



THE INSTITUTION OF FIRE ENGINEERS
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2012 SYLLABUS FOR IFE LEVEL 3 CERTIFICATE IN FIRE SCIENCE, OPERATIONS, SAFETY AND MANAGEMENT 500/5922/1.

The syllabus for the IFE Level 3 Certificate Examination has been prepared as a series of well defined objectives with the intention that students can acquaint themselves thoroughly with the required subject matter. It is meant to provide a **clear structure** for your study plan.

The guide to the study materials required for this examination is contained in the reading list published on the Institution's website.

Note: The IFE examinations syllabuses are progressive and candidates are reminded that the IFE Level 3 Certificate Examination will have regard to the level of knowledge already gained in the Level 2 Certificate Examination.

Candidates need to pass four examinations to achieve the Level 3 Certificate qualification. Each paper covers one of the following four accredited units in the qualification, namely:-

1. Fire Engineering Science: R/502/3107
2. Fire Operations: D/502/3109.
3. Fire Safety: Y/502/3108
4. Management and Administration in Fire and Rescue Services: R/502/3110.

Each paper consists of 25 multiple choice questions and a further five 5 questions which require short written responses. All papers are derived directly from this syllabus.

Candidates achieve the qualification with passes in all four papers, either in the same year or in subsequent years. The qualification comprises the four Ofqual-accredited units referred to above.

Fire Engineering Science: R/502/3107.

1. Mathematics

1.1 Carry out mathematical processes involving:-

- a) Transposition and transformation of formulae
- b) Use of the standard form of numbers
- c) Simple trigonometry

2. Mechanics

2.1 Define and be able to carry out basic calculations involving the following terms:-

- a) Force
- b) Momentum
- c) Mass
- d) Weight
- e) Pressure
- f) Velocity
- g) Acceleration

- h) Power
- i) Energy
- j) Work

2.2 Define and carry out simple calculations involving centres of gravity

3. Heat

3.1 Define heat and temperature and describe their relationship

3.2 Define and be able to carry out simple calculations involving Boyle's Law, Charles' Law, the Law of Pressures and the General Gas Law

3.3 Define the terms 'critical temperature' and 'critical pressure'

4. Hydraulics

4.1 Define the following and be able to carry out simple calculations involving these terms:-

- a) Density
- b) Relative Density
- c) Specific Gravity
- d) Pressure in fluids

4.2 Define atmospheric pressure and describe methods of measuring it

4.3 Calculate the capacity of spherical and cylindrical containers

4.4 Calculate the capacity of irregularly shaped open water supplies

4.5 Calculate the velocity and quantity of flow of water in hose and pipelines of differing internal surfaces and diameters

4.6 Explain the relationship between pressure, nozzle diameter and discharge from a branch

4.7 Define the term jet reaction and be able to calculate jet reaction forces

4.8 Explain the conditions required to enable water to flow in hose or pipes

4.9 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)

4.10 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 metres per second
L = flow in litres per minute
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

4.11 Know that the discharge of water can be found using the formula:-

$$L = \frac{Vd^2}{20} \text{ litres per minute}$$

(Where:- V = velocity in metres per second
L = flow in litres per minute)

d = diameter of hose or pipe

Be able to carry out simple calculations using this formula

4.12 Calculate the discharge through nozzles using the formula:-

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

(Where: - L = discharge in litres per minute
d = the nozzle diameter in mm
P = pressure at the nozzle in bars)

4.13 Understand the practical considerations of high nozzle pressures

4.14 Understand the significance of the difference in specific gravities between liquids such as petrol and water

4.15 Explain the qualifying factors to be overcome when lifting from open water

4.16 Explain the working of a siphon

4.17 Explain the terms brake power and water power

4.18 Demonstrate that

$$WP = \frac{100 \times L \times P}{60}$$

(Where:- WP = water power
L = flow litres/min
P = pressure in bars)

4.19 Calculate pump efficiency percentage using the formula:-

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

(Where:- WP = water power in watts
BP = brake power in watts)

5. Chemistry

5.1 Define the terms: atom, element, compound, mixture, solution, solubility and suspension

5.2 Outline the construction of an atom and show how the electron shell configuration has an effect on reactivity

5.3 Explain the construction of a simple chemical equation

5.4 Appreciate that a flame is a particular type of chemical reaction

5.5 Explain the term "flammable" with respect to a fuel/oxygen mixture

5.6 Define "flash point" and "fire point" and explain the difference between them

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:-

a) Volts

- b) Ampères
 - c) Ohms
 - d) Watts
 - e) Joules
- 6.2 Solve simple problems involving electrical energy and power
- 6.3 Define and solve simple problems involving Ohm's 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

Fire Operations: D/502/3109.

