Cork Institute of Technology

Higher Certificate in Engineering in Electrical Engineering – Award

(NFQ Level 6)

Summer 2007

Electrical Planning and Project

(Time: 3 Hours)

Answer **FIVE** questions.

In marking scripts, the Examiner will take account of clarity of expression and communication skills.

All questions carry equal marks.

Examiners: Mr. J. Buckley
Mr. M. Hennessy
Prof. E. McQuade

Q1. (a) Define the following terms when used in lighting system design.

(i) BZ Classification

(ii) Daylight Factor

(iii) Efficacy

(iv) Standard Maintained Illuminance

(v) Light Loss Factor

(vi) Utilisation Factor (6 marks)

(b) Two lighting standards are mounted 50 m apart; a single lantern with a uniform light intensity (in all directions) of 5000 candelas is mounted at a height of 10 m on each standard. Calculate the illuminance at a point between the two lighting standards located 9 m from one standard and 41 m from the other. (8 marks)

(c) Suggest some remedies for solving the problem of discomfort glare associated with an artificial lighting installation. (6 marks)

Q2. As consultant electrical engineering technician, your job is to plan the layout of a main distribution and metering system for a new shopping centre. The board incorporates both the ESB metering and the main distribution switchgear for the complex. The complex houses:

3 shops each with a load of 50A, 400V, 3-phase, 50Hz

1 shop with a load of 100A, 400V, 3-phase, 50Hz

1 main tenant with a load of 250A, 400V, 3-phase, 50Hz

The board is located within the complex and there is one ESB incoming supply.
Each of the shops is individually metered using centralised metering. The distribution board is fed from a 630 kVA transformer with 4.75% impedance. A sub distribution board located in each tenant's premises is fed from the main distribution board.

(a) Draw a line diagram of the main distribution / metering board showing:

(i) The current ratings and short circuit ratings for all protection devices

(ii) The location of all meters. State whether whole current or current transformer metering (C/T) metering) will be used. (17 marks)

(b) Indicate the IP rating of the switchboard. (3 marks)

Q3. (a) IS 3218 and BS 5839 distinguish between automatic fire systems for the protection of property and those installed for the protection of life. Outline the different classifications for each type. (10 marks)

(b) State the main function of each of the following fire alarm system components.

(i) automatic door closer

(ii) battery

(iii) end-of-line resistor/diode (10 marks)

Q4. (a) Explain what is meant by the following types of emergency luminaire:

(i) non maintained emergency luminaire

(ii) maintained emergency luminaire

(iii) sustained (combined) emergency luminaire (6 marks)

(b) Emergency lighting is provided for use when the general lighting system fails and must be powered from a source other than the source supplying the general lighting.

Explain how this can be achieved. (6 marks)

(c) A room measuring 8 x 8 m x 3 m height is to be provided with emergency lighting to give a uniform illuminance on the floor. Calculate the illuminance based on the following data:

(i) end of duration factor = 0.85

(ii) utilisation factor at zero reflectance = 0.48

(iii) emergency lighting design lumens = 180 lumens

(iv) service correction factor = 0.85

(v) number of luminaires = 2 (8 marks)

Q5. (a) What is the maximum percentage voltage drop in power cables allowed in the latest edition of the ETC1 (Electrotechnical Council of Ireland) National Rules of Electrical Installations and the 16th Edition of the I.E.E. regulations? (4 marks)

(b) Your employer wishes to install a 200 kW totally enclosed fan cooled (TEFC) slipring electric motor in his new agricultural lime mill. The mill will produce 20 tons of lime per hour and is supplied with limestone rock quarried locally. Determine the cable size required to supply the electrical power to the motor.

You may assume:

- The motor is located 100 m from the substation
- The motor efficiency is 0.9 (90%)
- The motor power factor is 0.85 lagging
- The system voltage is 400V, 3-phase 50Hz
- 200 kW refers to the shaft power of the motor. (8 marks)

(c) Assuming the motor is mounted outside on an exposed site, state the minimum IP rating for the motor and the electrical terminal box. (4 marks)

(d) The motor is run for 10 hours per day, six days per week.

