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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 : 1×7=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 : 2×4=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 : 5×3=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