1. Pre-planning

Understand the value of pre-planning 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

Understand:-

- a) Command and Control procedures
- b) Risk assessment methodology
- c) Principles of operational command and tactics
- d) Fire Service responsibilities at fire situations
- e) Use of Control Units, Forward Controls on the fireground and their relationship to Brigade Control Centres
- f) Understand within the Incident Command System (ICS):-
 - i. The levels of control (operational, tactical and strategic)
 - ii. The main elements of the Incident Command System
 - iii. The principles and benefits of Sectorisation
 - iv. The importance of limiting Span of Control
 - v. The tactical modes employed for firefighting
 - vi. The use of support or functional roles
 - vii. Firefighter safety at operational incidents

3. Fireground operations

Understand:-

- a) The first actions on arrival at an incident
- b) How to assess assistance needs
- c) The use of breathing apparatus at all stages in an incident, including safety, emergency and relief procedures
- d) The indications of dangerous conditions, e.g. building collapse
- e) Various methods of salvage and ventilation
- f) Various methods of reaching and attacking the seat of the fire
- g) The selection, use and limitations of specialised appliances

4. Rescue techniques

Understand various:-

- a) Methods of entry into buildings and vehicles
- b) Methods of searching for trapped persons including using communication lines and breathing apparatus
- c) Methods of rescue of trapped persons
- d) Methods and associated hazards in carrying out rescues from or near water
- e) Methods of rescue using ropes and specialist rope teams

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:-

- a) Occupied buildings and structures, including domestic and high rise property
- b) Basements and tunnels
- c) Shopping complexes
- d) Atrium buildings
- e) Historic buildings and premises containing valuable artefacts including museums and galleries
- f) Premises used to supply gas (natural and manufactured), electricity and fuel for power
- g) Premises used for petrochemical purposes including fuel storage and the refining of hydrocarbons
- h) Refrigeration plant
- i) Laboratories having the risk of chemical spillage
- j) Railway premises and rolling stock
- k) Road transport and roadways including motorways
- l) Explosives stores and ordnance factories
- m) Premises likely to contain dust explosion hazards
- n) Forests, heaths, bush and crops(wildland fires)
- o) High-rise buildings
- p) Marine incidents

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:-

- a) Lift and escalator incidents
- b) Underground accidents (including trench collapse)
- c) Rescues from cliffs, cranes, silos
- d) Rescues from collapsed buildings
- e) Extraction of persons from machinery
- f) Hazardous loads including methods of protection and decontamination of equipment and personnel
- g) Rescues at motor vehicle accidents

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 & Rescue Service Control Room

7.2 Understand the primary functions and responsibilities of Fire & Rescue Service Control centres

- 7.3 Outline methods of summoning personnel and transmitting call information and instructions to:-
- a) Fire stations
 - b) Mobile fire appliances
 - c) Individuals at locations other than fire stations

8. Pumps and primers

- 8.1 State the four types of positive displacement pumps
- 8.2 State the operating principles of centrifugal and peripheral pumps, including high pressure pumps and state their advantages and disadvantages
- 8.3 State the operating principles and application of ejector pumps, together with their advantages and disadvantages
- 8.4 Name the common primers in use and describe their principles of operation
- 8.5 Describe direct and indirect cooling systems
- 8.6 Describe in detail the correct method of using suction hose in various conditions
- 8.7 Name the gauges to be found on a typical pump and state their purpose
- 8.8 Outline potential faults and other symptoms that may arise when working from a pressure-fed supply or open water

9. Hose

- 9.1 List the main characteristics essential for good delivery and suction hose
- 9.2 Identify the causes and methods of avoiding deterioration in suction hose
- 9.3 State the appropriate methods of testing delivery and suction hose
- 9.4 Describe the principles of design and operation of various types of coupling for delivery and suction hose

10. Branches etc.

- 10.1 Describe the basic use and design of:-
- a) Hand held branches, controlled and uncontrolled
 - b) Dividing and collecting breechings
 - c) Ground monitors

