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, 15 DECEMBER 2011

0915 - 1215 hrs

Examination paper inserts:

Worksheet Q3

Notes for the guidance of candidates:

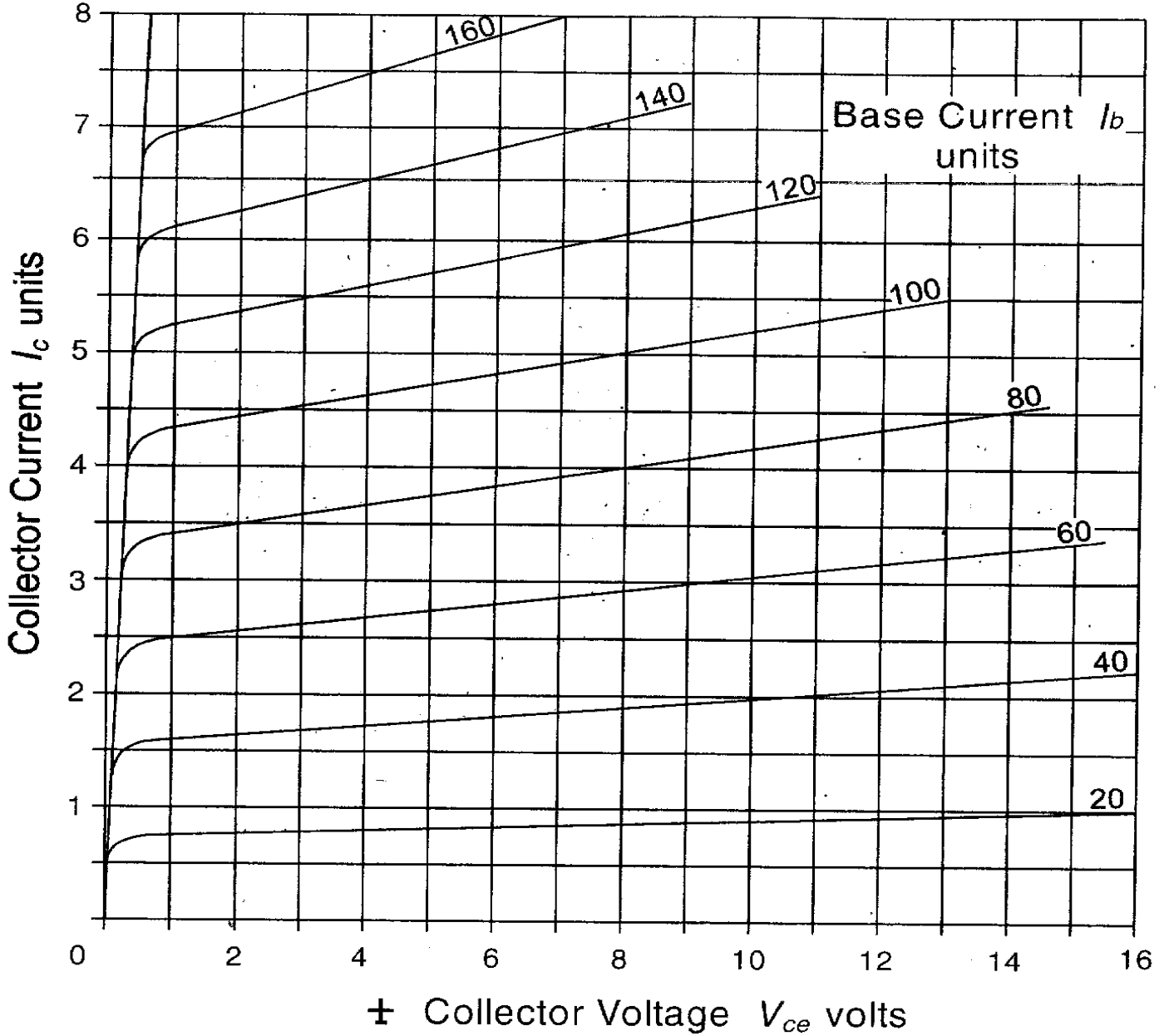
1. Non-programmable calculators may be used. 2. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination workbook Graph Paper

WORKSHEET Q3

(This Worksheet must be returned with your answer book)



COMMON EMITTER TRANSISTOR CHARACTERISTCS

TYPE	SCALE FACTORS per unit value of	
	I_b	I_c
1. Small Si	1 µA	1 mA
2. Power Si	1 mA	1 A

Candidate's Name .....

Examination Centre .....

ELECTROTECHNOLOGY

Attempt SIX questions only.

All questions carry equal marks.

Marks for each part question are shown in brackets.

