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3 (Sem-6/CBCS) PHY HE 1

2025

PHYSICS

(Honours Elective)

Paper : PHY-HE-6016

(Communication Electronics)

Full Marks : 60

Time : Three hours

**The figures in the margin indicate
full marks for the questions.**

1. Answer the following : $1 \times 7 = 7$

(i) What type of electromagnetic wave is used in satellite communication ?

(ii) Find the wavelength of a 150 MHz signal propagating in free space.

(iii) What is the height of the geostationary orbit above the earth's surface?

(iv) In amplitude modulation, the carrier frequency is usually lower than the modulating frequency. Is this statement true **or** false ?

(v) In phase modulation, what happens to the phase of the carrier wave when the amplitude of the modulating signal is zero ?

- (vi) What do you call the signal path from a satellite to a ground station?
- (vii) What is the name of the latest cell phone technology that is marketed as 4G?

2. Answer the following: $2 \times 4 = 8$

- (i) What do you mean by modulation? Why do we need modulation in radio communication systems?
- (ii) Define modulation index for amplitude modulated wave. What is the value of modulation index for AM wave if amplitude of modulating signal is 0.6V and carrier amplitude is 3V?
- (iii) What are the primary signal processing operations in pulse code modulation?
- (iv) State the difference between analog pulse modulation and analog modulation.

3. Answer **any three** from the following:

$5 \times 3 = 15$

- (i) A frequency modulated signal is represented by
 $V = 10 \cos(6.5 \times 10^6 t + 6 \sin 6280 t)$.
 Find the carrier and modulating frequencies, the modulation index and the maximum frequency deviation.
 $1 + 1 + 2 + 1 = 5$
- (ii) State sampling theorem. Discuss the basic concepts of amplitude shift keying and frequency shift keying. $1 + 2 + 2 = 5$

- (iii) Mention the advantages of digital communication. Explain the terms sampling and quantization in pulse code modulation. $1 + 2 + 2 = 5$

(iv) Draw the block diagram of earth station in satellite communication.

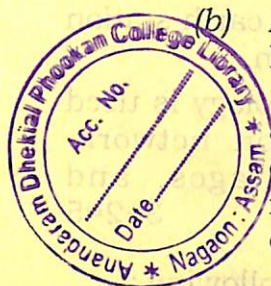
- (v) Explain how FDMA technology is used in mobile communication network. What are its advantages and disadvantages? $3 + 2 = 5$

4. Answer **any three** from the following:

$10 \times 3 = 30$

- (i) (a) What is frequency modulation?
- (b) Obtain an expression for the FM wave when the modulating signal is sinusoidal.
- (c) Point out the differences between AM and FM waves.
- (d) Explain with a neat circuit diagram the working of an FM wave generator. $1 + 3 + 2 + 4 = 10$
- (ii) (a) What do you mean by single sideband modulation technique?
- (b) Mention its advantages over amplitude modulation.
- (c) Describe with suitable block diagram, a method for generation of single sideband modulated wave. $2 + 2 + 6 = 10$

(iii) (a) Explain with circuit diagram how the diode detector is used in demodulating an amplitude modulated signal.



(b) A diode detector uses a parallel RC network with $R = 500k\Omega$ and $C = 100pF$. If an AM wave with 80% modulation is fed to this detector, what is the highest modulation frequency that can be detected with tolerable distortion?

6+4=10

(iv) (a) What is the basic function and purpose of a communication satellite?

(b) What is a geostationary satellite?

(c) Mention some of the advantages of geostationary satellites.

(d) Name the *four* access methods used in satellites. Which is the most widely used? 2+1+4+3=10

(v) (a) Draw the schematic diagram of a cellular mobile communication network and name its main components.

(b) Distinguish between 3G and 4G cellular networks. 6+4=10

(vi) Write short notes on: 5+5=10

(a) Multiplexing

(b) GPS navigation system