

**CELLULAR AND SATELLITE COMMUNICATIONS
(ECEN 4281)**

Time Allotted : 3 hrs**Full Marks : 70***Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Rake receiver is used by
(a) FDMA (b) CDMA (c) TDMA (d) SDMA.
- (ii) GSM up-link frequency band is
(a) 824-849MHz (b) 915-935 MHz
(c) 895-915MHz (d) 935-960 MHz.
- (iii) A power is measured as – 50 dBm. In dBW, the same power magnitude will be
(a) - 80 (b) - 20 (c) - 50 (d) + 20.
- (iv) Frequency factor of a cellular system is given by
(a) 1/N (b) 1/2N (c) 1/4N (d) 2N.
- (v) First generation cellular was called hybrid as
(a) the traffic channel was digital and control channel was analog
(b) only the traffic channel was analog
(c) TDMA/FDMA was applied
(d) none of these.
- (vi) CDMA uses the entire bandwidth of
(a) 1.25 GHz (b) 125 KHz
(c) 1.25 MHz (d) 1.25 KHz.
- (vii) Minimum number of GEO satellites required to cover earth is
(a) 2 (b) 3 (c) 4 (d) 5.
- (viii) For C-band satellites, the uplink (to satellite) frequency band is (5.9 - 6.4) GHz, the downlink frequency band will be
(a) (3.7 - 4.2) GHz (b) (8.1 - 8.6) GHz
(c) (3.7 - 4.2) MHz (d) none of these.

- (ix) DTH dishes are examples of
(a) cassegrain antenna
(b) primary-focus feed type antenna
(c) C-band antenna
(d) log-periodic antenna.
- (x) Inter-satellite link is used for
(a) global coverage (b) mobile communication
(c) improved bit rate for long distance (d) both (a) and (b).

Group – B

2. (a) Explain the concept of 'Frequency Reuse'. Define a cluster in a GSM network.
In a GSM network, a cluster is formed of 7 cells. There are, in all, 10 clusters. The reuse factor is, therefore, 10. Explain.
Explain the fact that reuse factor for CDMA is unity.
- (b) The up or down frequency band in GSM is 25 MHz wide. The channel spacing is 200 KHz. Yet the total number of channels is 124 but not 125. Justify.

6 + 6 = 12

3. (a) What is handoff? Discuss different handoff strategies. Differentiate hard and soft handoff.
- (b) Discuss fixed and dynamic channel allocation strategies in a cellular network.

(2 + 4 + 2) + 4 = 12

Group – C

4. (a) The channel spacing in GSM system was increased to 200 KHz from 25 KHz with respect to 1G system. Yet, the number of subscribers has remained the same. Explain this paradox.
- (b) Draw the block diagram of a typical GSM system. Describe the operations of (i) HLR, (ii) GMSC and (iii) VLR.

3 + (5 + 4) = 12

5. (a) What is direct sequence spread spectrum? How is it related to the number of subscribers in a CDMA network? What is near-far problem in CDMA network? How is it solved?

- (b) If a transmitter produces 50W of power, express the power in (i) dBm and in (ii) dBμ. If this power is applied to an unity gain antenna with a 900 MHz carrier frequency, determine the received power at a free space distance of 1Km. from the antenna. Also find the received power at a distance of 10 Km. Assume unity gain for receiver antenna and a loss factor of 1.

$$(4 + 3) + 5 = 12$$

Group – D

6. (a) What are the functions of different blocks (T, T and C) in a TT & C module in a satellite? Draw the schematic diagram of a TT & C module and explain the operation of the twice-around processing block.
- (b) Determine the value of overall carrier to noise ratio at the earth station in a satellite link, if a signal is transmitted to a transponder with a carrier to noise ratio of 15 dB and transponder transmits with a ratio of 20 dB.

$$9 + 3 = 12$$

7. (a) Explain with a diagram the process of launching a satellite in orbits. What do you understand by “powered flight”?
- (b) What are the features and advantages of a satellite in a geostationary orbit? Name 2 Indian satellites in such an orbit.

$$(5 + 2) + (4 + 1) = 12$$

Group – E

8. (a) State and explain Friis’ equation for RF propagation. Explain on the basis of the equation why does the received power decrease at higher carrier frequency.
- (b) What are the various satellite subsystems that are common in any setup? Write an expression for Friis formula for received power using standard notations.

$$6 + (4 + 2) = 12$$

9. Write short notes on any three of the following:

$$(3 \times 4) = 12$$

- (i) Apogee and Perigee
- (ii) Principles of Rocket Propulsion
- (iii) 3G- Mobile communication
- (iv) CDMA
- (v) Geosynchronous Satellite.