NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

APPLIED PHYSICS DEPARTMENT

SPH 1206 – ELECTRICAL CIRCUITS AND ELECTRONICS

BSc HONOURS PART I: MAY 2002 DURATION: 3 HOURS

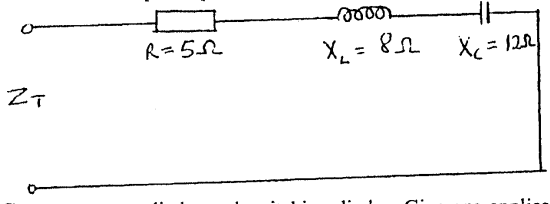
ANSWER ALL PARTS OF QUESTION 1 IN SECTION A AND ANY 3 QUESTIONS FROM SECTION B. SECTION A CARRIES 40 MARKS AND SECTION B CARRIES 60 MARKS

SECTION A

1 (a) Describe the use of a transformer as isolation device. [4]

(b) Draw the symbols for NPN and PNP BJTs and N-channel JFET and MOSFET. [4]

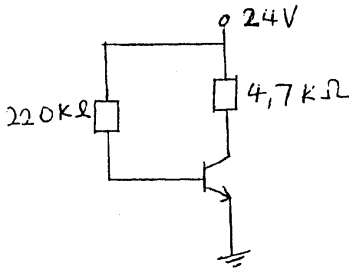
(c) Determine the input impedance of the series network



[4]

(d) Compare power diodes and switching diode. Give one application of each. [4]

(e)



Given that ß = 100, Calculate Ic and V_{CE} [4]

(f) Define the following with respect to semiconductors.

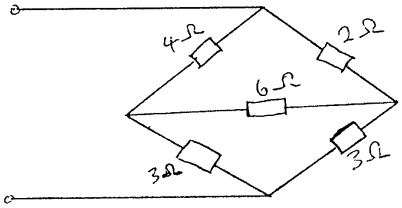
(a) Leakage current
(b) N - Material [4]

(h) Describe drif current in BJTs [4]

(i) Give the colour coding of the following resistors

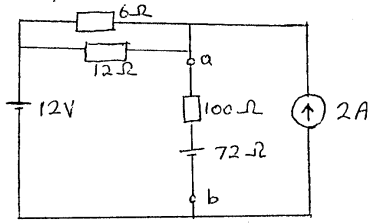
37 kΩ, 0,11 kΩ, 98 MΩ, 2,2 kΩ [4]

(j) Find the total resistance of the network.



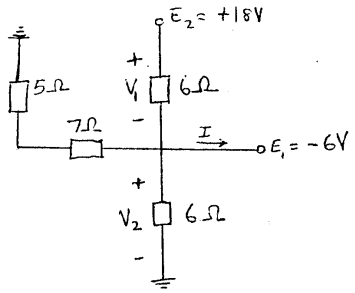
[4]

2. (a) Find the Norton equivalent circuit for the network external to a - b.



[10]

(b) For the network below, determine the voltages V_1 and V_2 and the current I



[10

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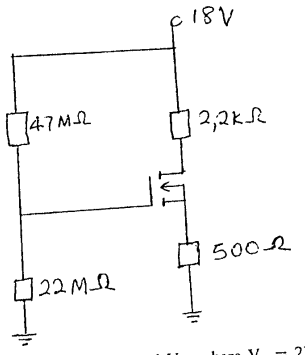
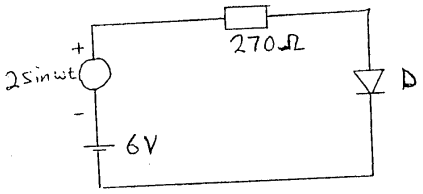
(b)



Determine the values of V_{GS}, I_D, and V_{DS} where $V_T = 2V$ ß $= 0,5 \times 10^{-3}$. [10]

(a) Assuming that the diode on the diagram is biased above the knee and has a bulk resistance of 0,1 Ω, find the total current in and total voltage across the diode.

Sketch current versus time.



[15]

(b) Give two types of diodes and their applications. [2]

(c) What is a curve tracer [3]

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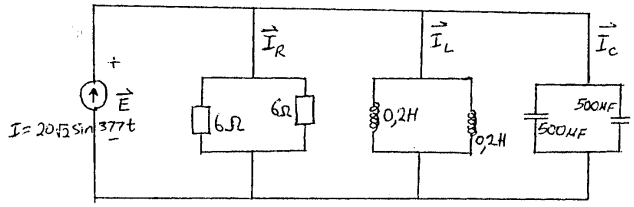
begin

3.