11. Foam and foam making equipment

- 11.1 Define the categories of fire and firefighting foams
- 11.2 Outline the operational use of foam
- 11.3 Describe the principle performance characteristics of:-
- a) A low expansion branchpipe or generator
 - b) A medium expansion branchpipe or generator
 - c) A high expansion generator
- 11.4 Describe the relative expansion ratios associated with low, medium and high expansion foam making

12. Ropes

- 12.1 Compare natural and man made ropes
- 12.2 Describe the construction of these types of rope
- 12.3 Identify the causes of their deterioration and the methods of avoiding this

13. Ladders

- 13.1 Outline the safety precautions to be observed when handling, pitching and climbing ladders
- 13.2 Understand the general principles of working with ladders and be able to identify safe and unsafe working angles

14. Lighting

Describe various types of portable lighting equipment

15. Chemical protection

- 8.1 Describe various types of chemical protective clothing
- 8.2 Describe the designs of clothing that provide total environmental protection by being “gas tight” or limited protection against splashing by harmful chemicals

16. Radiation equipment

Identify and describe basic radiation detection equipment

Fire Safety: Y/502/3108

1. Building construction, character and use of building materials

1.1 Elements of structure:-

- a) State the function of a column
- b) State the 6 principal materials used for the construction of columns; i.e. timber, brick, stone, reinforced or pre-stressed concrete, cast iron and steel
- c) Identify the means of increasing the fire resistance of columns
- d) Describe the construction of a common type of cast iron column
- e) Explain the various methods of constructing steel columns
- f) Explain the major disadvantage of steel in building construction as its inability to withstand high temperatures
- g) Identify the primary function of a structural beam
- h) Identify and describe a continuous beam
- i) Describe the reaction of an applied load upon a beam
- j) Identify the means of increasing the fire resistance of beams
- k) Understand the effect of charring on timber beams
- l) Understand the need to reinforce concrete when used in the manufacture of beams
- m) Understand why reinforcement is undertaken in the lower section of concrete beams
- n) Explain that, in 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
- o) State and describe the principal types of load-bearing wall construction
- p) Explain the general principles of brick wall construction
- q) Understand what part of a cavity wall carries the weight of upper floors
- r) Identify the more common types of floor construction, e.g. timber joisted, compressed board panels, reinforced concrete and hollow block

- s) State the factors which affect the performance of floors when involved in fire
- t) Identify the 6 methods of supporting floor joists in or on walls

1.2 Other elements of structure:-

- a) Describe the construction and identify the component parts of a flat roof
- b) Describe the construction and identify the component parts of a pitched roof
- c) Identify and describe the component parts of a staircase
- d) Recognise and describe the construction and operating principles of the following doors:-
 - i. Hinged
 - ii. Swing
 - iii. Revolving
 - iv. Sliding
 - v. Folding
 - vi. Cantilever
 - vii. Roller shutter
- e) Understand the function of doors in relation to fire
- f) Understand the construction of sandwich panels
- g) Identify and describe the use of fire doors for smoke control purposes
- h) Recognise and describe the function of escape windows

2. Fixed installations

2.1 Sprinklers:-

- a) Understand the purpose of a sprinkler system
- b) Recognise and describe a sprinkler system
- c) Know the five main types of sprinkler installations as: wet type, dry pipe, alternative (wet and dry) pre-action, recycling pre-action. Systems based on wet pipe and dry pipe may also include extensions of the following additional type: tail end dry type and deluge
- d) Knowledge of the two categories of sprinkler heads, namely:-
 - i. Fusible solder
 - ii. Quartzoid bulb
- e) Understand the relationship between the different colours of sprinkler heads
- f) Recognise and describe the controls, gauges and alarms of an automatic sprinkler system
- g) Know the accepted sources of water supply as: town mains, elevated private reservoir, gravity tank, suction and booster pumps, and pressure tanks

2.2 Drenchers:-

- a) Understand the purpose of a drencher system
- b) Recognise and describe the three main types of drencher systems i.e. roof, wall and window drenchers
- c) Know how each of the drencher types in (b) above operates and the basic criteria regarding siting

2.3 Water Spray Projector Systems:-

- a) Describe the action of water and steam in extinguishing an oil fire
- b) Differentiate between the two basic types of water spray steam systems installed as fixed equipment