1. For the network shown in Fig Q1, calculate EACH of the following:

   (a) the value of R_X so that the total current drawn from the 12 V supply shall be 2 A as shown; (8)

   (b) the potential difference across R_X; (3)

   (c) the value to which the 5 Ω resistor must be changed to give zero potential difference across R_X. (5)

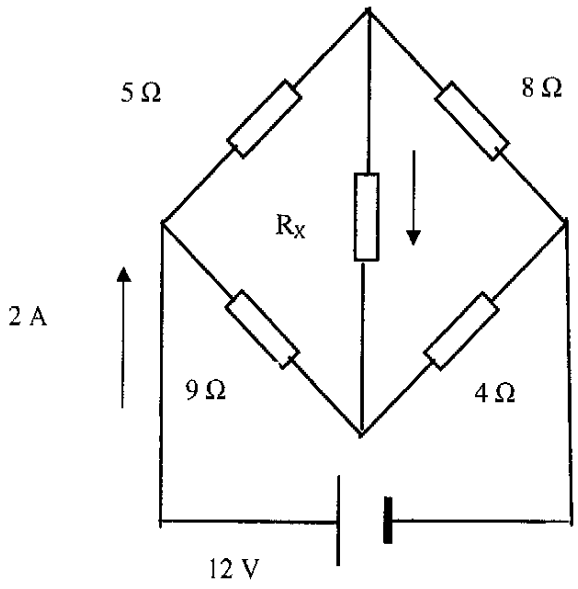


Fig Q1

2. When connected to a 20 V d.c. supply a relay starts to operate 0.52 ms after switching on the supply, at which time the instantaneous current is 200 mA. The relay coil has a time constant of 5 ms.

(a) Calculate EACH of the following:

(i) the final steady state relay current; (6)

(ii) the resistance and inductance of the relay coil. (4)

(b) To increase the operating time a 40 Ω resistor is connected in series with the relay coil.

Calculate the new time delay assuming the instantaneous current is 200 mA. (6)

3. A small silicon transistor with the characteristics given in Worksheet Q3 is used in a common emitter amplifier circuit with a 14 V d.c power supply and a 2 kΩ resistive load. The base bias current is 80 μA with a sinusoidal input signal of +/- 40 μA.

(a) Draw the load line on the characteristics. (2)

(b) Determine EACH of the following:

(i) the R.M.S. signal current in the load; (4)

(ii) the d.c. power dissipated in the load; (4)

(iii) the R.M.S. output voltage; (4)

(iv) the current gain of the transistor. (2)

4. The series a.c. circuit shown in Fig Q4 is connected to 120 V, 50 Hz supply. It draws a current of 2.4 A at a power factor of 0.8 lagging. The resistor R_2 dissipates 57.6 W and the volt drops across the various parts of the circuit are as shown.

Calculate EACH of the following:

(a) the values of R_1, L and C; (10)

(b) the power factor of the coil (R_1 and L); (3)

(c) the power factor of the combination R_2 and C. (3)

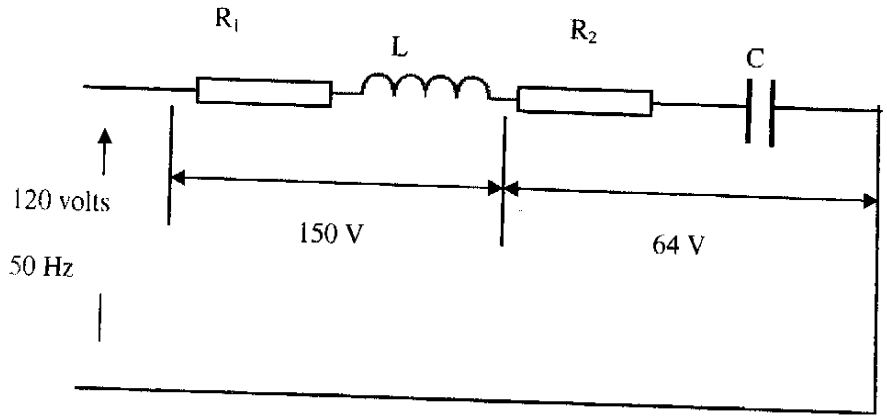


Fig Q4

5. A star connected three phase load has a coil of resistance 50 Ω and inductance 0.1 H in each phase. It is connected to a three phase three wire supply of 415 V, 50 Hz.

Calculate EACH of the following:

(a) the line current; (5)

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

(c) the value of each of three identical delta connected capacitors which if connected in parallel with this load will raise the overall power factor to unity. (7)

6. A three phase, four pole induction motor runs off a 440 V, 50 Hz supply. It delivers a shaft output power of 50 kW. The rotational losses (windage and friction) amount to 4 kW and the speed is 24 rev/sec.

If the input current is 120 A at a lagging power factor of 0.7 and the stator copper loss is 3 kW, calculate EACH of the following:

(a) the rotor copper loss; (6)

(b) the stator iron loss; (6)

(c) the efficiency. (4)

7. (a) Describe, with the aid of a sketch, the construction of a double wound, single phase transformer and explain the principle of its operation. (4)

(b) Explain why the transformer is rated in kVA rather than kW. (4)

(c) State why the iron loss is not load dependent. (4)

(d) State how the copper losses in the two windings vary with the loading of the transformer. (4)

8. (a) Sketch a basic circuit diagram for a star/delta starter for a squirrel cage motor. (8)

(b) Explain why the starting voltage and hence the starting current is reduced using a star/delta starter. (4)

(c) By what factor is the initial starting current reduced using a star/delta starter compared to the direct on line starting current. (4)

9. (a) Sketch a circuit for a basic d.c. voltage stabilising circuit using a Zener diode and a series resistor. (5)

(b) Sketch the reverse current characteristic for a typical Zener diode. (3)

(c) List the factors which determine the value of the series resistor in the circuit. (4)

(d) List the factors which determine the power rating of the chosen Zener diode. (4)