EE-101, Introduction to Electrical and Electronic Circuits
Mid-Sem Exam

Friday, 14th Sep '2017
5:30 p.m.- 7:30 p.m.

Max. Marks: 60
Overall Weightage : 30%

Notes: (a) Symbols have the usual meanings as used in the lectures.
(b) Be brief and to the point. Show all the steps of your answer.
(c) If a question has multiple parts, try answering them in one place.

Q1 (a) What is an ideal independent voltage source? Explain with a help of a diagram. (2)

(b) Two inductors are made by winding a copper wire around a magnetic core as shown in Figs. 1(a) and 1(b). If the flux marked in the given direction is increasing, determine the polarity of the voltages v_1 and v_2 (i.e., determine if they are positive or negative). Justify your answer. (3)

(c) For the circuit shown in Fig. 2, determine the expression for the voltage $v_o(t)$, for $t > 0s$. Given: $v_s(t) = 30\sin(100t)$ for $t \geq 0s$ and $v_o(t)$ is -10V at $t = 0s$. (5)

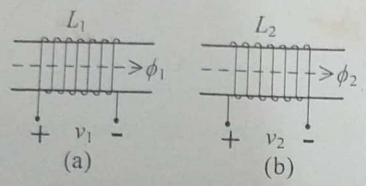


Fig. 1

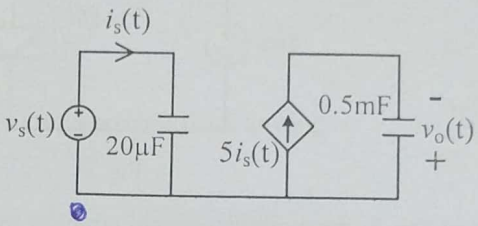


Fig. 2

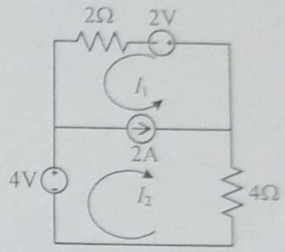


Fig. 3

2. (a) For the circuit shown in Fig. 3, determine the loop currents I_1 and I_2 using mesh analysis. Also, find the power absorbed by the '2A' source. (5)

(b) Determine the Norton equivalent of the circuit shown in Fig. 4 as seen from the terminal 'A-B'. (4)

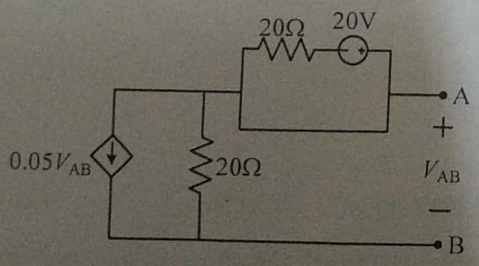
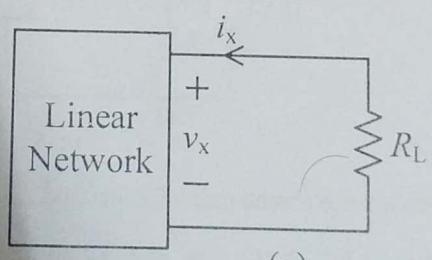
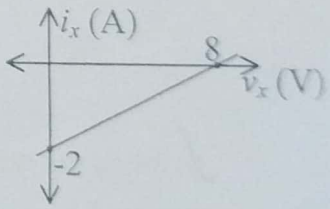


Fig. 4



(a)



(b)

Fig. 5

Q3. (a) The *V-I* characteristic of the linear network in Fig. 5(a) is obtained by varying the load 'R_L' from zero to infinity. The *V-I* characteristic of the network is shown in Fig. 5(b). Determine the maximum power that can be delivered by the linear network. (3)

(b) In the circuit shown in Fig. 6, if $V_x = AV_1 + BV_2 + CI_3$, then, find the values of A, B, and C. (5)

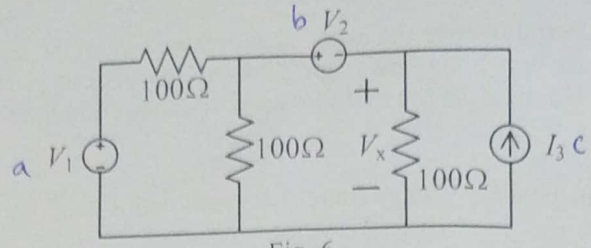


Fig. 6.

