2023

4th Semester Examination

PHYSICS (Honours)

Paper : C 10-T

[Analog Systems and Applications]

[CBCS]

Full Marks : 40 Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Group - A

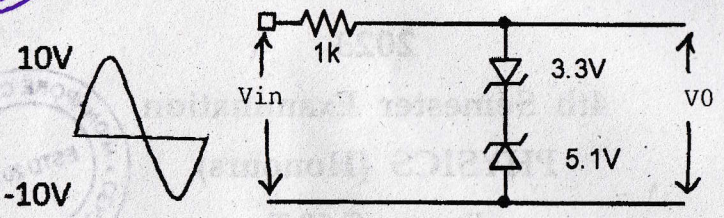
Answer any ***five*** of the following : 2×5=10

1. Define the mobility of charge carriers in a semiconductor. Why is the mobility of the hole less than that of the electron? 2

2. What do you mean by ripple in case of full wave rectifier? How can you reduce it? 2

3. Sine wave of 10 V peak value is applied at the input (Vin) shown in figure below. Sketch output wave (V0) of the given figure. 2

P.T.O.



4. Explain the early effect. 2

5. Determine the CMRR and express it in dB for an op-amp with an open-loop differential voltage gain of 85,000 and a common-mode gain of 0.25. 2

6. Define the hybrid parameters for a basic transistor circuit in any configuration. 2

7. Draw the circuit diagram for phase shift oscillator using transistor and explain how total phase shift 360° is achieved. 2

8. Write down the characteristics of an ideal op-amp. 2

Group - B

Answer any ***four*** of the following : 5×4=20

9. What is the charge neutrality condition in p-n junction diode? Define law of mass action. Determine the concentration of hold in n-type semiconductor using charge neutrality condition and law of mass action. 2+1+2

10. What are the factors that affects the bias stability of a transistor? Find the Q point of a self bias transistor circuit

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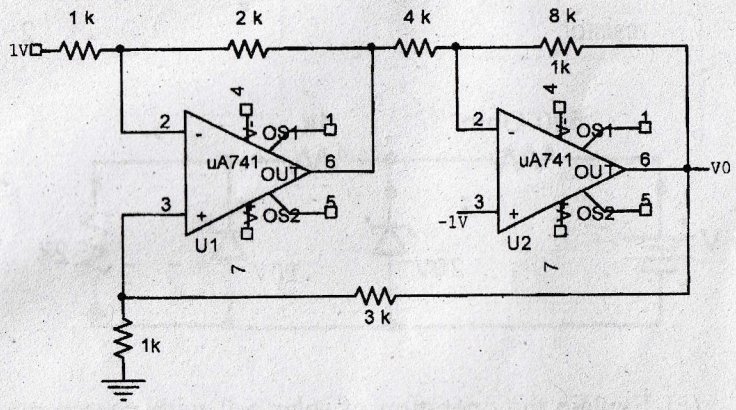
with the following specifications : $V_{cc} = 22.5$ V, $R_L = 5.6\,K\Omega$, $R_e = 1\,K\Omega$, $R_1 = 90\,K\Omega$, $R_2 = 19\,K\Omega$, $V_{BE} = 0.7$ V and $\beta = 55$. Assume $I_B >> I_{CO}$. 1+4

11. Draw the circuit diagram of differential amplifier of gain 3.3 using op-amp. Find out the output voltage (V0) of the given figure below, k represents kΩ. 1+4



12. What do you mean by comparator? What is zero crossing detector? 2+3

13. Draw the schematic diagram of an n-channel JFET and explain its operation. 1+4

14. (a) Derive expression for mid frequency voltage gain of a R-C coupled amplifier.

(b) What is the difference between amplifier and oscillator? 3+2

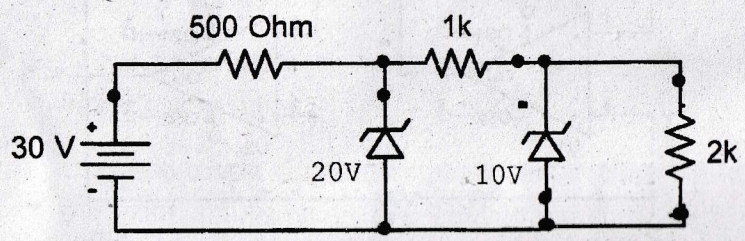
P.T.O.

Group - C

Answer any ***one*** of the following : 10×1=10

15. (a) An LED operates at 1.5 V and 5 mA in forward bias. Assuming an 80% external efficiency of the LED, how many photons are emitted per second? 3

(b) Determine the voltage and current across the 2 kΩ resistor. 2



(c) Explain the operation of solar cell with necessary schematic diagram. Draw the I-V characteristic curve on it. Write down the name of two semiconductor materials which are used for fabrication of solar cell. 3+1+1

16. (a) Show that OP-AMP can be used as a logarithmic amplifier. 3

(b) Derive the expression of voltage gain with negative feedback in terms of open loop gain and feedback factor. Write down the basic conditions for oscillation in feedback amplifier. 2+1

(c) Determine the output voltage (V0) in terms of V1 and V2 of the circuit given below. 4