Compute (a) E, I_R I_C and I_C

(b) The total power factor

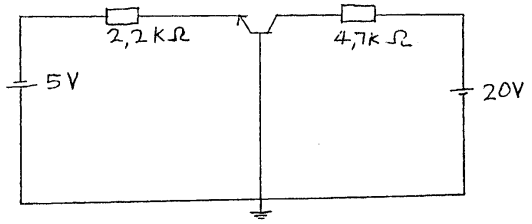
(c) Total power delivered to the network

(d) The impedance of the parallel combination of X_L and X_C [20]

4. (a) A silicon diode has a saturation current of 0,1 p A at 20°C. Find the current when it is forward biased by 0,6 V. Find the current in the same diode when the temperature is raised to 100°C. Comment on the values of the currents. [10]

(b) A bar of intrinsic silicon having cross-sectional area of 3×10^{-4} m² has an electron density of $1,5 \times 10^{16}$ electrons/m³. If $\mu_n = 0,14$ m²/(V.s) and $\mu_p = 0,05$ m² / (V.s) how long should the bar be in order that the current in it be 1,2 mA when 9 V is applied across its ends. [10]

5. (a) Determine the equation for the load line of the diagram below. Sketch the load line.



7. a) A magnetic circuit is made up of steel laminations shaped as shown in *Fig. 6.* The width of the iron is 40 mm and the core is built up to a depth of 50 mm, of which 10 percent is taken up by insulation between the laminations. The air-gap is 2 mm long and the effective area of the air-gap is 2500 mm^2 . The coil is wound with 1000 turns. If the leakage factor is 1.2, calculate the magnetising current required to produce a flux of 0.0025 *Wb* across the air-gap. **[20]**

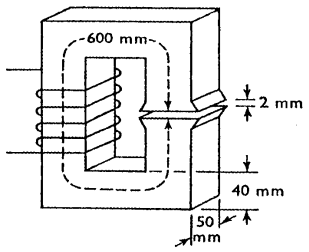


Fig. 6

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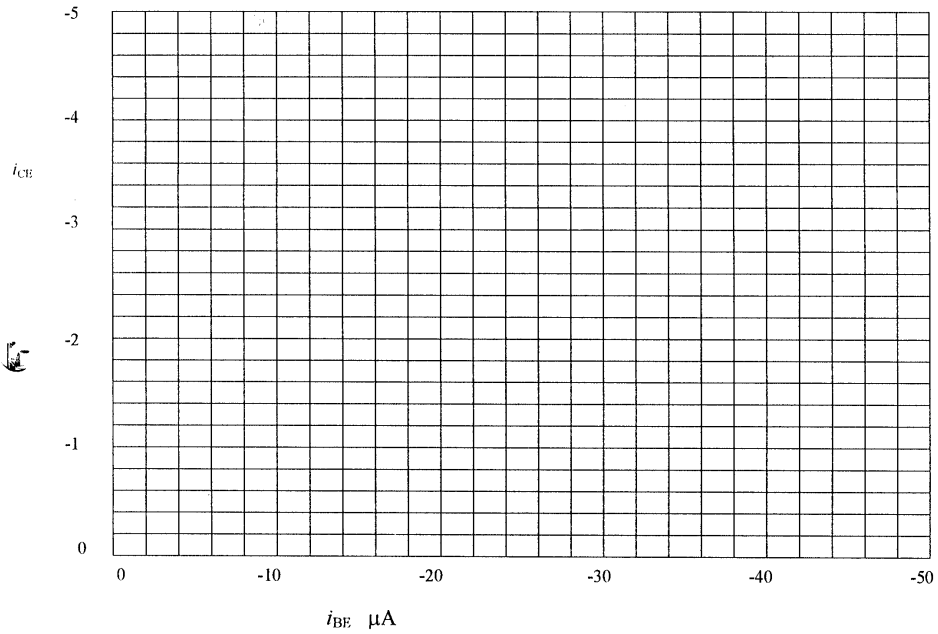

Figure 5d.

