

BTEC Nationals

IVA – LEARNER INSTRUCTIONS

**Edexcel Level 3 BTEC National
Certificate/Diploma**

Building Services Engineering

Unit 3: Construction Technology and Design

Unit 19: Services Controls

**IMPORTANT: THIS SECOND EDITION REPLACES THE
LEARNER INSTRUCTIONS THAT WAS POSTED ON THE
WEBSITE AT THE START OF JULY. PLEASE DESTROY
PREVIOUS VERSION**

Issued June 2004 – Second Version

For use during the remainder of the duration of operation
of the specification issued May 2002

edexcel 

INSTRUCTIONS FOR LEARNERS COMPLETING IVAs

1. The Integrated Vocational Assignment (IVA) is a compulsory part of your qualification. If you do not complete the IVA you may not receive your certificate.
2. Your tutor(s) will tell you how long you have to complete the IVA and the access you may have to resources.
3. Read the IVA carefully and make sure that you understand the work you should hand in and what is required of you. If you are uncertain, discuss it with your tutor(s).
4. The IVA requires you to work by yourself and to produce original work. You should not share your work with any other learners. For example, if you produce an illustration or diagram electronically, you should not give it to another learner. Similarly, you should not accept and use such information from others. You are required to sign that the work submitted is your own.
5. If you work in a group at any stage, you must present your own responses to each task for assessment.
6. Information taken from sources for research, e.g. internet and textbooks, must be identified and not presented as your own work. You should list the sources used.
7. Some tasks may require Observation Records/Witness Statements. Your tutor(s) will organise for these to be completed and you must attach these to your submitted work.
8. In presenting your final work, you should not include draft work or reference materials such as handouts, notes and leaflets, unless the tasks specifically ask you to do so.
9. Presentation of your work:
 - Check that you have completed all tasks.
 - Label work with the appropriate task/sub task number.
 - Present tasks in the correct order.
 - Label each page with your name and page number.
 - Submit all electronic materials in paper format
 - Clearly label video or audio tapes submitted as part of your assignment.
 - All papers should be securely bound.
 - The completed IVA should NOT be presented in plastic envelopes, a box file or a lever arch file.

SCENARIO

A recently constructed science park on a greenfield site, on the outskirts of a university city, has involved large infrastructure projects such as the provision of access from the nearby motorway and major drainage schemes, together with the full range of public utilities.

The assignment is based around the construction of a motel on Plot J that includes a lounge bar, restaurant, conference facilities and bedrooms, together with accommodation for the manager and car parking for the patrons.

The primary use of the development will be to provide accommodation and conference facilities for the business users of the science park. It is considered that the corner location will attract a wide range of users who will require easy parking facilities.

The local planning authority favours the concept and has no restrictions on roof designs. The proposal has developed to the stage shown by the initial footprints on the Outline Site Plan (Appendix A). The developers Building Services Consultants have completed a feasibility study and have provided outline proposals for the various buildings on this plot. These are indicated on the outline 'Building Services Installations Schedule' (Appendix B).

YOUR ASSIGNMENT TASKS

Task 1

The RIBA Plan of Work relates to the various stages of the briefing, production of information and construction process. With reference to this project:

- a) Explain the stages of the design process for the project and the factors that affect this.
- b) Describe the roles of the following design team members in the design process:
 - Client
 - Architect
 - Architectural Technologist
 - Landscape Architect
 - Structural Engineer
 - Services Engineer
- c) Explain the various stages of the project planning process and the factors that affect planning decisions.
- d) Evaluate the time factors that may bear upon the design and construction of the project.

This task gives opportunities to provide evidence toward the Assessment Criteria:

Unit 3: P1, P2, M1, D1

Unit 19: None

Task 2

This task relates to the superstructure of buildings 3 and 4 for which the client has no preference to the form of construction. However, the client requires the building to be low maintenance with an expected life span of 25 years.

- a) Describe with the aid of sketches, the common forms of low-rise buildings. Select any two forms of construction suitable for this project (one of traditional design and one that uses modern construction methods). Show how these forms of construction meet the following important concepts:
- Durability
 - Stability
 - Human comfort
 - Environmental efficiency
 - Aesthetics

This task gives opportunities to provide evidence toward the Assessment Criteria:

Unit 3: P5, M2
Unit 19: None

Task 3

This task relates to the provision of accommodation within this project for the building services installations specified on the outline 'Building Services Installations Schedule'.

