RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. THIRD SEMESTER EXAMINATION, MARCH 2021

SECOND YEAR [BATCH 2019-22]

Date : 12/03/2021

PHYSICS (HONOURS)

Time : 11 am - 1 pm

Paper : V [CC 5]

Full Marks : 50

Answer **any five** questions: [5 × 10]

1. a) How does the depletion region form in a PN junction diode?

   b) In a PN junction diode, draw the schematic diagram for the following:

      i) Electric field variation

      ii) Variation of electro-static potential

      iii) Electron energy variation

      iv) Energy band diagram in unbiased condition

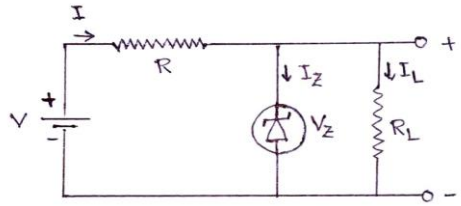
   c) In a diode rectifier without filter the load resistance R_L = 1000 Ω, supply voltage V_S = 311.*sin*(314t) volts and the source resistance R_S = 50 Ω. Determine (i) the DC component of load voltage, (b) the peak instantaneous diode current and (c) the peak inverse voltage across the diode.

   [2+(1+1+1+2)+(1+1+1)]

2. a) What is the difference between Avalanche breakdown and Zener breakdown of a PN junction diode?

   b) Mention the comparisons between ordinary semiconductor diode and Zener diode.

   c) In the following circuit the source voltage V is 12 volts and the voltage across the Zener diode V_Z is 9 volts. The maximum and minimum allowable Zener currents are 4 mA and 40 mA respectively. Find the value of the resistance R. Find also the range of allowable values of the resistance R_L.



   d) Why is Bridge rectifier superior than centre tapped full-wave rectifier? [1.5+1.5+(2+3)+2]

3. a) What do you mean by pinch-off in a FET? Draw the schematic of cross-section of a depletion type MOSFET at pinch-off and beyond pinch-off respectively.

   b) Compare enhancement type and depletion type MOSFET. Explain how a Depletion type MOS can be used as an Enhancement type MOS.

   c) In a common-source JFET amplifier the load resistance R_L = 500 kΩ. Assume g_m = 0.2 mA/V and r_d = 100 kΩ. Calculate the voltage gain of the amplifier. [(1+2)+(2+1)+4]

4. a) Draw the energy variation curve for an open-circuited n-p-n transistor. How is the curve modified when the transistor is operating in the active region?

   b) A p-n-p transistor working in the CB mode has an input dynamic resistance of 50 Ω. The current gain of the amplifier is 0.98 and the load resistance in the collector circuit is 3 kΩ. Calculate the voltage gain and the power gain.

c) For a CE configuration, it is found that for a fixed base current of 30 μA, collector current changes from 3.5 mA to 3.7 mA when collector-emitter voltage changes from 7.5 V to 12.5 V. Calculate its output resistance and β at 12.5 V. [(1.5+1.5)+3+4]

5. a) What do you mean by distortions in amplifiers? Discuss the origin of the input and the output nonlinear distortions in transistor amplifiers. What is the desired position of the Q-point for a minimum distortion and why?

b) A CE amplifier has a load resistance of 5 kΩ and an unbypassed 100 Ω resistor in the emitter lead.

The *h*-parameters are: h_{ie} = 5000 Ω, h_{re} = 7.5 X 10^{-4}, h_{fe} = 150 and h_{oe} = 30 μA/V. Determine the current gain, the input resistance, the output resistance and the voltage gain.

c) What is the need of cascading of amplifiers? Obtain overall voltage gain of a cascaded system of n number of amplifiers. [(1+2+1.5)+3+(1+1.5)]

6. a) Draw the circuit diagram of a two stage RC coupled CE amplifier. Show how the magnitude and phase angle of its voltage gain vary with frequency. Qualitatively explain these variations.

b) An RC coupled amplifier has a mid-frequency gain of 100. The gain is 80 at 50 Hz and 100 Hz. Calculate the half-power frequencies.

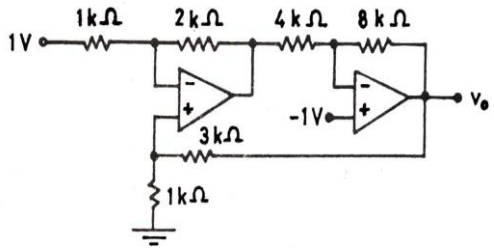
c) Show that the negative feedback in an amplifier can reduce (i) phase distortion and (ii) frequency distortion. [(1+1+2)+3+(1.5+1.5)]

7. a) Compare Colpitts, Hartley and Crystal oscillator.

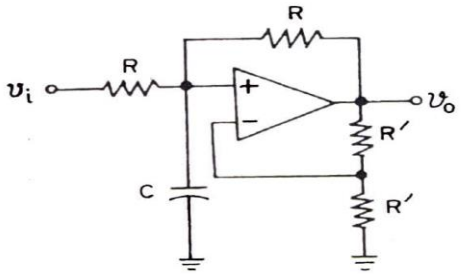
b) A Wien Bridge oscillator is to be operated in the frequency range 30 Hz to 3 KHz. The variable capacitance has a range 50 pF to 500 pF. Find the resistance values required. If the resistances in the other arms are in the 5:1 ratio, then find out the required gain of the amplifier.

c) What is multivibrator? Describe the operation of a multivibrator with circuit diagram, that can produce clock pulses. How do you control the time period of these clock pulses? [3+3+(0.5+3+0.5)]

8. a) Find out the output voltage v_o in the following circuit:



b) For the following circuit derive an expression of the output voltage v_o in terms of the input voltage v_i. What is the function of the circuit?



c) What is DAC? Describe the working principle of a R-2R ladder type DAC. [3+3+(0.5+3.5)]

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