Jaypee Institute of Information Technology
End Term Examination, Odd 2021
B.Tech, III Semester

Course Title: Electrical Science-2 | **Maximum Time: 2 Hrs**
Course Code: 15B11EC211 | **Maximum Marks: 35**

After pursuing the course, the student shall be able to:
CO1: Study and analyze the complete response of the first order and second order circuits with energy storage and/or non-storage elements.
CO2: Understand two-port network parameters and study first order, second order passive filters.
CO3: Study the properties of different types of semiconductors, PN junction diode, zener diode and analyze diode applications.
CO4: Study the characteristics, operation of bipolar junction transistor (BJT) and its biasing, stability aspects.

Note: Attempt all the questions:

Q1. For the circuit shown in Fig. 1, find the value of (a) i_L (b) i_1 and i_2 at time t=0.15s. **[3,CO1]**

Q2. Calculate the Z parameters Z_{11}, Z_{12}, Z_{21} and Z_{22} for the circuit shown in Fig. 2. **[3,CO2]**

Q3. For the circuit shown in Fig. 3, determine the transfer function $H(jw) = \frac{V_0(jw)}{V_i(jw)}$ **[3,CO2]**

Q4. For a silicon sample shown in Fig. 4, with l=2cm, w=d=0.4cm, B_z=5x10^{-5}weber-cm^{-2}, V_x=1.5V, I_x=7.5mA and V_H=6mV, find (a) Hall constant R_H (b) majority hole charge concentration P_0 (c) mobility μ_H. **[3,CO3]**

Q5. A silicon sample is doped with donor concentration 6x10^{15} cm^{-3} and acceptor concentration 2x10^{15} cm^{-3}. Determine (a) Electron hole concentration (b) Position of Fermi level i.e. E_C-E_F. Take n_i= 1.5x10^{10} cm^{-3}. **[3,CO3]**

Q6. A silicon sample is doped with donor concentration 6x10^{15} cm^{-3} has τ_p (mean free time of holes)=1μs. The sample is uniformly illuminated to produce electron hole pair at a rate G_L=2x10^{19} cm^{-3}/s (a) Determine excess charges Δn and Δp (b) Resistivity of the illuminated sample. Take n_i= 1.5x10^{10} cm^{-3}, μ_n = 1350 cm^2/V-sec and μ_p = 480 cm^2/V-sec **[3,CO3]**

Q7. A silicon P-N abrupt junction at 300K has $N_A = 10^{15}$ cm^{-3}, $N_D = 2x10^{15}$ cm^{-3}. For equilibrium condition, draw the energy band diagram for the following bias conditions (a) Reverse bias of 3V (b) forward bias of 0.7V. The energy-band diagram should be shown with proper label of energy levels and built-in potential. Take n_i= 1.5x10^{10} cm^{-3} V_T = 26 mV. **[3, CO3]**

Q8. (a) A full wave bridge rectifier with 120V RMS sinusoidal input has a load resistance of 1KΩ. Assume silicon diode has cut in voltage V_γ = 0.7V and R_f = 0. Determine

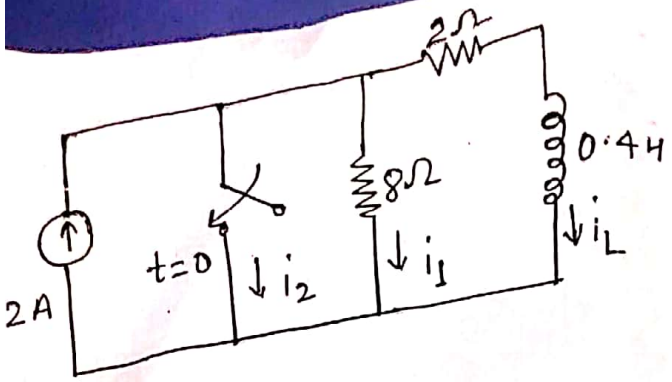
i. DC voltage across the load resistance.
ii. PIV rating of the diode.
iii. Maximum current through each diode during conduction.
iv. Power rating of each diode. **[4, CO3]**

(b) Draw the waveform of output voltage for the circuit shown in Fig. 5. Briefly explain the working of the circuit for the given input in the time interval 0 to T3. Assume ideal diode. **[3, CO3]**

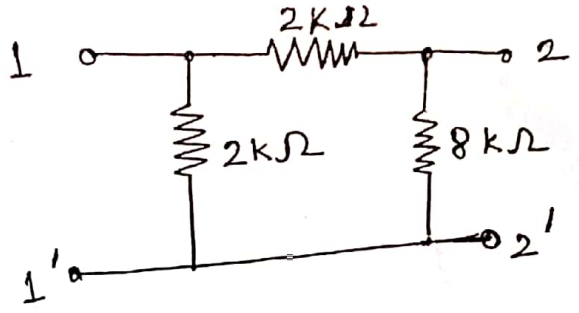
Q9. Determine the output voltage V_O and the diode current i_{d1} and i_{d2} for the circuit shown in Fig. 6 if (a) V_I = 0V (b) V_I = 4V. Assume ideal diode. **[4, CO3]**