- a) Produce at least four clear and well annotated sketches to proportion and at least two scale section drawings through the building with text to show how accommodation can be provided for the distribution of the mechanical and electrical building services installations within and between the buildings. Drawings should include all construction and materials detail.
- b) Produce a specification of the space requirements needed to accommodate and distribute the service installations outlined for this project.
- c) Choose any TWO of the plant rooms/plant areas specified. For each plant room produce ONE plan and ONE sectional elevation showing room and other key dimensions, plant layouts, plant bases, access and provision for pipes, ductwork, cables and ancillary equipment.

Explain how you arrived at your decisions relating to sizes and dimensions.

This task gives opportunities to provide evidence toward the Assessment Criteria:

Unit 3: P3, P4, M3
Unit 19: None

Task 4

Consider the four primary services utilities to buildings 2, 3 and 4 when answering the following:

- a) Describe with the aid of line diagrams and well annotated sketches, the provision of the four primary services utilities to the buildings.
- b) Compare the four services utilities in terms of installation and maintenance issues.
- c) Summarise the limitations imposed on primary services by legal and health and safety requirements. Give at least three examples, cross-referenced to relevant regulations, for each service).

This task gives opportunities to provide evidence toward the Assessment Criteria:

Unit 3: P6, M4, D2

Unit 19: None

Task 5

This task relates to the control requirements of the building services installations specified on the outline 'Building Services Installations Schedule'.

- a) Describe the purpose of control systems for building services installations both in general and with particular reference to the installations for this motel project.
- b) Explain with the aid of a diagram using standard symbols and conventions, the following features, functions and equipment associated with building services control systems. Include typical applications for each within the installations for the buildings:
 - (i) Open and closed loop control
 - (ii) Two position control
 - (iii) Proportional control
 - (iv) Integral control
 - (v) Thermostats
 - (vi) Sensors
 - (vii) Actuators
 - (viii) Final control elements
 - (ix) Controllers
- c) For the building services installations and plant given in the outline proposal, identify TWO different applications for basic non-electric/electronic self-acting (or direct-acting) controls. ONE of these should be a control associated with a major item of services plant and ONE should be associated with the services distribution network or control of terminal units.

- d) Choose TWO applications from the outline proposal that would require, or would benefit from sequencing operations. For each:
- (i) Analyse and propose control strategies
 - (ii) Explain the important concepts of your control proposals and illustrate the control logic
 - (iii) Produce clear detailed proposals for the control system specification and control logic.

This task gives opportunities to provide evidence toward the Assessment Criteria:

Unit 3: None

Unit 19: P1, P2, P3, P4, P5, M3

Task 6

This task requires you to make detailed proposals for the control of some of the building services installations specified in the outline proposals.

- a) Choose THREE of the following installations from the outline proposal. For EACH produce a specification and a clear annotated schematic drawing showing your control system.

Your drawings should include all control devices and components to achieve control of the major plant, principle circuits and typical detail of the control of final terminal units (as appropriate)

- (i) LTHW Installation
 - (ii) Chilled Water installation
 - (iii) Air Conditioning installation for restaurant
 - (iv) Warm Air heating/ventilation installation to the Conference Centre
 - (v) Domestic Hot Water for buildings 2 & 3
 - (vi) Cold Room/Deep Freeze installations
 - (vii) Ceiling mounted cassette type split air conditioning/heat pump installation (Building 4)
- b) Analyse how the control strategies proposed in a) above meet the operational needs of the installations and justify the rationale used in producing the strategies.
- c) Describe the function, features and potential application for the use of micro-processors within two of the control strategies proposed in a) above.

- d) Analyse the use, operation and benefits of using a micro-processor based Building Management System within this motel project.
- e) Evaluate the financial and operational benefits of the control systems you have specified in a) and b) above, when compared with alternative control strategies.

