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17EC755

Seventh Semester B.E. Degree Examination, July/August 2022
Satellite Communication

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1. a. How do all three laws of Kepler, Newton's law of gravitation and Newton's 2nd law of motion help in determining the satellite orbits? Explain in brief with necessary diagrams (wherever applicable) and mathematical identities. (10 Marks)
- b. A Rocket injects a satellite with 8 km/s horizontal velocity from the height of 1620 km from earth's surface. What will be velocity of the satellite at a point distant 9500 km from centre of the earth, if the direction of satellite makes an angle of 33° with the local horizontal at that point? Earth's radius = 6380 km. (05 Marks)
- c. How does Doppler shift and Ellipse effect the overall performance of satellite system? (05 Marks)

OR

2. a. With proper geometrical diagrams and an assumed position of satellite in space (x, y and z coordinates), describe the process of Azimuth elevation calculation. (10 Marks)
- b. Refer Fig.Q2(b) below, the semi major axes of two satellites are 19000 km and 24000 km. Determine the relationship between their orbital periods. For satellite No.2, semi minor axes is 18100 km. Determine the apogee and perigee distances for this satellite No.2.

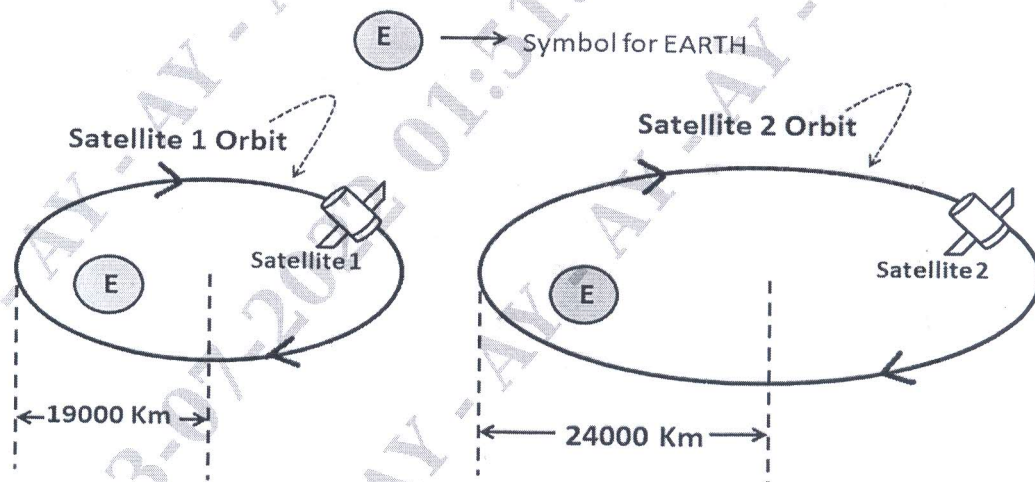


Fig.Q2(b)

(10 Marks)

Module-2

3. a. With neat block schematic, explain the detailed functioning and features of the tracking, telemetry and command subsystem of a satellite. What are the major functions provided by ISTRAC network related to TT and C? (10 Marks)
- b. It is desired that the battery system on-board the satellite is capable of meeting the full power requirement of 3.6 KW for the ellipse period of 66 minutes. If the satellite uses NiH₂ cells of 1.3 V, 90 Ah capacity each with an allowable DoD (Depth of Discharge) of 80% and discharge-efficiency of 96%. Find: (i) Number of cells required (ii) Total mass of the battery system. Specific energy specification of the battery is 58 Wh/kg. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 4 a. Explain the functioning of each block of earth station architecture. (08 Marks)
 b. Explain why Effective Isotropic Radiated Power (EIRP) and receiver figure of merit (G/T) are termed as two main key performance parameter governing earth station? (06 Marks)
 c. Explain the main functions of High Power Amplifier (HPA) and up/down converters as integral parts of a satellite earth station. (06 Marks)

Module-3

- 5 a. Compute the free-space path loss in decibels for the following conditions:
 (i) Path length of 9 km at 4 GHz operating frequency.
 (ii) Earth station transmitting antenna EIRP = 48 dBW, satellite receiving antenna gain = 20 dB and received power at satellite = - 120 dBW. (08 Marks)
 b. Write down received power equation (in dB) at satellite and name each of the three terms. How does this P_R equation get modified when loss components are also considered? (04 Marks)
 c. With related performance graphs, explain 'Free Space Loss' and 'Attenuation Due to Rain' effects related to propagation of electromagnetic wave through atmosphere. (08 Marks)

OR

- 6 a. Write down five main differences between FDMA and TDMA. (05 Marks)
 b. Explain in detail the functioning of frequency hopping CDMA (FH-CDMA) transmitter and FH CDMA receiver. Draw the block schematics for both (transmitter and receiver). (10 Marks)
 c. In brief, explain the transmission path for SCPC/FM/FDMA system with line schematic, containing five baseband channels. (05 Marks)

Module-4

- 7 a. What are the performance parameters of a transponder? With neat block schematic, explain the architecture and functioning of 'Transparent or Bent Pipe' transponder. (10 Marks)
 b. Explain the functioning of 'Satellite Cable TV' and 'Direct to Home' satellite television in brief. In block schematic for both cases show the signal transmission and reception paths. (10 Marks)

OR

- 8 a. Write and explain three main disadvantages of satellite network with respect to terrestrial networks. (06 Marks)
 b. Write in brief about the national satellite systems of India (INSAT series). (06 Marks)
 c. Draw neat block diagram for 'basic elements of a satellite communication system'. Explain in detail only the features and functions of 'low noise amplifier' block in this. (08 Marks)

Module-5

- 9 a. Write in detail about the pay loads and various types of active and passive sensors-on-board remote sensing satellites. Mention four applications of these sensors. (10 Marks)
 b. Write in detail about the orbits and payloads related to weather forecasting satellites. How do these satellites measures the cloud parameter to help predict rainfall in an area? (10 Marks)

OR

- 10 a. Write in detail about five main applications of remote sensing satellites. (10 Marks)
 b. Write about different types of positioning modes of GPS. Explain with the help of signal transmission-reception diagram for both modes. (06 Marks)
 c. What are the different sources of errors in GPS? (04 Marks)