Q10. Write a short note of the following

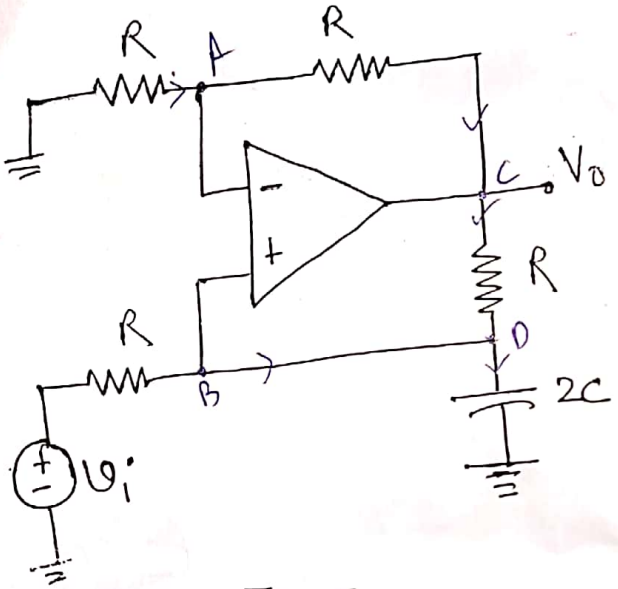
(a) Ebers-Moll model of the PNP BJT.
(b) Base Width Modulation.
(c) Output characteristics of common emitter PNP transistor **[4,CO4]**



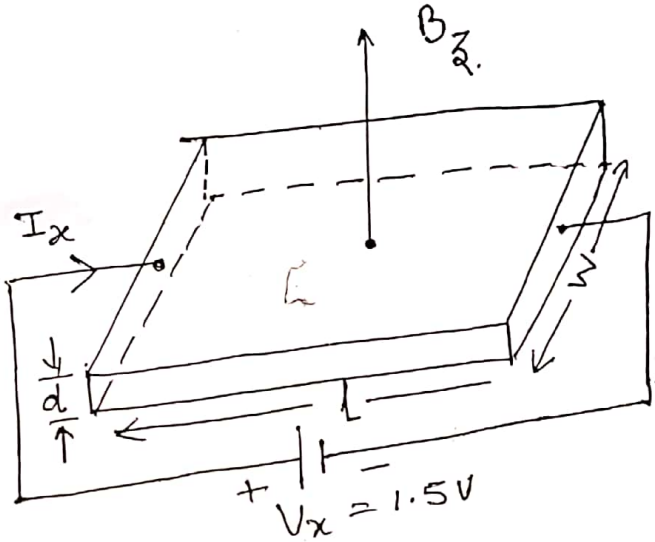
Fig·1



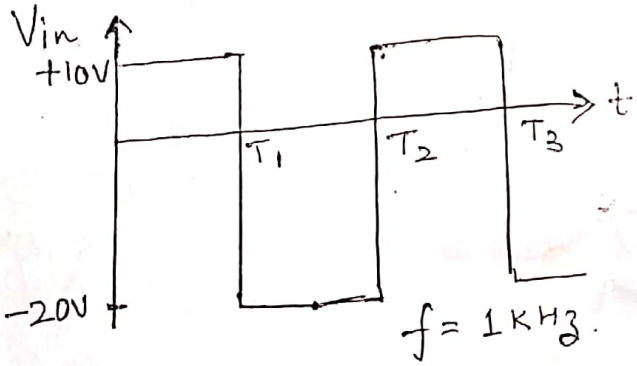
Fig·2

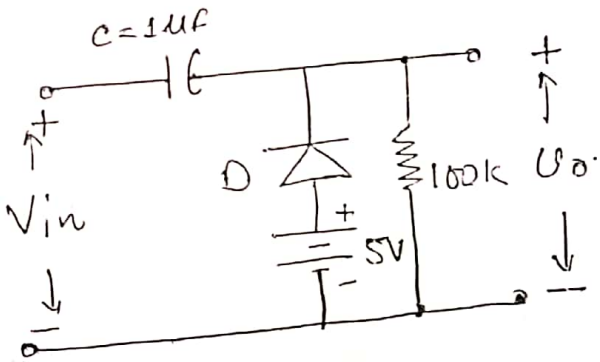


Fig·3

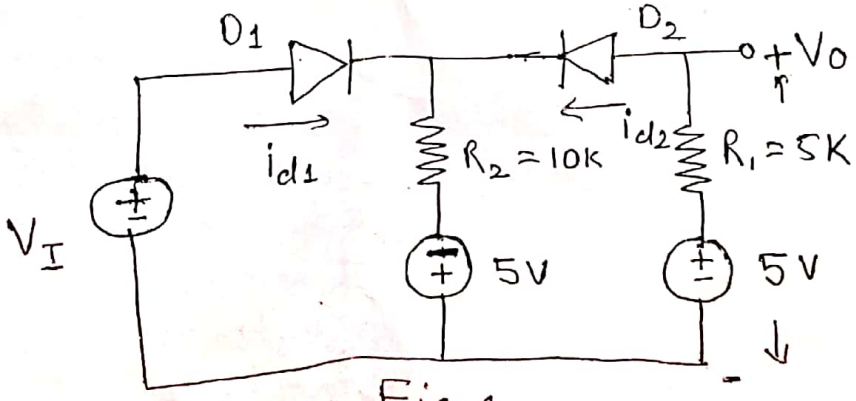


Fig·4





Fig·5



Fig·6