Assuming the motor is running on full load, calculate:

(i) the kW/hrs (kilowatt hours) the motor consumes each week.

(ii) the kV Ar/hrs (kilovar hours) the motor consumes each week. (4 marks)

Q6. (a) (i) What is the importance of RCDs (residual current devices) in socket circuits?

(ii) State the trip earth fault current for domestic socket circuits. Why is this level necessary?

(iii) Describe, with the aid of a sketch, the operation of a RCD. (6 marks)

(b) A UPS is required for a computer room which contains twenty computers. Each computer has a consumption of 360 VA at a power factor 0.56 lagging.
The supply is 230 V 1Ø 50 Hz. Diversity of machine use is 80%.
Calculate the load on the UPS under stated conditions. (7 marks)

(c) The computer room in (b) above requires an electrical sub-distribution board.
The board will supply power to the lights and the sockets. Draw a line diagram for a typical installation showing the main switch fuse, RCDs (residual current devices) and MCBs (miniature circuit breakers). What factors should be taken into account when deciding on the number of RCDs to be used in a computer application? (7 marks)

Q7. (a) Discuss the advantages / disadvantages of critical path analysis (CPA) as a tool in project management. (10 marks)

(b) An extension has been added to a medium sized factory and you must programme the installation of a 240 mm^2, 4 core PVC insulated steel wire armoured XPLE insulated (PVC SWA XPLE) cable with copper conductors. The cable must be terminated at both ends. Prepare a CPA and bar chart, showing activities associated with the installation of the cable. (10 marks)

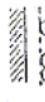
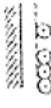
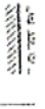
TABLE 52 H6

ARMOURED XLPE INSULATED CABLES WITH COPPER CONDUCTORS

Current-carrying capacities and voltage drop values

Installation reference methods C E F and G

Ambient temp: 30°C Conductor temp 70°C

Reference method & example	C Cables fixed to a wall				E Multicore cable in free air		F Single core cables touching in free air			G Single core cable spaced in free air	
	Single core cables		Multicore cables								
											
Cross-Sectional area mm²	1 phase	3 phase	1 phase	3 phase	1 phase	3 phase	1 phase	3 phase trefoil	3 phase flat	3 phase horizontal	3 p ver
	A mV	A mV	A mV	A mV	A mV	A mV	A mV	A mV	A mV	A mV	A
	1	2	3	4	5	6	7	8	9	10	
1.5	- -	- -	21 29	18 25	22	19					
16	- -	- -	110 2.9	94 2.5	115 See	99 See	- See	-			
25	- -	- -	146 1.9	124 1.65	152 col 3	131 col 4	- col 1	-	See	col 10	
35	- -	- -	180 1.35	154 1.15	188	162	-	-	col 2		
50	237 1.00	220 0.88	219 1.00	187 0.87	288	197	253	222 0.87		288	266
70	303 0.71	277 0.65	279 0.69	238 0.60	291	251	322	285 0.62		358	331
95	367 0.55	333 0.52	338 0.52	289 0.45	354	304	389	346 0.47		425	393
120	425 0.45	383 0.44	392 0.42	335 0.37	410	353	449	402 0.39		485	449
150	488 0.38	437 0.39	451 0.35	386 0.30	472	406	516	463 0.33		549	510
185	557 0.33	496 0.34	515 0.29	441 0.26	539	463	587	529 0.28		618	574
240	656 0.28	579 0.30	607 0.24	520 0.21	636	546	689	625 0.24		715	666
300	755 0.25	662 0.28	698 0.21	599 0.185	732	628	792	720 0.21		810	755
400	853 0.22	717 0.27	- -	- -	-	-	899	815 0.195		818	297
500	962 0.093	791 0.25	- -	- -	-	-	1016	918 0.180		923	871
630	1082 0.073	861 0.24	- -	- -	-	-	1146	1027 0.170		992	940

A: Amperes maximum mV: Millivolt /m