



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

(FORMERLY KNOWN AS THE INTERMEDIATE SYLLABUS.)

The IFE Level 3 (Intermediate) syllabus 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.

Details of the IFE Level 3 Certificate qualification in Fire Science, Operations, Safety and Management can be found at:-

<http://www.accreditedqualifications.org.uk/awardingbody/qualifications/The+Institution+of+Fire+Engineers+qualifications.seo.aspx>

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 (Intermediate) Examination will have regard to the level of knowledge already gained in the former Preliminary Examination.**

There are two Intermediate examinations. Paper 1 consists of 100 multiple choice questions and Paper 2 requires short written responses to 20 questions. Both papers are derived directly from this syllabus.

Candidates achieve the qualification with passes in both papers – in either the same year or in consecutive years. The qualification comprises four Ofqual-accredited units.

### **Fire Engineering Science: R/502/3107.**

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#### **1. Mathematics**

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

#### **2. Mechanics**

- 2.1 Define and be able to carry out basic calculations involving the following terms:-
- Force
  - Momentum
  - Mass
  - 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.**

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### **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

### **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

### **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

## 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

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 accidents
- b) Underground accidents
- c) Rescues from cliffs
- 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
- h) 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:-

- 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

## **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**

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**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 and 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 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
- o) Explain 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, solid reinforced concrete and hollow block
- s) Explain the factors which affect the performance of floors when involved in fire
- t) Identify the 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) Recognise 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) Recognise and describe the construction and operating principles of windows e.g. sash, casement, louvered, tilt and turn.
  - g) Understand the construction of sandwich panels

## 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:-
  - i. Those in which the operating medium is fusible solder, and...
  - ii. Those in which a bulb is ruptured by the expansion of a contained liquid
- e) Understand 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 Know the basic devices which are considered as purely manual means for giving a warning of fire
- 3.2 Understand the disadvantages of the purely manual means of giving a warning of 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 "call point" provided on a system identified in (c) above
- 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 designed to operate at one of the particular stages identified in 2.1 f) above

- 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.**

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- 1. Understand the following elements of organisation:-
  - a) Line management
  - b) Functional management
  - c) Staff duties
  - d) Definition of objectives
  - e) Definition of responsibilities
  - f) Responsibilities and relationships
  - g) Chain of command
  
- 2. Describe the relationship between:-
  - a) Task needs
  - b) Group needs
  - c) Individual needs
  
- 3. Describe different styles of command and leadership
  
- 4. Describe the need for counselling and discipline
  
- 5. Demonstrate an understanding of record keeping and reporting procedures
  
- 6. Identify simple methods of budgetary control
  
- 7. Identify the training needs of an organisation
  
- 8. Describe the features of a simple exercise plan
  
- 9. Understand the use of various types of training aids