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 28 MARCH 2013

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. Fig Q1 shows a supply system fed with a different voltage at each end. The resistance of the twin supply cable ('go and return') is 0.001 Ω/m.

   Calculate EACH of the following:

   (a) the current supplied from each end of the system; (6)

   (b) the p.d. at each of the three load points; (6)

   (c) the power lost in the supply cables. (4)

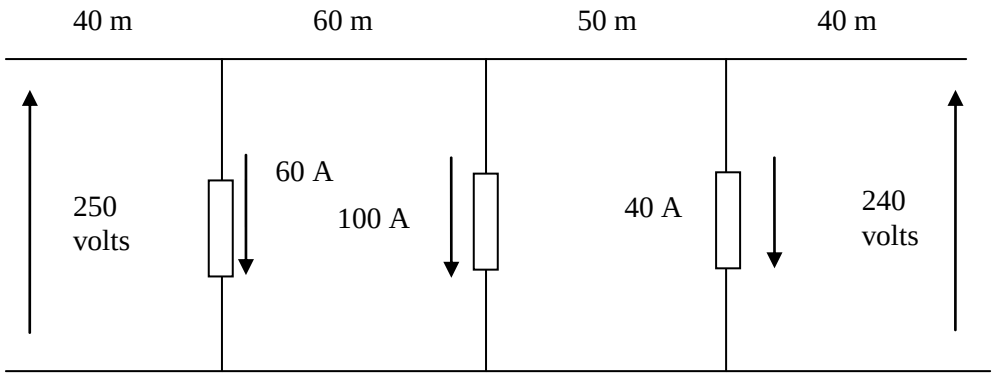

Fig Q1

2. A capacitor of 500 μF is charged from a 24 V d.c. supply via a 200 Ω resistor. When fully charged it is disconnected from the power supply and connected across a 20 Ω resistor in order to be discharged.

Calculate EACH of the following:

(a) the peak charging current; (2)

(b) the time for the capacitor to become fully charged; (2)

(c) the time taken for the capacitor to charge to 12 V; (3)

(d) the voltage across the capacitor after 25 ms of charging; (3)

(e) the peak discharge current; (2)

(f) the discharge current after 5 ms; (2)

(g) the voltage across the capacitor after 5 ms of discharge. (2)

3. A power silicon transistor with the characteristics shown in Worksheet Q3 has a maximum permissible dissipation of 16 Watts.

(a) Plot a dissipation curve of 16 Watts on the characteristics. (6)

(b) Determine, by superimposing a suitable load line on the characteristics, the minimum safe value of collector load resistance which may be used with a supply voltage of 12 V. (6)

(c) Determine from the characteristics the variation in collector current when a signal of +/- 40 mA is applied to the base if the bias is fixed at 60 mA. (4)

4. The circuit shown in Fig Q4 is supplied from a 400 Hz a.c. supply.

Determine EACH of the following:

(a) the supply voltage *V*; (4)

(b) the value of the resistor *R* and the capacitor *C*; (6)

(c) the p.d. across the resistor *R*; (3)

(d) the p.d. across the capacitor *C*. (3)

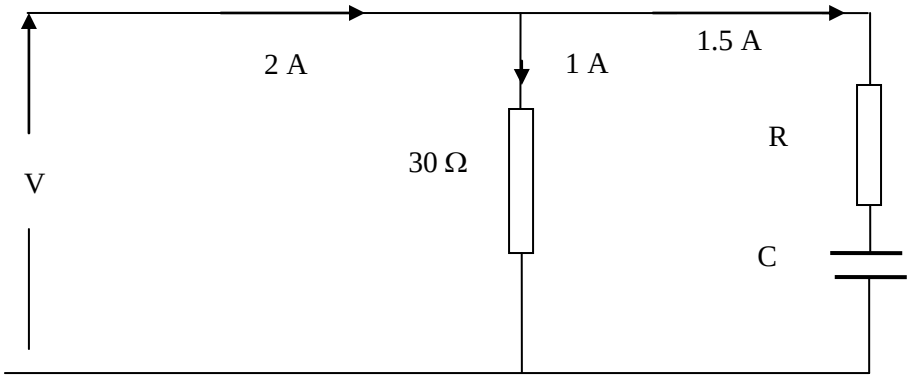

Fig Q4

5. Three identical coils each of inductance 0.1 H and resistance 30 Ω are connected in delta to a three phase three wire supply of 440 V 50 Hz. Three identical capacitors connected in star are now joined to the same supply to raise the overall power factor to 0.9 lag.

Calculate EACH of the following:

(a) the value of each capacitor; (8)

(b) the percentage reduction in line current; (4)

(c) the kVA taken by the capacitors. (4)

6. Two 440 V three phase alternators operating in parallel supply the following loads:

- 1200 kVA at 0.8 lag
- 900 kW at U.P.F.
- 450 kW at 0.75 lead

Calculate EACH of the following, if one alternator provides 1200 KW at unity power factor:

(a) the power factor of the second alternator; (6)

(b) the output current of the second alternator; (6)

(c) the total current supplied to the three loads. (4)

7. (a) Explain what is meant by the term *power factor correction*. (4)

(b) Explain TWO advantages of power factor correction in a large marine distribution system. (6)

(c) Describe TWO methods by which power factor correction can be achieved. (6)

8. (a) Sketch a circuit diagram illustrating the auto transformer method of starting a large squirrel cage induction motor. (6)

(b) State the sequence of events in starting an induction motor by the auto transformer method. (4)

(c) State ONE advantage of the auto transformer starter. (2)

(d) State ONE disadvantage of the auto transformer starter. (2)

9. (a) Explain why it is necessary to monitor and detect faults between the phase windings and earth of a star connected alternator with an earthed neutral point. (4)

(b) Sketch a circuit diagram of one arrangement for detecting phase to earth faults in a star connected alternator with earthed neutral. (7)

(c) Explain how the circuit given in Q9(b) enables earth faults to be detected. (5)