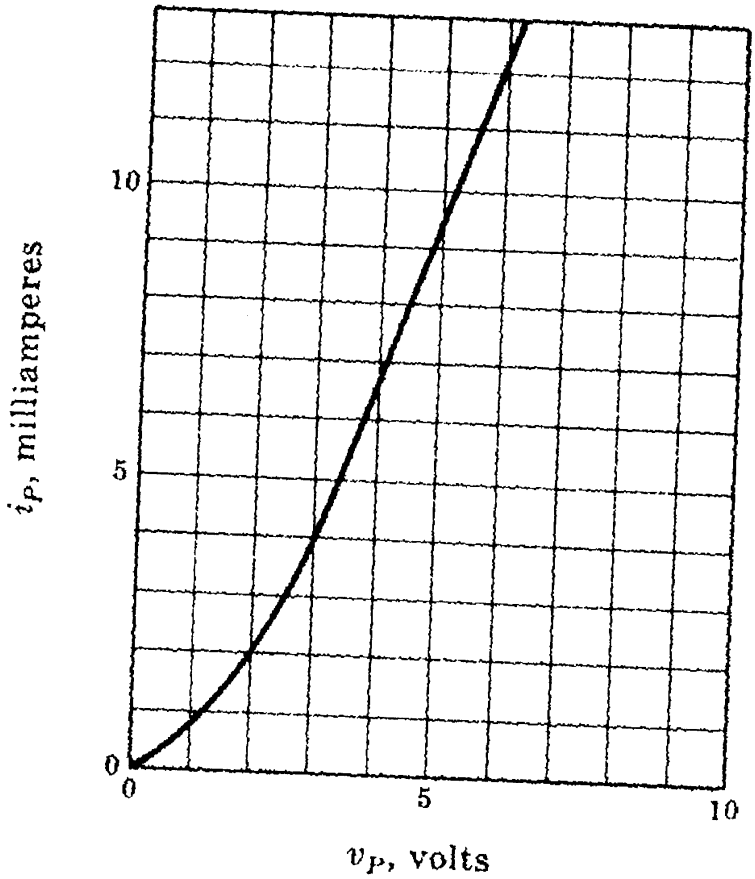

Figure 3b. Diode characteristic curve for diode in Fig. 3a.

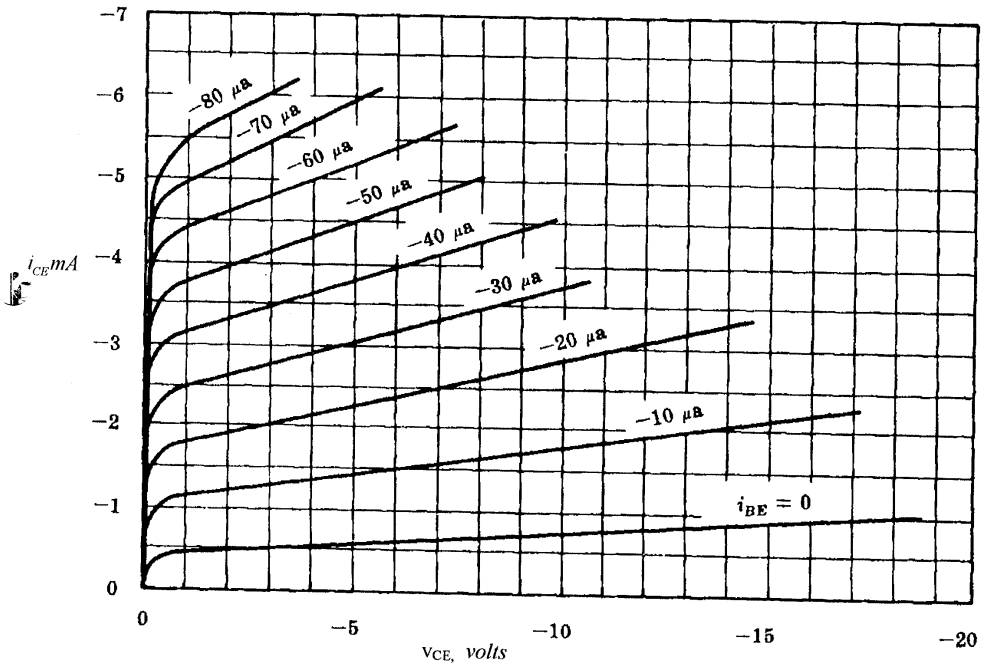

Figure 5b. Transistor static collector characteristics

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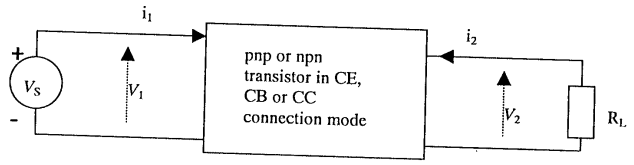
FORMULAE FOR PERFORMANCE FACTORS



Performance factor	Formulae
Current Amplification factor	$A_i = \frac{i_2}{i_1} = \frac{h_f}{1 + h_o R_L}$
Input resistance	$R_{in} = \frac{v_1}{i_1} = h_i - h_r R_L A_i = h_i - \frac{h_r R_L h_f}{1 + h_o R_L}$
Voltage amplification factor	$A_v = \frac{v_2}{v_1} = \frac{-A_i R_L}{R_{in}} = \frac{-h_f R_L}{h_i + R_L(h_i h_o - h_r h_f)}$
Power gain	$A_p = \lvert A_v A_i \rvert = \frac{{h_f}^2 R_L}{(1 + h_o R_L)[h_i + R_L(h_i h_o - h_r h_f)]}$
Output resistance	$R_{out} = \frac{v_2}{i_2} = \frac{h_i + R_S}{h_o R_S + h_i h_o - h_r h_f}$