

2026

6th Semester Examination (CCFUP : NEP)

PHYSICS

Paper : MDSE 2-T

(Single Core Major Elective-2)

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

[Advanced Electronics]

Full Marks : 40

Time : Two Hours

Group - A

Answer any *five* questions : $2 \times 5 = 10$

1. What is aliasing effect and how it can be avoided?
2. What are the differences between ROM and RAM?
3. The peak-to-peak voltage of an AM wave is 224 V and minimum dip-to-dip voltage is 96 V. Find the percentage of modulation and amplitude of carrier.
4. Draw the circuit diagram for phase shift oscillator using transistor and explain how phase shift of 360° is achieved.

P.T.O.



(2)

5. Explain how an OP-AMP can be used as voltage comparator. 1+1
6. What do you mean by negative feedback? Write the effects of negative feedback. 1+1
7. Write and explain Barkhausen's criterion for self-sustained oscillation. 1+1
8. What is a solar cell? Draw the typical I-V characteristic curves of a solar cell. 1+1

Group - B

Answer any *four* questions : 5×4=20

9. State and explain sampling theorem. Find the Nyquist rate and Nyquist interval for the signal : $y = \sin(100\pi t)$. 3+2
10. Draw the circuit diagram of a Hartley oscillator. Find an approximate expression for frequency of oscillation. Hence, obtain the condition of sustained oscillation. 2+2+1
11. What is multiplexer? Design a 4-to-1 multiplexer using basic gates and explain its operation. 1+(2+2)
12. Show that an amplitude-modulated wave can be represented by a carrier and two side frequencies for each modulation frequency. A sinusoidal carrier voltage of frequency 1 MHz is amplitude-modulated by sinusoidal voltage of frequency 5 kHz. Calculate the bandwidth of AM wave. 3+2

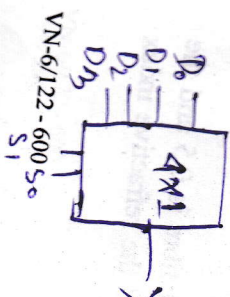
(3)

13. Draw a circuit diagram of a log amplifier using diodes and OP-AMP. Calculate the expression for output voltage. 2+3
14. Design an asynchronous 4-bit ripple counter and explain its operation. 2+3

Group - C

Answer any *one* question : 10×1=10

15. (a) Deduce an expression for voltage gain and phase difference for a lead-lag network (R-C network). From this show that the gain of the oscillator must be greater than 3 for sustained oscillation. Design a Wien-Bridge oscillator using this network. Calculate the frequency for sustained oscillation. (2+2+2+2)+2
- (b) What is photodiode?
16. (a) What is frequency modulation? Show that the amount of frequency deviation is independent of the modulating frequency. (1+3)+(3+3)
- (b) Construct a 4-bit shift register using D type flip-flops. Write down a table for readings of the shift register after each clock pulse by assuming the data word 1011.



Input Output

D ₀	0	1
D ₁	0	0
D ₂	1	0
D ₃	1	0

P.T.O.

(4)

OR

**[Semiconductor Device Physics,
Laser and Optical Fiber]**

Full Marks : 60

Time : Three Hours

Group - A

Answer any *ten* questions : $2 \times 10 = 20$

1. Define direct and indirect band gap semiconductors.
2. Calculate the density of donor atoms that has to be added to an intrinsic germanium semiconductor to make the conductivity 4 mho/cm. Given the electron mobility of the n-type semiconductor is $3900 \text{ cm}^2/\text{Vs}$.
3. What do you mean by Hall effect? What information can be obtained from Hall effect measurements? 1+1
4. Discuss the variation of position of Fermi level in n-type and p-type semiconductors with temperature.
5. A transistor has $\alpha = 0.99$. If it is connected in CE mode, what would be the change in collector current for a change of $10 \mu\text{A}$ in base current?

6. Write the working principle of LED.
7. Explain the difference between the spontaneous emission and the stimulated emission.
8. The numerical aperture of an optical fibre is 0.5 and the refractive index of core is 1.54. Find the refractive index of the cladding.

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9. If 15% of the power fed in the launching end of a 500 m long fibre is lost during propagation, calculate the attenuation in dB/km.
10. What is reverse saturation current in a p-n junction diode? How does it depend on temperature? 1+1
11. "The barrier potential across a p-n junction diode cannot be measured simply by placing a voltmeter across the diode terminals" — Explain.
12. What do you mean by lifetime and diffusion length of carriers?
13. Distinguish between avalanche breakdown and Zener breakdown.
14. What is thermal runaway in a BJT? Mention its effect on the I-V characteristics. 1+1
15. What do you mean by active and passive laser resonators?

Group - B

Answer any *four* questions : $5 \times 4 = 20$

16. Discuss drift and diffusion motion of carriers in a p-n junction diode. Derive Einstein relation between diffusion constant (D) and mobility (μ) in a p-n junction diode. 2+3

expression of carrier concentration for a non-degenerate semiconductor. Explain its temperature dependence.

- (b) A p-n junction diode is given a forward bias of 0.5V. Determine the static and dynamic resistances of the diode at 27°C if the reverse saturation current is $1\mu\text{A}$. Given $\eta=2$. (2+3+2)+3