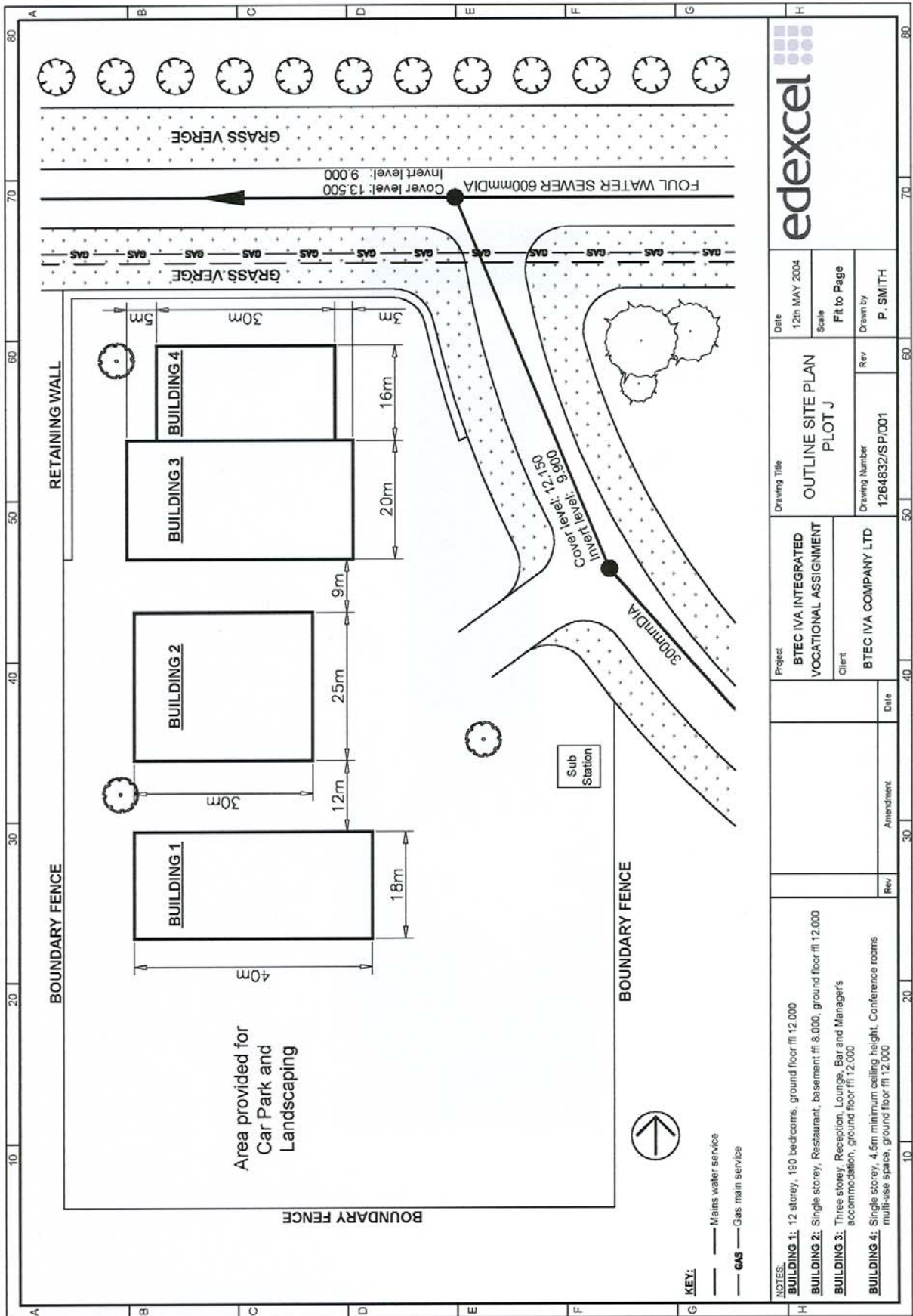
This task gives opportunities to provide evidence toward the Assessment Criteria:

Unit 3: None

Unit 19: P6, M1, M2, M4, D1, D2

Notes for all Tasks:

- All tasks relate to the project brief, and outcomes must be met separately by each learner.
- Material from centre handouts, books and other printed materials should not be included in the submission.
- All notes should be original and produced by the learner; where published material is referred to in the assignment, full references must be given.
- Sketches and drawings must be the learner's own work, and may be produced by hand or using appropriate computer software, and should be to industry standard, where appropriate.



