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 78 as amended MANAGEMENT ENGINEER REG. III/2 (UNLIMITED)

040-33 - ELECTROTECHNOLOGY

THURSDAY, 30 MARCH 2017

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 525 m, two core distributor cable is fed at one end with 240 V.d.c and at the other end with 250 V.d.c.

   The following roads are applied at distances measured from the 240 V end:

   - Load 1 10 A at 100 m
   - Load 2 100 A at 250 m
   - Load 3 70 A at 450 m
   - Load 4 75 A at 500 m

   The cable resistance (go and return) is 0.16 Ω per 100 m.

   Calculate EACH of the meeting:

   (a) the current supplied at each end of the distributor; (6)

   (b) the voltage of each load point; (8)

   (c) the power delivered at each end of the distributor. (2)

2. A relay coil has a resistance of 200 Ω and the current required to operate the relay is 150 mA.

   When the coil is connected to 50 V d.c. it takes 40 ms for the relay to operate.

   (a) Calculate EACH of the following:

   (i) the steady state relay current; (2)

   (ii) the time constant for the coil; (4)

   (iii) the inductance of the coil. (4)

   (b) To increase the operating time for the relay, a 50 Ω resistor is connected in series with the coil.

   Calculate the new operating time for the relay. (6)

3. The p.d. between base and emitter for the transistor shown in Fig Q3 is 0.3 V and the steady state output voltage V_c is 6 V.

Determine EACH of the following, assuming that the base current is small enough to be ignored:

(a) the voltage at the base with respect to earth; (3)

(b) the p.d. between emitter and collector; (3)

(c) the value of the load resistor R_L; (3)

(d) the power dissipated in the 200 Ω resistor; (3)

(e) the power dissipated in the transistor. (4)

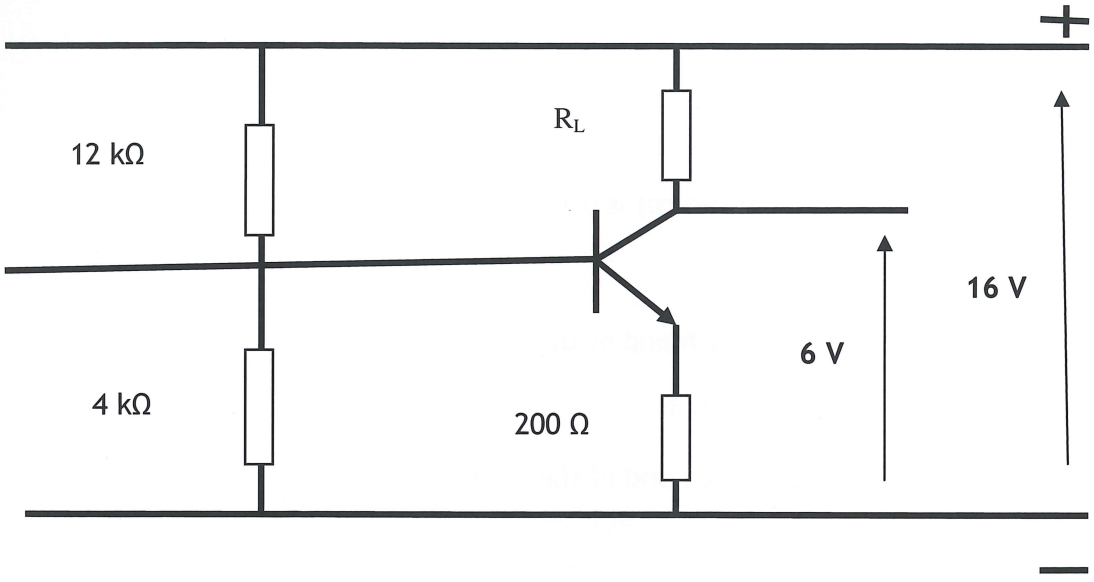

Fig Q3

4. (a) A 400 V/110 V transformer has 3468 turns on each primary phase winding. If the volt drop in the windings are negligible, calculate the number of turns of each secondary phase winding for EACH of the following connections:

(i) Delta/delta; (5)

(ii) Delta / star. (5)

(b) Explain why the two transformers described in Q4(i) and Q4(ii) cannot be operated with their primaries and secondaries connected in parallel. (6)

5. A balanced star connected three phase load has a coil of inductance 0.2 H and resistance 50 Ω in each phase. It is supplied at 415 V, 50 Hz.

Calculate EACH of the following:

(a) the line current; (4)

(b) the power factor; (3)

(c) the value of EACH of three identical delta connected capacitors to be connected across the same supply to raise the power factor to 0.9 lag; (6)

(d) the new value of the line current. (3)

6. A 6 pole 3 phase squirrel cage induction motor runs on 380 V 60 Hz supply.

It draws a line current of 80 A at a power factor of 0.8 lag.

The shaft speed is 19 rev/sec.

If the iron losses are 2 kW, the stator copper loss is 1 kW and the windage and friction loss is 1.5 kW, calculate EACH of the following:

(a) the slip as a per unit value; (3)

(b) the rotor copper loss; (5)

(c) the shaft output power; (5)

(d) the efficiency. (3)

7. (a) Sketch the reverse voltage/current characteristic for a low power Zener diode with a breakdown voltage of 10 V. (5)

(b) Sketch a simple voltage regulator circuit using a Zener diode. (5)

(c) State which factors determine the value of the series resistor used in the circuit described in Q7(b). (3)

(d) State which factors determine the power rating of the Zener diode in the circuit described in Q7(b). (3)

8. (a) Explain the term *power factor correction.* (3)

(b) State TWO advantages of power factor correction. (4)

(c) Explain, with the aid of a circuit diagram, how power factor correction can be effected in a three-phase circuit using capacitors. (5)

(d) State ONE method, other than the use of capacitors, by which power factor correction can be effected in a 3 ph circuit. (4)

9. (a) Explain how torque is produced in a 3 phase squirrel cage induction motor. (5)

(b) State why the starting current is several times higher than the full load current. (3)

(c) State why the power factor is very low on starting. (3)

(d) Describe ONE method of construction by means of which the starting power factor may be raised, the starting current lowered and the starting torque improved. (5)