Q4. (a) In the circuit shown in Fig. 7, find I_D and V_D using (i) the iterative process and (ii) the constant voltage drop model with $V_D = 0.7V$. Assume that the forward voltage drop across the diode is 0.7 V at 1 mA forward current. The forward voltage changes by 0.1V/decade of current change. (5)

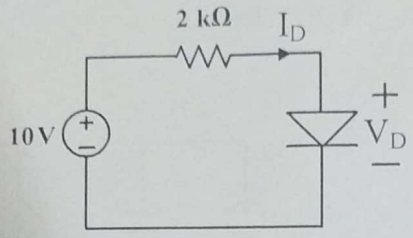


Fig. 7

(b) In the circuit shown in Fig. 8, the minimum zener current of the ideal zener diode (i.e. $r_z = 0$) is 10 mA. The zener diode is required to maintain 5 Volts across the load resistance 'R_L'. Determine the following: (4)

(i) Minimum value of 'R_L'.
(ii) Minimum power rating of the zener diode required for a safe operation.

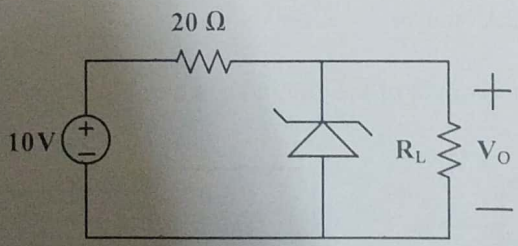


Fig. 8

(c) Briefly (but clearly) explain the mechanism of Zener and Avalanche breakdown in diodes? (2)

Q 5. (a) In the circuit shown in Fig. 9, 'v_a', 'v_b' and 'v_c' are three input signals, which can only take a voltage level of either 0 V or 5 V. Determine the values of 'v_a', 'v_b' and 'v_c' such that the output signal 'v_o' = 5 V. Assume the diodes to be ideal. Which Boolean logic expression does this circuit represent? (4)

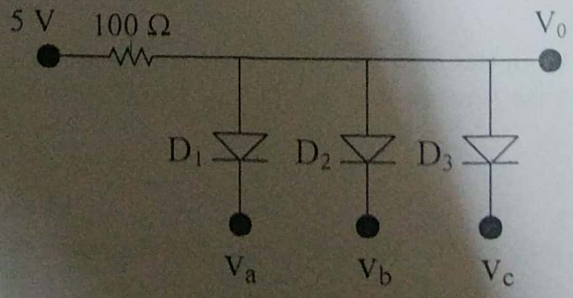


Fig. 9

(b) In the circuit shown in Fig. 10, the forward voltage drops of the diodes 'D_1' and 'D_2' are 0.7 V each. Assuming both the capacitors to be identical, determine the value and plot the output voltage 'V_O' for the given periodic input voltage 'V_{IN}'. (4)

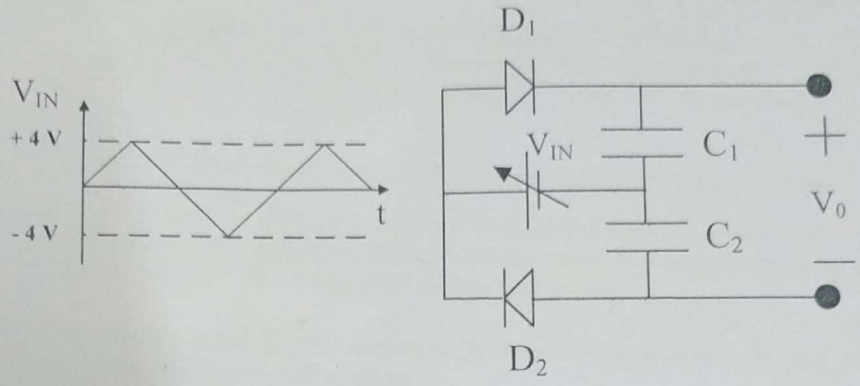


Fig. 10

Q6. (a) For the circuit shown in the Fig. 11, if $\beta = 110$, determine the following: (8)

(i) Quiescent point (i.e. I_C and V_{CE});
(ii) Operating region of the transistor;
(iii) The collector voltage (V_C);
(iv) The emitter voltage (V_E).

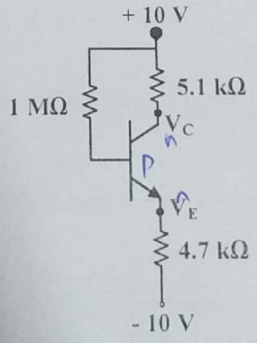


Fig. 11

(b) For a transistor amplifier what do you understand by DC biasing? Explain transconductance (g_m) and obtain an expression for it. Draw the equivalent hybrid-π model of the transistor amplifier. (6)