Outline Proposals for Building Services Installations

Appendix B

BUILDING 1 (12 Storey Hotel Block with 190 bedrooms)			
Location	Services Required	Proposed Installation	Rating
Bedrooms	Heating and cooling:	Fan coil units in each room with three-speed fan. LTHW to the FCU supplied on a constant temperature circuit from the boiler plant in building 2. Chilled water supplied from the chiller plant outside building 2.	3.0 kW per room heating, 4.5 kW per room Cooling,
	Ventilation:	Natural Ventilation via openable window and trickle background ventilation	In accordance with Building Regulations
	Lighting	General lighting supplemented with feature lighting, bedside lights, and desk lamps.	General lighting 100 lux
En-Suite Bathrooms	Heating:	Towel rails in each bathroom. Fitted on a LTHW constant temperature circuit from the boiler plant in building 2.	400W each towel rail
	Extract Ventilation	Individual independent mechanical ventilation installation.	0.015 m ³ /s
	Supply Ventilation	Via transfer grille from bedroom	0.012 m ³ /s
	Domestic Hot & Cold Water	Bath, over-bath shower mixing valve, wash basin and wc. 10 rooms are specially adapted for disabled guests.	As appropriate
	Lighting	General lighting supplemented with feature lighting and mirror lights.	General lighting 300 lux
Corridors/circulation Space/Entrance lobby, cleaners room, linen store etc:	Heating	LTHW radiators. Fitted on a LTHW constant temperature circuit from the boiler plant in building 2.	Various outputs, as appropriate total heating duty 195 kW
	Lighting	General lighting supplemented with some feature lighting for pictures etc	Various levels.
Ground Floor Calorifier Plant Room	Domestic Hot Water	2 x 1800 ltr calorifiers heated with LTHW supplied from the boiler installation situated in Building 2. Calorifier to supply all hot water points within Building 1 via a pumped secondary circulation system. Cold feed to calorifiers from the roof top storage tanks.	60 kW heating coil in each calorifier.
Roof-Top Tank Room	Domestic Cold Water	2 cold water storage cisterns with associated valves etc. Mains water supply from a boosted cold water installation situated in building 2.	2 x 10000 ltr cold water storage cisterns.
Summary of Services Supplies to Building1		1 off 950 kW LTHW constant temp circuit (from Building 2) 1 off 855 kW Chilled water circuit. (from Building 2) 1 off cold water supply rated at 2 litres/second. (from boosted cold water system in Building 2) 600 kW electrical load.	

BUILDING 2 (Single Storey restaurant with basement kitchens and plant rooms)

Location	Services Required	Proposed Installation	Rating
Restaurant (Ground Floor)	Heating and cooling:	Single zone, single duct air conditioning system to provide heating cooling, humidification (via a steam humidifier) and de-humidification. LTHW and chilled water provided from the basement boiler and external chillers.	68 kW Heating, 165 kW Cooling Air supply 13 m ³ /s.
	Supply Ventilation:	Via air conditioning system, 20% fresh air 80% re-circulated air	As above
	Extract Ventilation	Ducted mechanical ventilation installation	13 m ³ /s of which 80% is re-circulated.
	Lighting	General lighting supplemented with feature and display lighting.	General lighting 150 lux
Toilets	Heating:	LTHW radiators on constant temperature circuit	Various outputs as appropriate.
	Extract Ventilation	Mechanical ducted ventilation installation from AHU in Basement	0.2 m ³ /s
	Supply Ventilation	Mechanical tempered air ducted ventilation installation.	0.16.m ³ /s 4 kW heater battery duty
	Domestic Hot & Cold Water	Wash basins, urinals and wc including disabled facilities and baby changing room	As appropriate
	Lighting	General lighting supplemented with feature lighting in the restaurant toilets.	General lighting 300 lux
Kitchens (Basement)	Heating	Ducted warm air heating and ventilation installation to provide heating and 100% fresh air ventilation.	120 kW Heater battery duty,
	Supply Ventilation	Via warm air heating system.	5.5 m ³ /s
	Extract Ventilation	Mechanical ducted ventilation installation	6.8 m ³ /s
	Domestic Hot & Cold Water	Hot and cold water supply to a range of specialist catering appliances, sinks and dish-washers etc	As appropriate
	Lighting	General lighting	500 lux
Basement Boiler Plant Room	LTHW Heating	4 x 350 kW gas fired boilers to provide LTHW heating to all circuits and buildings within the motel complex together with associated pumps, pressurisation units, controls and fuel supplies etc.	
Basement Air Handling Plant room	Warm air Heating & Ventilation	1 x air conditioning AHU for restaurant, with extract and recirculation (see above for spec) 1 x toilet tempered air ventilation supply AHU (see above for spec) 1 x toilet extract fan (see above for spec) 1 x kitchen warm air heating and ventilation AHU (see above for spec) 1 x kitchen extract fan (see above for spec) together with associated control panels and associated equipment.	
Chiller Compound (at rear of Building 2)	Chilled water	3 x 120 kW, air cooled chiller units to provide chilled water to air conditioning unit in building 2 and all fan coil units.	
Basement Cold Rooms/freezers	Food storage	1 x 13 m ³ refrigerated cold room 1 x 13 m ³ freezer room	
Basement cold water tank room	Water supply	1 x 10000 litre break tank together with pumps and ancillary equipment to provide cold water supplies throughout the motel complex.	