3. Alarm systems

- 3.1 Identify and describe the simple devices which are manual means of warning about fire
- 3.2 Understand the disadvantages of the manual means of warning about fire
- 3.3 Understand the design and operating principles of a simple electrical fire alarm system

- 3.4 Describe the design and operating principles of a fire alarm call point
- 3.5 Understand the prime function of an automatic fire detector
- 3.6 Identify the important stages in the development of a fire relative to automatic fire detectors
- 3.7 Know the types of detector used in the installation and operation of a simple electrical fire alarm system
- 3.8 Recognise and describe the operating principles of the open circuit alarm system
- 3.9 Recognise and describe the operating principles of the closed circuit alarm system
- 3.10 Know the basic requirements of power supplies for automatic fire alarm systems
- 3.11 Know the criteria applying to the siting of automatic fire alarm control and indicating equipment

Management and Administration in Fire and Rescue Services: R/502/3110.

1. The elements of organisation:-

- a) Chain of command; organisational structure; responsibilities and reporting relationships.
- b) Line management
- c) Functional management
- d) Staff duties
- e) Responsibilities of top level and middle managers, first line supervisors and front line staff.
- f) Definition of objectives
- g) Objectives at corporate, departmental, team and individual levels.

2. Define and describe the relationship between:-

- 2.1 Task needs
- 2.2 Group needs
- 2.3 Individual needs

3. Leadership and management

- 3.1 Decision making
- 3.2 Management theories:-
 - a) Scientific Management
 - b) Hierarchy of Needs
 - c) Hawthorne Studies
 - d) Theory of Motivation
 - e) Theory X and Theory Y
- 3.3 Staff motivation.
- 3.4 "Getting it wrong":-
 - a) Low productivity
 - b) Poor organisational design

- c) Poor delegation
- d) Poor communication
- e) Excessive conflict
- f) Poor co-ordination
- g) Weak control

3.5 Delegation

3.6 Different leadership styles:-

- a) Autocratic
- b) Bureaucratic
- c) Charismatic
- d) Democratic
- e) Laissez-faire
- f) People-oriented and task-oriented styles
- g) Transactional
- h) Transformational
- i) Situational

4. **Counselling and discipline**

- 4.1 Definitions of counselling and discipline
- 4.2 Features of a good disciplinary procedure
- 4.3 Stages of a disciplinary procedure

5. **Record keeping and reporting procedures**

- 5.1 The need for record keeping
- 5.2 Advantages of good record keeping
- 5.3 Types of record keeping systems
- 5.4 Reviewing systems of record keeping

6. **Budgets and budgetary control**

- 6.1 Definition of the term ***budget***.
- 6.2 Revenue costs and Capital Expenditure.
- 6.3 Features of a good budget
- 6.4 Advantages of budgetary control
- 6.5 Problems associated with budgetary control

7. **The training needs of an organisation**

- 7.1 Definition of the term *training needs*.
- 7.2 Training needs analyses.
- 7.3 Planning to meet training needs
- 7.4 Staff appraisal and training
- 7.5 Training aids

8. Exercise plans

- 8.1 Purpose of exercises
- 8.2 Types of exercise
- 8.3 Developing exercise plans

9. Health and safety at work

- 9.1 The importance of health and safety at work
- 9.2 Duties of employers with regard to health and safety
- 9.3 Duties of employees with regard to health and safety
- 9.4 Risk assessment and safety statement
- 9.5 Safe Person Concept
- 9.6 Protective equipment and protective measures
- 9.7 Reporting accidents
- 9.8 Health and safety issues

10. Total Quality Management

- 10.1 Definition of *quality*.
- 10.2 Key features of Total Quality Management.
- 10.3 Benefits of Total Quality Management.
- 10.4 The contribution made by the following to Total Quality Management:-
 - a) Quality assurance systems.
 - b) Quality teams.
 - c) Business plans.
 - d) Devolved financial management.
 - e) Job descriptions and employee specifications.
- 10.5 The work of the following in promoting concepts of Total Quality Management:-
 - a) W. Edwards Deming.
 - b) Joseph Juran.
 - c) Philip Crosby.
 - d) John Oakland.

11. Equality and Diversity

- 11.1 Definition of **equality**.
- 11.2 Definition of **diversity**.
- 11.3 Definition of **direct discrimination**.
- 11.4 Definition of **indirect discrimination**.
- 11.5 The importance of valuing equality and diversity for an organisation.
- 11.6 Equality and diversity policies.