve at any point
- 21.2 Explain the terms 'maximum' and 'minimum' when applied to functions
- 21.3 Apply the technique of differentiation to locating maximum and minimum values of a function

22. Integration and areas under curves

- 22.1 Introduce the reverse process of differentiation, which is called "integration"
- 22.2 Explain what is meant by an 'indefinite integral' and a 'definite integral'
- 22.3 Show how integration can be used to find the area under a curve

23. Tables and charts

- 23.1 Explain the distinction between discrete and continuous data
- 23.2 Show how raw data can be organized using a tally chart
- 23.3 Explain what is meant by a frequency distribution and a relative frequency distribution
- 23.4 Show how data can be represented in the form of bar charts, pie charts, pictograms and histograms

24. Statistics

- 24.1 Introduce the three common averages - mean, median and mode - and shows how to calculate them
 - 24.2 Explain what is meant by the variance and standard deviation and shows how to calculate them
- 25.1 Introduce theoretical and experimental probability and how to calculate them
 - 25.2 Explain the meaning of the term 'complementary events'
 - 25.3 Explain the meaning of the term 'independent events'

25. Probability

Reading List



April 2002

Introduction

The provision of a reading list or a source of useful references has been a contentious issue within the IFE for many years, and occasionally an attempt has been made to provide such a list. The value of such a list has been questioned when such a rich source of study material already exists in the form of the Fire Service Manuals. Those mighty tomes, of course, form the backbone of any study within the field and should be the first port of call for any study within the field. Yet they also suffer from the same difficulty that the IFE face in publishing any written material, namely, how to keep up to date with the flow of information.

The process of commissioning an author, of producing a book and then publishing, is a long one; so that by the time it is accomplished, the material it contains may suffer from a time lag, and may be out of date. This is particularly true of some areas of study such as Management, where theories are dispensed like confetti, and the language is altered to make an old theory sound more appealing.

The Internet as a very powerful tool used to dispense information has helped increase the speed of change; so the written word becomes ever more quickly ancient.

Yet the IFE is an international Institution with a large overseas membership; for some examination candidates, access to any kind of material can be difficult, and for others verging on the impossible.

To a student anywhere in the world, the book still frequently represents the only available source of study; it can be carried into the most inaccessible of places and referred to at the most dismal of times, for as long or as short a period as required.

The syllabus provides an outline of the subjects and areas of study, but a book list provides a more detailed source of references in which to find that subject. The reading and study is the responsibility of the student alone.

Notwithstanding all of the difficulties outlined, the Institution therefore feels that it has a duty to try to provide a guide to the sources of information, and as far as is practical the books themselves, as an encouragement to the student and future torch bearers of the knowledge they contain.

Use of the List

It is impossible to provide a list which will be completely up to date, fully comprehensive and contain references to material that is available to all members of the IFE anywhere in the world. Although that is not really an excuse for not trying, students are asked to bear this in mind during the long periods of study when the brain is in turmoil, the dawn of understanding has not yet broken and pins are being forcefully inserted into the doll of the examiners.

The aim of any method of study is to coach the student to a stage where they are capable of fending for themselves. Of finding and reading their own sources, in a critical way with an understanding of what is being read or said and with the information being analysed for content and credibility.

When using this list students are then asked to bear a number of simple rules in mind

1. This list does not set out to be comprehensive but provides a starting point with sources of information which contain most of the information required

2. Many other useful sources exist which are not listed, and students are encouraged to discover their own and to read as many as possible
3. One text may give a list of references to other material and a student can build up a list of references of their own by looking for the bibliography in each text.
4. Some areas of study are well established in other academic fields e.g. Hydrodynamics in Civil Engineering, and students are encouraged to study material from those areas.
5. The references are not listed by level of examination for the same topics of study may occur at different levels and need to be studied to a different depth.

The first stage of study for the student should therefore be a comparison of the syllabus topics with the references below in order to compile a list of suitable study material. At the lower levels of the examination this should be straightforward and involve perhaps only one book. As the level of the examination increases, more and more references in different locations will need to be sought. The successful student is usually the candidate who is able to organise their study material and time in a logical manner.

With these simple ideas in mind the list has been divided into three categories

1. General References

This section is aimed at leading students to those sources, which are the most general, are published or updated at intervals, are common to all areas of study and should be consulted on a regular basis. For that reason no specific reference is given to any particular volume but they do provide the starting point for any reading or study.