Calorifier Room	Hot water supply	400 litre unvented calorifier heated with LTHW supplied from the boiler plant in adjacent boiler plant room. Calorifier to supply all hot water points within Building 2 via a pumped secondary circulation system. Unvented calorifier fed from the boosted cold water supply in adjoining cold water tank room.	23 kW heating coil in calorifier.
Summary of Services Supplies to Building 2		Mains cold water supply rated at 2.7 litres/second. 790 kW Electrical load for the building	

BUILDING 3 (Three Storey Reception, Lounge Bars and managers accommodation)

Location	Services Required	Proposed Installation	Rating
Ground floor reception & smokers bar	Heating	LTHW radiators. Fitted on a LTHW variable temperature circuit from the boiler plant in building 2.	55 kW Heating,
	Supply Ventilation:	Mechanical tempered air ducted ventilation installation from AHU in third floor plant room. 100% fresh air with plate heat exchanger. Heater battery from boiler plant in building 2	2.2 m ³ /s 67 kW heater battery duty
	Extract Ventilation	Ducted mechanical ventilation installation from AHU in third floor plant room	2.2 m ³ /s
	Lighting	General lighting supplemented with feature and display lighting.	General lighting 200 lux
Ground & First floor toilets	Heating:	LTHW radiators on variable temperature circuit	5 kW. each floor
	Extract Ventilation	Mechanical ducted ventilation installation from AHU in third floor plant room	0.2 m ³ /s each floor
	Supply Ventilation	Mechanical ducted ventilation installation from AHU in third floor plant room	0.16.m ³ /s each floor
	Domestic Hot & Cold Water	Wash basins, urinals and wc including disabled facilities and baby changing room	As appropriate
	Lighting	General lighting supplemented with feature lighting in the restaurant toilets.	General lighting 300 lux
First floor non-smokers lounge bar	Heating	LTHW radiators. Fitted on a LTHW variable temperature circuit from the boiler plant in building 2.	55 kW Heating,
	Supply Ventilation	Mechanical tempered air ducted ventilation installation from AHU in third floor plantroom. 100% fresh air with plate heat exchanger. Heater battery from boiler plant in building 2	1.1m ³ /s 38 kW heater battery duty.
	Extract Ventilation	Ducted mechanical ventilation installation from AHU in third floor plant room	1.1m ³ /s
	Lighting	General lighting	200 lux

Managers Accommodation	Domestic Heating & Hot Water Installation	Independent domestic heating system consisting of 20kW gas fired boiler providing heating via radiators and domestic hot water via a storage calorifier.
Third floor AHU plant room	Ventilation	1 x tempered air ventilation AHU for ground floor lounge bar with extract fan and plate heat exchanger heat recovery (see above for spec) 1 x tempered air ventilation AHU for first floor lounge bar with extract fan and plate heat exchanger heat recovery (see above for spec) 1 x toilet tempered air ventilation supply AHU (see above for spec) 1 x toilet extract fan (see above for spec) together with associated control panels and associated equipment.
Summary of Services Supplies to Building 3		1 off 120 kW LTHW variable temperature circuit (from Building 2) to radiators 1 off 105 kW LTHW constant temp circuit (from building 2) to heater batteries in AHU 1 off cold water supply rated at 1.2 litres/second. (from boosted cold water system in Building 2) 1 off hot water supply rated at 0.78 litres per second with secondary circulation (from calorifier in building 2) 120 kW electrical load.

