[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5676 **J**

Unique Paper Code : 2222012403

Name of the Paper : Analog Electronics

Name of the Course : **B.Sc. Hons. – (Physics)_NEP: UGCF-2022**

Semester : IV

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **Four** questions in all. Question No. **1** is compulsory.
3. Simple non-programmable calculators are allowed.

1. Attempt **any five** parts. (3×5=15)

   (a) Explain the working principle of a photodiode. Also Draw I-V characteristics.

   (b) Draw the I-V characteristics of a Zener diode and explain its use as a voltage regulator.

   (c) A diode is used in a half-wave rectifier. If the peak input voltage is 12 V, calculate the average output voltage (assume ideal diode).

   (d) Why is voltage divider bias preferred over fixed bias in amplifier circuits?

   (e) A transistor has $\beta = 120$ and base current = 30 μA. Find the collector current.

   (f) Define the slew rate of an op-amp. If an op-amp has a slew rate of 0.5 V/μs, how much time will it take to swing from 0 to 3 V?

   (g) State any three differences between an ideal op-amp and a practical op-amp.

2. (10+5)

   (a) Explain the construction and working of a full-wave bridge rectifier. Derive expressions for average output voltage and ripple factor.

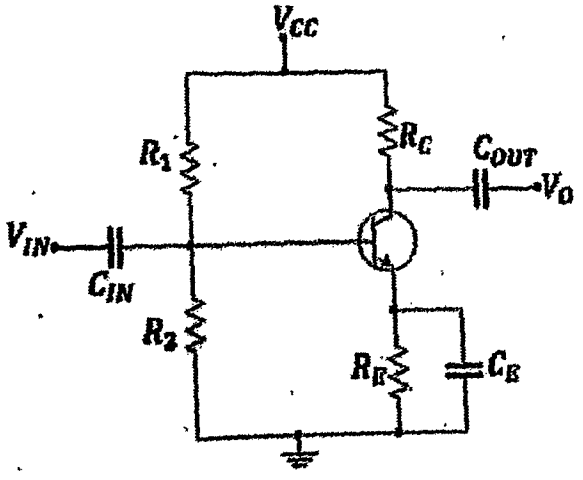
P.T.O.

(b) A Zener diode voltage regulator circuit is connected with 15 V input and a 9 V Zener. Calculate the current through Zener if the load draws 10 mA and the series resistance is 100 Ω. Also draw the proper circuit diagram of a Zener diode voltage regulator.

3. (10+5)

(a) Explain the input and output I-V characteristics of a transistor in CE configuration. Describe the active, cut-off, and saturation regions.

(b) In the voltage divider bias circuit, R_1 = 33 kΩ, R_2 = 10 kΩ, R_C = 2 kΩ, R_E = 1 kΩ, V_{CC} = 15 V, and β = 100. Calculate the base voltage V_B, emitter voltage V_E, and collector current Ic. Assume V_{BE} = 0.7 V, C_{in} = C_{out} = 10 μA and C_E = 50 μA.



4. (10+5)

(a) Explain the construction and working of RC phase shift oscillator. Derive the condition for sustained oscillation and expression for its frequency.

(b) A Hartley oscillator operates at a frequency of 1 MHz. The capacitor in the tank circuit is 200 pF, and the mutual inductance is 0.002 mH. If both the inductors in the circuit are of same value, calculate the value of L.

5. (10+5)

(a) Draw the circuit diagram of a basic integrator using an operational amplifier and derive the expression for its output voltage. Draw the circuit of a practical integrator and explain the need for modifications over the basic integrator.

(b) A zero-crossing detector is used to process a sinusoidal input signal with a peak-to-peak voltage of 5 V and a frequency of 60 Hz. What will be the period of the output waveform generated by the detector. If the output of the op-amp swings from –5 V to +5 V and the slew rate of the op-amp is 0.5 V/μs, estimate the minimum time the op-amp takes to complete this transition.

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