EXAMINATION FOR THE ISSUE OF A LICENCE TO ACT AS WIREMAN - LIC 'A'

Paper I (Theory) Time Allowed - 3Hrs

July 2014

WRITE ALL YOUR WORK IN THE ANSWER BOOK PROVIDED. EVERY ANSWER SHOULD INCLUDE ALL WORKINGS, NECESSARY DIAGRAMS AND FORMULAE.

START EACH ANSWER ON A FRESH PAGE.

Choose any **FIVE** questions.

1. (a) With the aid of a well labelled **cell** diagram explain briefly the following terms:
   - the cell e.m.f. (E). Note: It is important to show the correct connection of the +ve and –ve terminals
   - the internal resistance of the cell
   - the terminal voltage (V) across the load. **(4 marks)**

   (b) A cell has an e.m.f. of 1.5 V and an internal resistance of 0.02 Ω. This is connected across a 0.8 Ω load resistor. Calculate the current that will flow. **(6 marks)**

   (c) Consider two batteries that each has a 12V, e.m.f. and an internal resistance of 0.1 Ω respectively. These are connected in series.
   Calculate :
   (i) its terminal voltage when the serial combination is connected to a 10Ω load. **(6 marks)**
   (ii) what power does the 10Ω load dissipation. **(4 marks)**

2. (a) A d.c. single phase 8kW load is to be fed from a Distribution Board 40 metres away. The supply voltage at the Board is 110V DC. A 2-core copper cable having a cross sectional area of 4.0mm^2 already exist and will be used to supply the load.
   Calculate:
   (i) The cable resistance if the ***resistivity*** of copper is 17.5 μΩmm. **(3 marks)**
   (ii) The load current. **(2 marks)**
   (iii) The voltage drop in the cable. **(5 marks)**

   (b) If another 2-core copper cable having a cross-sectional area of 10mm^2 is connected in parallel with existing cable,
   Calculate:
   (i) The resistance of the new cable. **(2 marks)**
   (ii) The current in each cable. **(6 marks)**
   (iii) The voltage at the load terminals. **(2 marks)**

3. (a) Express Ohm's Law in symbols and state it in words. **(2 marks)**

(b) A circuit is built up from five resistors. Resistors of 4, 6, and 8 ohms respectively are connected in parallel to form a group. Resistors of 3 and 6 ohms respectively are connected in parallel to form another group. The two parallel groups of resistors are connected in series across a 100 volts supply.

(i) Draw a well labelled circuit diagram. **(2 marks)**
(ii) Calculate the voltage across each parallel group. **(4 marks)**
(iii) Calculate the main supply current. **(3 marks)**
(iv) Calculate the current taken by each resistor. **(5 marks)**

(c) Calculate the value of the resistor that must be connected in parallel across the whole combination so that the total current will be increased by 100%. **(4 marks)**

4. (a) Explain the type of losses found in a transformer. **(4 marks)**

(b) Draw a single-phase step-up auto transformer, clearly indicating the connections labelling. Give one advantage and one disadvantage for the auto transformer. **(5 marks)**

(c) A water fountain has a water pump with the following ratings:

Voltage	Power	Power factor	Frequency
24V a.c	35W	0.82	50Hz

This water pump is to be controlled from a single-phase 230V a.c. supply.

(i) What type of transformer is required? **(1 mark)**
(ii) Calculate the minimum VA rating of the transformer and choose the correct rating from the following table. **(2 marks)**

VA	**35**	**35**	**40**	**40**	**50**	**50**	**100**	**100**
Vprim	240	230	230	230	230	220	230	230
Vsec	24	24	12	24	24	24	12	24

(iii) Calculate the primary and secondary currents **(4 marks)**

(iv) Calculate the primary and secondary number of turns if the volt per turn is 0.2Volts **(4 marks)**

5. (a) With the aid of a diagram explain what is meant by a capacitor.
Give also **two** types of capacitors. **(5 marks)**

(b) Three capacitors of 60 μF, 40 μF and 24 μF are connected in series to a 300V d.c. supply.
Calculate:

(i) the equivalent single capacitor **(5 marks)**
(ii) the charge stored on each capacitor **(4 marks)**
(iii) the p.d. across each capacitor **(6 marks)**

6. When an inductive coil is connected across a direct current (d.c.) supply of 210 Volts there is a current of 16 amperes flowing in the circuit but when the same coil is connected across a 240 Volts alternating current (a.c.) 50 HZ supply a current of 15 amperes flows through the circuit.

Calculate:

(i) The resistance of the coil. **(5 marks)**
(ii) The impedance of the coil. **(5 marks)**
(iii) The inductance of the coil. **(5 marks)**
(iv) What will be the effect on the current flowing through the coil when it is connected across an a.c. mains supply if the frequency is increased? Explain why. **(5 marks)**

END OF PAPER