BUILDING 4 (Single Storey Conference Centre)			
Location	Services Required	Proposed Installation	Rating
Conference Room	Heating & Cooling	8 off ceiling mounted cassette split air conditioning heat pump systems. Condenser units fitted on platform on the roof. Units to provide both sensible and latent cooling.	68kw cooling, 44kw heating
	Supply Ventilation:	Mechanical tempered air ducted ventilation installation from AHU on roof platform. 100% fresh air ducted to the ceiling cassette units.	1.6 m ³ /s 55 kW heater battery duty
	Extract Ventilation	Ducted mechanical ventilation installation from AHU on roof platform	1.6 m ³ /s
	Lighting	General variable level lighting supplemented with feature and display lighting.	General lighting up to 300 lux
Roof top Plant Platform	Air Conditioning and Ventilation	Condenser units from split air conditioning systems 1 x tempered air ventilation AHU for conference centre 1 x extract AHU together with associated equipment.	
Summary of Services Supplies to Building 4		1 off 55 kW LTHW constant temp circuit (from Building 2) to heater batteries in AHU 62kw electrical load	

BTEC NATIONAL CERTIFICATE & DIPLOMA in CONSTRUCTION
UNIT 3: Construction Technology and Design

ASSESSMENT CRITERIA MAPPING

Criteria	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
P1	✓					
P2	✓					
P3			✓			
P4			✓			
P5		✓				
P6				✓		
M1	✓					
M2		✓				
M3			✓			
M4				✓		
D1	✓					
D2				✓		

ASSESSMENT CRITERIA MAPPING

Criteria	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
P1					✓	
P2					✓	
P3					✓	
P4					✓	
P5					✓	
P6						✓
M1						✓
M2						✓
M3					✓	
M4						✓
D1						✓
D2						✓

ASSESSMENT CRITERIA

For ease of reference, the assessment criteria from the unit specifications that are relevant to assessing and grading this IVA are repeated below. You should refer to the full unit specification for information on unit content.

Assessment Evidence Unit

Unit 3: Construction Technology and Design		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that the learner is able to:	To achieve a distinction grade the evidence must show that the learner is able to:
<ul style="list-style-type: none"> • identify and describe the various stages of the design process, the factors that affect the design process and the roles of the various members of the design team • identify and describe the various stages of the planning process and the factors that affect planning decisions • produce clear and appropriate sketches and drawings relating to the design and construction of a simple project • produce and interpret sample specifications • identify and describe a range of traditional and modern construction methods • identify and describe the main services utilities to be considered at the design and construction stages. 	<ul style="list-style-type: none"> • relate the various stages of the briefing, production of information and construction processes to the RIBA Plan of Work • describe and interpret important concepts relating to simple structures • make varied and appropriate decisions relating to sizes and dimensions for given conditions of use • compare the main services utilities in terms of installation and maintenance issues. 	<ul style="list-style-type: none"> • evaluate the time factors that bear upon design and construction • summarise the limitations imposed upon services installations by legal and health and safety requirements.

Unit 19: Service Controls		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that the learner is able to:	To achieve a distinction grade the evidence must show that the learner is able to:
<ul style="list-style-type: none"> • identify the types and application of basic non-electric/electronic controls used for building services installations and plant • describe the purpose of building services control systems and identify common control terms/standard symbols • identify the features, functions, and application of the different types of control systems and their constituent parts commonly used for building services applications • explain the important concepts of control logic and logic diagrams • analyse and propose control strategies for building services applications that require sequencing of operations • describe the function, features and application of micro-processors within building services control systems. 	<ul style="list-style-type: none"> • make valid and appropriate decisions relating to the selection and specification of control systems for a variety of building services applications • produce comprehensive designs for control systems for common building services installations and plant arrangements • produce clear and appropriate proposals for control logic and control systems specification for building services arrangements that incorporate sequencing • analyse and report on the use, operation, and benefits of micro-processor based control systems for the control of a variety of complex building services installations. 	<ul style="list-style-type: none"> • analyse and justify the rationale used in the production of control strategies and demonstrate how proposed control systems satisfy operational needs • evaluate the financial and operational benefits of a variety of specific control system within building services installations and plant arrangements.