

U.G. 3rd Semester Examination - 2024**PHYSICS****[HONOURS]****Course Code : PHY-H-CC-T-07 (A&B)****[CBCS]**

Full Marks : 40

Time : $2\frac{1}{2}$ Hours*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.***Answer all the questions from Selected Option.****OPTION-A****PHY-H-CC-T-07****(Analog Systems and Applications)**1. Answer any five questions: $2 \times 5 = 10$

a) Explain avalanche and Zener breakdown mechanism.

b) A transistor in active mode has collector and base currents 4mA and 20 μ A respectively. Calculate the values of α and β .

c) How the concept of virtual ground helps in analyzing an inverting operation amplifier?

d) The band gap of a specimen of Gallium Arsenide is 1.98eV. Determine the wavelength of electromagnetic radiation radiated upon direct recombination of holes and electrons in the sample.

[Turn over]

- e) What do you mean by DC load line and operating point of a transistor?
- f) Explain current flow mechanism for the reverse bias of a P-N diode. Why it is called saturation current?
- g) What are the advantages of using h-parameters?
- h) If the deflection sensitivity of a cathode-ray tube is 0.01 mm/V, determine the shift produced in the spot when 250V is applied to the vertical plates.

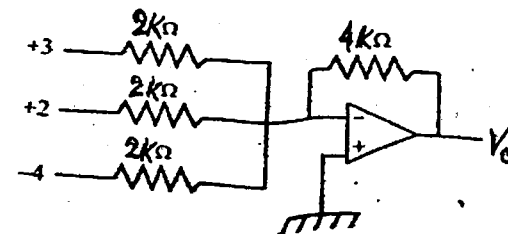
2. Answer any two questions: $5 \times 2 = 10$

- a) On which factors does biasing of a transistor depend? What are the leakage currents of a transistor and how they are related? Why do Si or Ge diode not emit light but GaAs diodes do?
 $2+2+1$
- b) Oscillators are not given any ac input then where from ac comes at the output? Explain how it is achieved? What is positive feedback in an amplifier? Write two advantages of positive feedback.
 $1+2+2$
- c) Explain the operation of a 4-bit R-2R ladder digital to analog converter. What are the differences between Weighted and R-2R Ladder resistive network?
 $3+2$

- d) Draw the output characteristic curve of a transistor in CE mode and label different portions of the curve. Hence justify the nature of the curve in the active region and saturation region.
 $1+1+3$

3. Answer any two questions: $10 \times 2 = 20$

- a) i) What is meant by mobility, drift velocity? Give a brief idea of PN Junction Fabrication with proper diagram. Calculate the ripple factor for a half wave rectifier.
- ii) A Zener ($V=9V$, $P=0.2W$) is employed to run a car stereo system having load of 5000Ω and requiring 9V stabilized voltage supply. If the car contains a 12V battery find the value of the series resistor and its power rating.
 $(2+2+1)+(2+3)$
- b) i) Determine the output voltage of the three input adder circuit shown below.



- ii) What do you mean by 3dB frequencies of an R-C coupled amplifier and why they are so called?

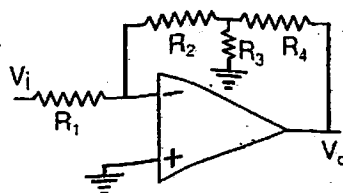
iii) Draw the circuit diagram of a Colpitts Oscillator circuit having two capacitors of 24nF and 240nF respectively are connected in parallel with an inductor of 10mH. Determine the frequency of oscillations of the circuit.

3+2+(2+3)

c) Draw the basic configuration of an emitter follower. What will be its input impedance and output impedance. What is the advantage of emitter follower configuration? What is p-channel MOSFET? Explain with proper diagram. Define α and β of a transistor. Deduce the relation between them.

2+2+1+3+2

d) What do you mean by virtual ground related to OP-AMP circuit? How does it differ from the concept of actual ground? Draw a circuit diagram of an integrator using OP-AMP and find its output V_o for the input V_i . If V_i be a square wave, then sketch the waveform for V_o . Find the output V_o for an ideal OP-AMP shown in the circuit below.



2+1+2+1+4

OPTION-B

PHY-H-CC-T-07

(Digital Systems and Applications)

GROUP-A

1. Answer any five questions: 2×5=10
 - a) Distinguish between ROM and RAM.
 - b) Subtract $(1110)_2$ from $(1011)_2$ using 2's complement method.
 - c) Express the Boolean expression $Y = AB + \bar{B}C$ in terms of minterms and maxterms.
 - d) What do you mean by assembly language and high level language?
 - e) Convert the hexadecimal number $(AF4.D6)_{16}$ into its binary equivalent.
 - f) Write down two advantages and two drawbacks of ICs.
 - g) What is time-base signal of a CRO? Show its typical waveform.
 - h) "EX-OR gate acts as inequality checker."—explain this statement.

GROUP-B

2. Answer any two questions: $5 \times 2 = 10$

- a) i) Simplify the Boolean expression $Y = A\bar{B}C + \bar{A}\bar{B}C + BC + \bar{B}\bar{C}$ using Karnaugh map.
- ii) Write down the truth tables for difference and borrow parts of a half-subtractor. Realize it using basic gates. $2 + (1 + 2)$
- b) i) How sequential logic system differ from combinational logic system?— Give examples for the both.
- ii) Construct a SR flip-flop using NAND gates. Explain its operation with truth table. How can it be converted into a clocked SR flip-flop? $2 + (1 + 1 + 1)$
- c) i) Explain how CRO is used to determine the frequency of an AC signal and the phase difference between two signals with same frequency.
- ii) Mention the function of stack pointer and program counter in 8085 microprocessor. Write down the different types of flags used in it. $2 + (2 + 1)$

- d) i) What are linear and digital ICs?
- ii) What is binary-coded-decimal? Explain with an example. State and explain De Morgan's theorems of Boolean algebra. $2 + (1 + 2)$

GROUP-C

3. Answer any two questions: $10 \times 2 = 20$

- a) i) Draw the circuit diagram of a decade ripple counter and explain its operation with timing diagram. Write some applications of such counters.
- ii) What are the different types of memories used in computer systems? Why cache memory is used there? Name the registers used in 8085 microprocessor. $(4 + 1) + (2 + 1 + 2)$
- b) i) How synchronous counters differ from the asynchronous one? Construct a three bit synchronous counter and explain its operation with timing diagram.
- ii) What do you mean by computer bus and bus width? Write down the functions of different buses used in 8085 microprocessor. $(1 + 4) + (2 + 3)$

c) i) Prove the Boolean identity $A+BC=(A+B)(A+C)$. Realize the Boolean expression $Y = \bar{A}B + A\bar{B}C$ using two input NAND gates only. What is multiplexer?

ii) Draw the circuit realization of JK flip-flop and explain its operation with truth table. What is race-around condition? How it is avoided using master-slave JK flip-flop?

$$(1+3+1)+(2+1+2)$$

d) i) Draw the circuit diagram of 4-bit adder/subtractor that realize 2's complement method. Explain its operation.

ii) Using basic gates, construct a decoder that decodes BCD as decimal digits 0 to 9.

iii) Explain the operation of a 4-bit shift register using JK flip-flops. Mention some uses of registers.

$$(1\frac{1}{2}+1\frac{1}{2})+3+(3+1)$$