

B. SC. PHYSICS (HONS.) EXAMINATION, 2023

(2nd Year, 2nd Semester)

ANALOG SYSTEMS AND APPLICATIONS

PAPER – CORE 10

Time : 2 hours

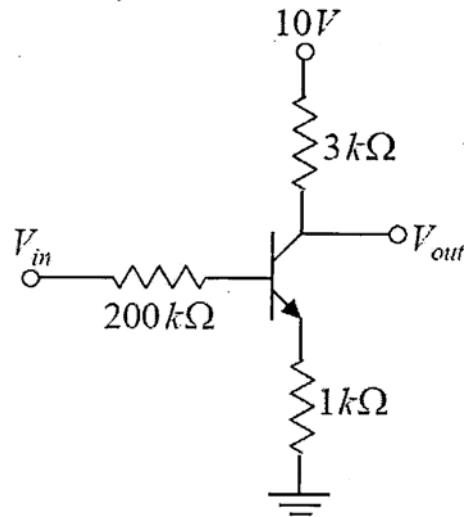
Full Marks : 40

1. a) Define Fermi Energy. Draw the $f(E)$ vs. E curves for $T = 0$ K and $T > 0$ K.
b) How does the temperature affect drift and diffusion current in a semiconductor?
c) Is there any advantage of Bridge Rectifier?
d) A crystal diode having internal resistance $r_{in}=20\ \Omega$ is used for half wave rectification. If the applied voltage $v = 50\sin\omega t$ and load resistance $R_L=800\ \Omega$, find (i) I_{max} , I_{dc} , I_{rms} (ii) a.c. power input and d.c. power output (iii) d.c. output voltage. 3+2+2+3
2. a) How the fill factor and efficiency can be calculated from the current-voltage characteristics of a solar cell?
b) A 6.8 V, 300 mW Zener diode is used as a voltage regulator with load resistance $R_L=1\ k\Omega$ and a series resistance $R_S = 220\ \Omega$. Find the minimum and maximum values of input voltage for which the output will be maintained constant at 6.8V.

[2]

- c) Draw the emitter bias circuit. Explain how the introduction of emitter resistance improves the stability of biasing in emitter bias circuit compared to fixed bias circuit. 3+3+4

3. a) For the transistor shown below, assume $V_{in} = 5V$, $V_{BE} = 0.7V$ and $\beta_{dc} = 100$. Find V_{out} .

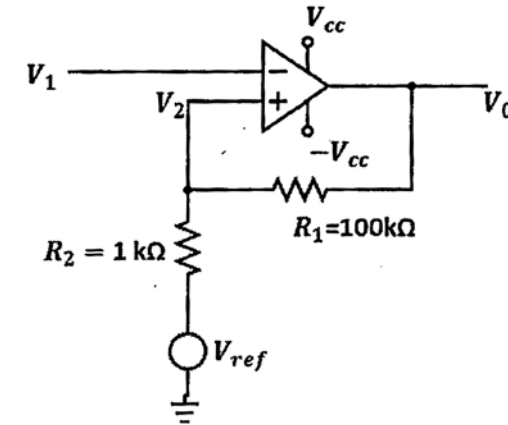


- b) In a CE amplifier, the load impedance consists of a resistance and inductance in series. What should be the phase difference between input and output signals? Give explanation.
- c) Draw and explain the frequency response graph of a RC coupled amplifier.
- d) In Oscillator although there is no supply of continuous ac signal in the input, how will we get ac signal in the output?

[3]

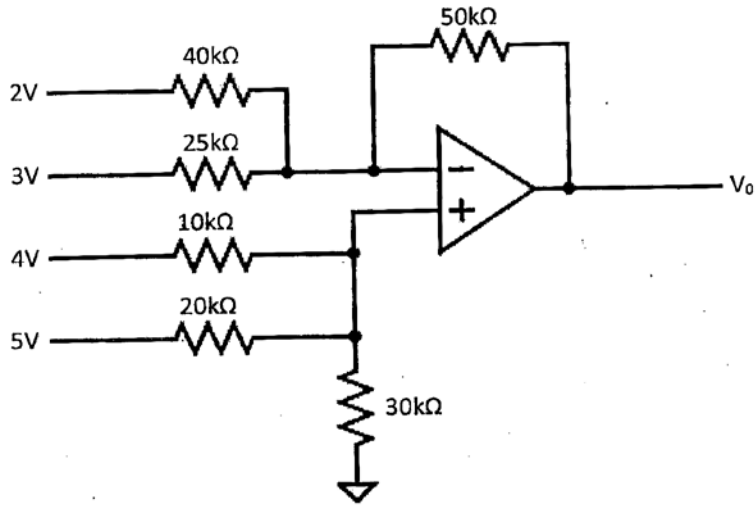
- iii) Draw the output waveform if $V_1 = 5 \sin 100\pi t$ V.

2+2+2



[2]

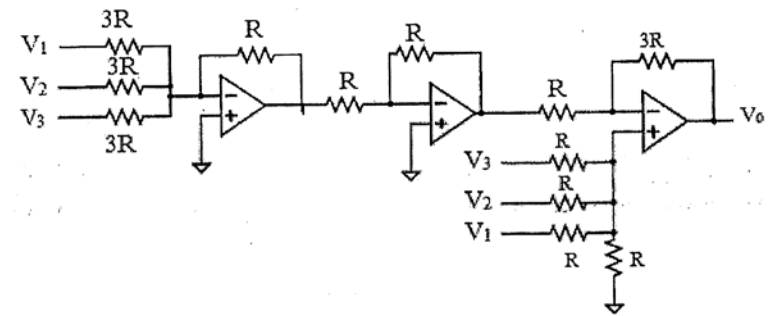
6. a) Find V_0 in circuit provided in figure below. 4



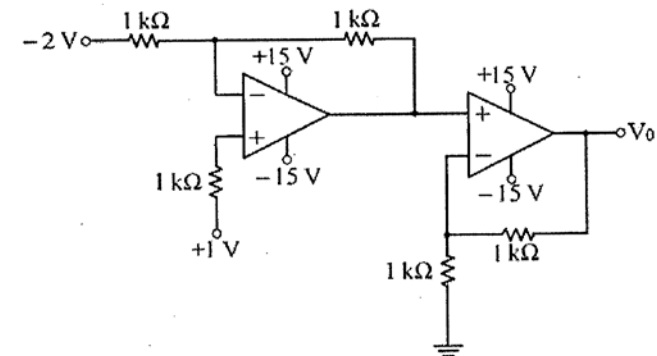
- b) In circuit given below $V_{ref} = 4\text{ V}$, output saturation voltages are $\pm 15\text{ V}$ and V_1 is an adjustable dc voltage source.
- Calculate the values of upper and lower threshold voltages,
 - In an experiment the V_1 has been gradually increased from 0 to 8 V and then decreased from 8 to 0 V. Draw the V_0 versus V_1 curve.

[3]

4. a) Draw circuit diagram of a differential amplifier working in double ended differential mode configuration. Draw suitable equivalent r_e model of this circuit and determine the expression for its gain. 2+2+4
- b) Write down the characteristic features of an operational amplifier (op-amp). 2
5. a) Find V_0 in circuit shown in figure below.



- b) Find V_0 in circuit shown in figure below. 5+5



[Turn over