- Manuals of Firemanship or equivalent in non-UK countries and references to fire service operating practices.
- British Standards (or Buildings and equipment standards) or equivalent for non-UK countries
- Fire Engineers Journal
- Institution of Fire Engineers publications
- Fire safety and fire related journals
- Fire Protection Association publications
- Fire magazine
- NFPA publications
- Fire Service College – Moreton in Marsh, publications
- The legislation which is appropriate to the location and situation e.g. UK Building Regulations and UK Fire Precautions Act
- Fire research and investigation reports
- Technical Bulletins from the Fire Research Station (Building Research Establishment)
- Fire policy guidance documents
- Home Office bulletins (UK)
- Health and safety, occupational and environmental standards
- Health and Safety Executive publications or equivalent in non-UK countries
- The Internet, which contains a vast amount of information and is constantly changing.

2. Essential reading

In this section are placed those references that are “cheap and cheerful”. That is the aim is to provide a reference to reading lists, which are readily available and are relatively cheap. There may be some overlap and the list may contain some reference to a specific source from the earlier General References list. That is entirely deliberate.

| Title | Author | Publisher |
|--|---|--------------|
| Fire Engineering Science | | |
| Chemistry & Combustion | Wharry & Hirst | IFE |
| Hydraulics for Civil Engineering Tech | T Cairney | Longman 1984 |
| Building Construction | | |
| Design Principles for Smoke Ventilation in Enclosed Shopping Centres | Morgan & Gardner | BRE |
| Fire Investigation | | |
| Principles of Fire Investigation | Ide & Cooke | IFE |
| Aero Studies | | |
| Airports and Aircraft Fire protection, fire fighting and rescue techniques (2nd edition) | RW Docherty | IFE |
| Manuals of Firemanship books 4 and 6b (chapter 4) | The Stationery Office | |
| Fire Service Manual Volume 2 Fire service operations - aircraft incidents | The Stationery Office | |
| CAP 168 | Civil Aviation Authority | |
| Airport services manual Part 1 - Rescue and Fire-fighting (3rd Ed) | International Civil Aviation Organisation | |
| Communications | | |
| Manual of Firemanship Bk 1 Communications and Mobilising | The Stationery Office | |
| Command and Control | | |
| Manual of Firemanship Bk 11 Control of a Fire | The Stationery Office | |
| Manual of Firemanship Bk 12 1 Principles of Command and Control | The Stationery Office | |
| Incidents Involving Aircraft, Shipping and Railways | | |
| Manual of Firemanship Book 4 Airports and Aircraft | The Stationery Office | |
| Fire Safety on the Railways | Institute of Mechanical Engineers | |
| Marine Fire Studies | | IFE |
| Firefighting Vehicles and Appliances | | |
| Fire Service Manual - Volume 2 | The Stationery Office | |
| Petrochemical Fire Studies | | |
| Fire Service Manual - Volume 2 Fire Service Operations -Petrochemical Incidents | The Stationery Office | |
| Fixed Installations | | |
| Manuals of Firemanship Bk 9 Fire Protection of Buildings | The Stationery Office | |
| Human Resource Management | | |
| Management Theory & Practice (5th Ed.) Continuum | | GA Cole |
| Risk Assessment | | |
| Risk Assessment for the Emergency Services | RA Klein | IFE |

3. Recommended Reading

This section contains references to the mighty tomes of knowledge that are expensive to buy. Usually individual students will have access to them through their workplace or even the local reference or lending library. For most students it will be a reference that they will wish to “dip into occasionally” by reading or referring to short sections either to clarify a particular point or to gain further detail.

| Title | Author | Publisher |
|---|---------------------------|-----------------------------|
| Fire Engineering Science | | |
| Fire Dynamics | D Drysdale | Wiley & Sons 1985 |
| Handbook of Dangerous Substances | | Sax |
| Basic Physics, Volume 2 (4” edition) | Halliday, Resnick & Krane | Wiley & Sons |
| BS 5908, Fire Precautions in Chemical plants | | British Standards Institute |
| Building Construction | | |
| Mitchell’s Building Construction | JS Foster | Batsford |
| Practical Fire Precautions Buildings and Fire | Shields & Silcock | IFE |
| Fire Investigation | | |
| Kirks Fire Investigation | J De Haan | Bradley Publishing |
| Communications | | |
| Radio System Technology | DC Green | Longman |
| RDS The Radio Data System | Keplitz & Marks | Artech Home Publications |
| Foundations of Wireless & Electronics | MG Scroggie | Newnes |
| Cellular Radio & Personal Communications | TS Rappapant | IEEE |
| Satellite Based Cellular Communications | B Pallen | McGraw Hill |
| Electronics Communications Systems | Schweber | Prentice Hall Int |
| Command and Control | | |
| Disasters and Emergencies: Managing the Response | WR Tucker | IFE |
| Fireground Tactics | F Emanuel | H.M. Ginn Corp |
| Decision Making: An Integrated Approach | Jennings & Wattam | Pitman 1994 |
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