CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – MARINE ENGINEER OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW 95 CHIEF ENGINEER REG. III/2 (UNLIMITED)

041-33 - ELECTROTECHNOLOGY

THURSDAY, 31 MARCH 2011

0915 - 1215 hrs

Examination paper inserts:

Notes for the guidance of candidates:

1. Non-programmable calculators may be used.

2. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination workbook
Graph Paper

ELECTROTECHNOLOGY

Attempt SIX questions only.

All questions carry equal marks.

Marks for each part question are shown in brackets.

1.   A 2 wire distributor is 1500 m long and is fed at end *A* with 250 V d.c. and at end *B* with 240 V d.c.   It supplies four loads: 700 A at 400 m, 600 A at 600 m, 500 A at 1000 m and 300 A at 1200 m, all distances being measured from end *A*.   The resistance of the <u>single</u> conductor is 0.01 Ω/km.

Calculate EACH of the following:

(a)   the current supplied at each end of the distributor;   (10)

(b)   the voltage across each load;   (4)

(c)   the total power supplied.   (2)

2.   A non-linear resistor whose characteristic is given by:

$$I(mA) = 0.1 \ V^2$$

is connected in series with a resistor of 680 Ω to a 16 V d.c. supply.

Determine EACH of the following:

(a)   the value of the voltage across each element;   (6)

(b)   the circuit current;   (4)

(c)   the value to which the linear resistance must be changed to give equal voltages across the two elements;   (4)

(d)   the circuit current for the condition in Q2(c).   (2)

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3.   In the two stage voltage amplifier shown in Fig Q3 both the npn and pnp transistors have high current gains.   Transistor T_1 has a base-emitter volt drop of 0.7 V and transistor T_2 has a base-emitter volt drop of 0.3 V.

Calculate EACH of the following:

(a)   the voltage between collector and emitter for each transistor;   (12)

(b)   the power dissipated in each transistor.   (4)
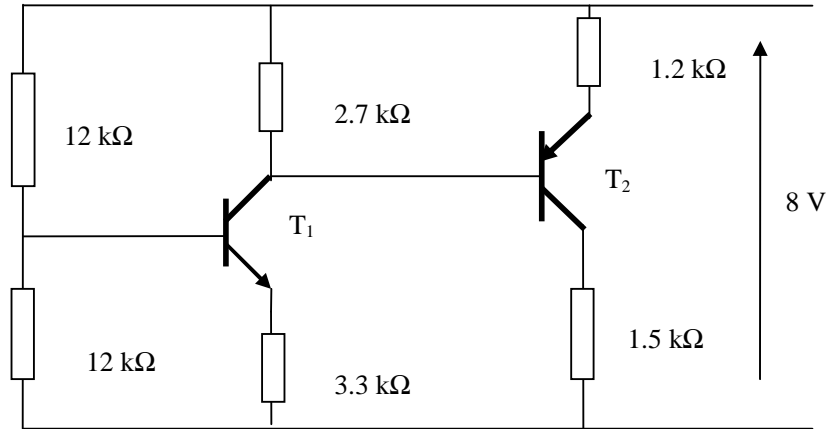

Fig Q3

4.   Two impedances Z_1 and Z_2 are connected in parallel to a 240 V single phase a.c. supply. The total current drawn is 10 A at unity power factor.   Impedance Z_1 takes a current of 5 A at p.f. 0.6 lag.

Calculate EACH of the following:

(a)   the current in impedance Z_2;   (6)

(b)   the resistance and reactance of each impedance;   (6)

(c)   the power dissipated by each impedance.   (4)

5. A three phase balanced star connected load has a capacitor of 100 µF in series with a resistor of 30 Ω in each phase. It is connected to a three phase supply of 440 V 50 Hz.

   Calculate EACH of the following:

   (a) the line current; (6)

   (b) the power factor of the load; (4)

   (c) the value of each of three identical delta connected resistors which, when connected to the same supply, will raise the overall power factor to 0.9. (6)

6. A 440 V/110 V single phase transformer takes a no load current of 5 A at power factor 0.25 lag. On load the transformer supplies 7.5 kVA at power factor 0.8 lag.

   Calculate EACH of the following, for the on load condition:

   (a) the transformer secondary current; (2)

   (b) the transformer primary current; (8)

   (c) the primary power factor; (3)

   (d) the efficiency of the transformer at this load. (3)

7. (a) List the various losses which occur in a squirrel cage motor on load. (4)

   (b) State, with reasons, which of these losses are:

       (i) independent of load current and speed; (4)

       (ii) dependent on load current. (4)

       (iii) dependent on speed. (4)

8. (a) Sketch a circuit diagram for a basic voltage stabilising circuit using a Zener diode and a series resistance, explaining how the circuit operates. (6)

   (b) State which factors determine the minimum values of the series resistor. (5)

   (c) State which factors determine the maximum stabilised output current which can be drawn from the circuit. (5)

9.   (a)   Sketch a circuit diagram showing the essential features of a star/ delta starter for a three phase induction motor, showing the connections to the stator windings.   (8)

      (b)   Explain why the starting current is reduced by the use of such a starter.   (4)

      (c)   State a disadvantage to the use of such a starter in practice.   (4)