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, 26 MARCH 2015

0915 - 1215 hrs

Examination paper inserts:

Worksheet Q3

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. In the network shown in Fig Q1 the 15 Ω resistor dissipates 60 W.

   Calculate EACH of the following:

   (a) the current taken from the supply; (6)

   (b) the value of the applied voltage V; (4)

   (c) the value to which the 60 Ω resistor must be changed to increase the current taken from the supply to 4 A. (6)

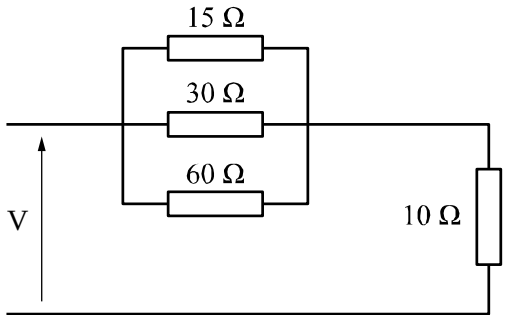

Fig Q1

2. Fig Q2 shows a non-linear resistor connected in series with a linear resistor 'R' to a 12 V d.c. supply. The characteristic of the non-linear element is given by $I(mA) = V^{3/2}$.

Determine EACH of the following:

(a) the value of 'R' to give a current of 12 mA in the circuit; (6)

(b) the value of the non-linear element when the current is 12 mA; (4)

(c) the value to which 'R' must be adjusted to give equal volt drops across the linear and non-linear resistors. (6)

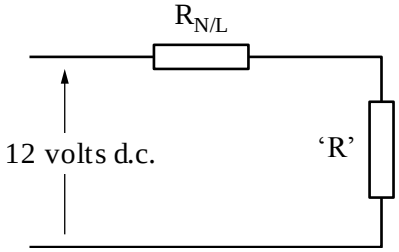

Fig Q2

3. A silicon power transistor with the characteristics given in Worksheet Q3 is operated from a 12 V supply and has a maximum power rating of 18 W.

(a) Plot the 18 W power dissipation curve on the characteristics. (5)

(b) Determine the minimum safe collector load resistor for the transistor. (4)

(c) If the transistor is biased with 80 mA and a sinusoidal signal of +/- 40 mA is applied to the base, determine EACH of the following:

(i) the variation in collector current; (2)

(ii) the corresponding variation in collector voltage; (2)

(iii) the a.c. power output of the transistor. (3)

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 5A 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 3ph 440 V a.c. generator supplies the following loads:

- a star connected load of 33 kVA at p.f. 0.9 leading
- a delta connected load of 40 kW at p.f. 0.85 lagging
- miscellaneous loads of 23 kVA at p.f. 0.8 lagging

Calculate EACH of the following:

(a) the kVA supplied by the generator; (10)

(b) the current supplied by the generator; (2)

(c) the phase currents for the star and delta connected loads. (4)

6. An unbalanced star connected three phase load is supplied from a 440 V 50 Hz four wire supply.

The current in the red line is 6 A lagging by 30°, the current in the yellow line is 5A in phase and the current in the blue line is 7A lagging by 15°.

Determine EACH of the following:

(a) the value of the current in the neutral line; (6)

(b) its phase relationship to the voltage between the red line and the neutral; (5)

(c) the total power dissipated in the circuit. (5)

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7. (a) Explain the term *single phasing* when applied to a three-phase induction motor. (6)

(b) Describe the effect of single phasing on a three-phase delta connected motor operating at 75% full load and 0.8 power factor. (6)

(c) Describe ONE method of protecting a three-phase motor against the effects of single phasing. (4)

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

(b) State which of these losses is:

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

(ii) dependent on load; (4)

(iii) dependent on speed. (4)

9. (a) Describe the FOUR conditions which have ideally to be met before an alternator can be connected to live busbars. (8)

(b) Explain the process by which load can be taken up by a newly synchronised alternator. (3)

(c) Describe the result of increasing the excitation of an alternator which is sharing load without increasing the shaft power input to the machine. (5)