

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.*

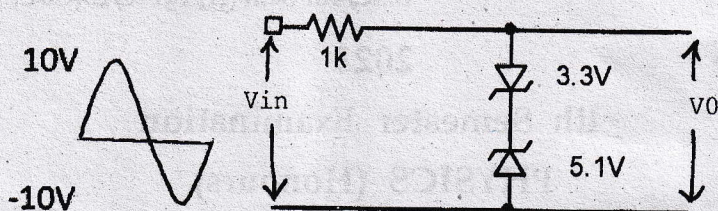
Group - A

Answer any **five** of the following : $2 \times 5 = 10$

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
(V_{in}) shown in figure below. Sketch output wave (V_0)
of the given figure. 2

P.T.O.

(2)



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

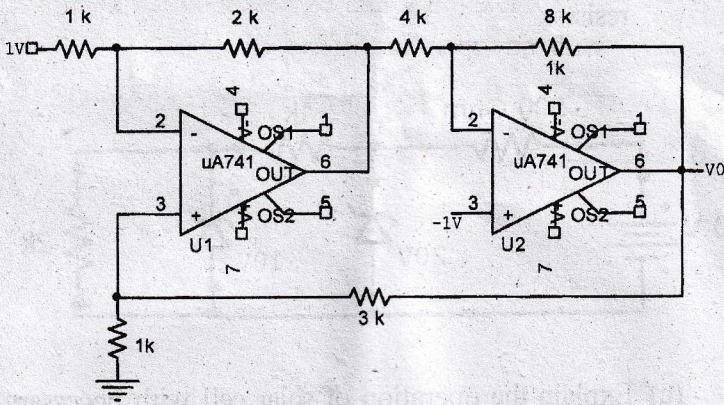
Answer any **four** of the following : $5 \times 4 = 20$

9. What is the charge neutrality condition in p-n junction diode? Define law of mass action. Determine the concentration of holes in n-type semiconductor using charge neutrality condition and law of mass action.
2+1+2
10. What are the factors that affect the bias stability of a transistor? Find the Q point of a self bias transistor circuit

(3)

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

(4)

Group - C

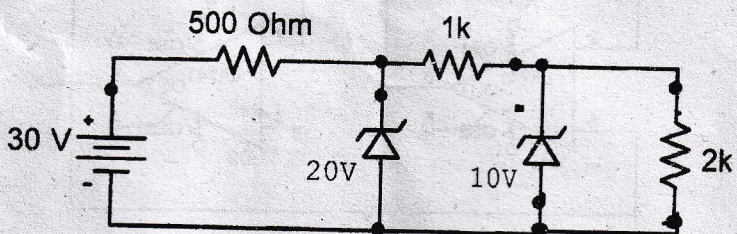
Answer any **one** of the following : $10 \times 1 = 10$

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 $2\text{ k}\Omega$ 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

(5)

- (c) Determine the output voltage (V_0) in terms of V_1 and V_2 of the circuit given below. 4

