UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2020

Programme Name: B. Tech ASE+AVE **Semester : VIII**
Course Name : Satellite System Engineering **Time : 03 hrs**
Course Code : AVEG 471 **Max. Marks : 100**

Part A : Each questions carries two marks (15*2=30)

Multiple Choice Questions

1. A geosynchronous satellite

a) Has the same period a that of the Earth b) Has a circular orbit

c) Rotates in the equatorial plane d) All of the above

2. Point on the satellite orbits farthest to the earth.

a) Apogee b) Perigee c) Prograde d) Zenith

3. The satellite orbit is 600 Km and Earth's equatorial radius 6378km, Find the velocity of the orbit?

a) 6.3 km/s b) 6 km/s c) 7.6 km/s d) 7 km/s

4. Why does the orbit take the shape of an ellipse or circle?

a) Position can be easily determined b) Consume less fuel

c) Most efficient geometry d) Better coverage on earth

5. For 0% overshoot the damping ratio for a second order system is

a) <1 b) >1 c) Zero d) 1

6. The steady state error for an input 2 u(t) applied to a type 0 system is

a) ½(1+Kp) b) 2/1+Kp c) 1/Kp d) 0

7. A satellite control system is described by the equation $\frac{d^2\, c(t)}{dt^2} + 5\frac{d\, c(t)}{dt} = 100\ (r(t) - 0.25\ c(t))$

Where, r(t) and c(t) being reference input and controlled variable respectively, the damping ratio is

a) 2.5 b) 1 c) 0.5 d) 0.25

8. Satellite derivative feedback control

a) increase rise time b) increase overshoot b) decrease steady state error

d) does not affect the steady state error

Fill in the blank Questions

9. For an underdamped system, damping ratio is----------------------------

10. Satellite frequency FDMA stands for-----------------------------------

11. Lead compensator pole is located to -------------------of the zero

12. The magnitude & phase relationship between _________input and the steady state output is called as frequency domain

True or False Questions

13. The downlink frequency is lower than the uplink frequency.

14. Satellite spacing is not affected by the bandwidth of the transmitting earth station

15. Finite steady state error is independent of K

Part B : Each questions carries ten marks (5*10=50) having internal choices in Q20

16. Explain the system engineering approach for small satellite? Discusses the International space station (ISS) spacecraft / Sub system requirements and trade off analysis

17. Write the MATLAB Programming for system $\frac{S^2}{(S+3)(S+8)(S+12)}$

a) Transfer function to pole zero conversion

b) State space to transfer function

c) r, p, k to transfer function

d) Step response of the given system including labels

e) Frequency response stability condition

18. Explain the losses in satellite signals? A satellite link operating at 14 GHz with a transmit power of 6 W and an antenna gain of 48.2 dB. The range between a ground station and a satellite is at 42,000 km of altitude. The receiver feeder losses of 1.5 dB and the atmospheric absorption loss is 0.5 dB and the antenna pointing loss is 0.5 dB. Depolarization losses may be neglected.

Calculate the following

a) Total loss for clear sky conditions
b) EIRP
c) FSL

19. A unity feedback satellite control system is $\frac{\mathbf{16}}{\boldsymbol{s^2+1.6s}}$ the damping ratio is to be made 0.8. Determine the value of Td and compare, the rise time, peak time, maximum overshoot for the system

a) Without derivative control

b) With derivative control ($1+ST_d$) cascade with G(s)

20. Define steady state errors? Static error coefficients comparison of Type 0, Type 1 and Type 2

a) Positional error coefficient

b) Velocity error coefficient

c) Acceleration error coefficient

(Or)

Briefly explain the controllers and compensators as given below

a) P, I, D Controller
b) PI, PD Controller
c) Lag, Lead, Lag-Lead compensator

Part C (20 Mark question having internal choices)

21. a) Using Routh Hurwitz criterion determine the relation between K and T so that unity feedback satellite system whose open loop transfer function given below is stable.

$$G(s) = \frac{K}{s[s(s+10)+T]}$$

b) Determine the stability of a satellite system having following charactertics equations

$$S^6 + S^5 + 5S^4 + 3S^3 + 2S^2 - 4S - 8 = 0$$

(Or)

For given satellite system A) $\frac{\mathbf{1}}{\boldsymbol{S}(\mathbf{1}+\boldsymbol{S})(\mathbf{1}+\mathbf{2}\boldsymbol{S})}$ B) $\frac{\mathbf{1}}{\boldsymbol{S}^{\mathbf{2}}(\mathbf{1}+\boldsymbol{S})(\mathbf{1}+\mathbf{2}\boldsymbol{S})}$ Find the gain $|G\ (j\omega)|$ in dB and phase angle G (jω) in degree for given frequency

Satellite System A	ω (rad/Sec)	0.35	0.4	0.45	0.5	0.6	0.7	1
Satellite System B	ω (rad/Sec)	0.45	0.5	0.55	0.6	0.65	0.75	1