Reg. No. :

Question Paper Code : 50030

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017

Fifth Semester

Aeronautical Engineering

AE 6505 – CONTROL ENGINEERING

(Regulations 2013)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions.

PART – A (10×2=20 Marks)

1. Define Analogy systems.
2. What are the components of electrical system ?
3. Differentiate between open loop and closed loop control system.
4. Define mixed node in Signal flow graph.
5. What are static error constants ?
6. Draw the time response of a first order system.
7. What is a Bode plot ?
8. State necessary and sufficient condition for the Routh-Hurwitz stability criterion.
9. What is a sampled data system ?
10. Mention the advantages of digital control system ?

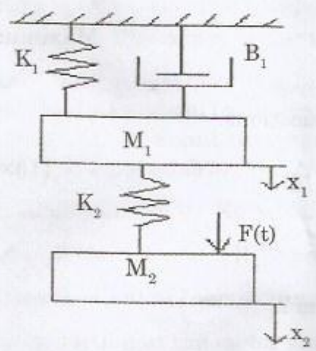
PART – B (5×13=65 Marks)

11. a) i) Explain the development of a flight control system. (6)

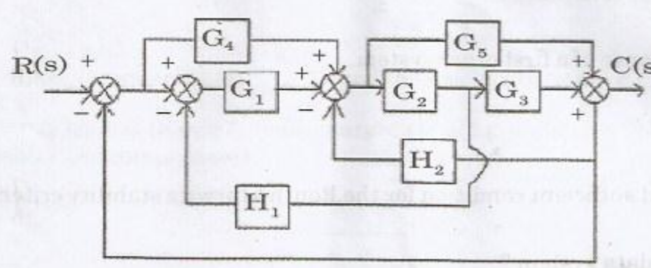
ii) Explain the theory of simple hydraulic system with neat diagram. (7)

(OR)

b) Determine the transfer function of the figure shown in below : (13)

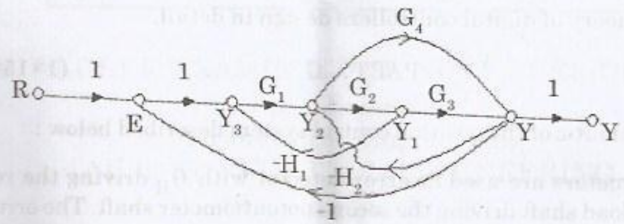


12. a) Determine the transfer function for the figure shown in below by using block diagram reduction technique. (13)



(OR)

b) Determine the transfer function for the figure shown in figure by using Mason's Gain formula. (13)



13. a) The open loop transfer function of a systems is given as $\frac{5}{s^2(s+3)(s+10)}$. Determine respectively the positional, velocity and acceleration error constants for these systems. Also for the system determine the steady state errors with step input r(t) = u(t), ramp input r(t) = t and acceleration input $r(t) = \frac{1}{2}t^2$. (13)

(OR)

b) i) Explain with neat sketch the time response of a second order system using Unit step input. (8)

ii) Determine steady state errors of Type 0, Type 1, Type 2 systems for unit step, unit ramp and unit parabolic inputs. (5)

14. a) Sketch the root locus diagram for a unity feedback system with its open loop function as $G(s) = \frac{k(s+3)}{s(s^2+2s+2)(s+5)(s+9)}$. Thus find the value of k at a point where the complex poles provide a damping factor of 0.5. (13)

(OR)

b) The forward path transfer function of a Unity-feedback control system is given as $G(s) = \frac{k}{s(1+0.1s)(1+0.5s)}$. Draw the Bode plot of G(s) and find the value of k so that the gain margin of the system is 20 dB. (13)

15. a) Explain the digital PID controllers and their effect on system performance. (13)

(OR)

b) Explain the theory of digital controllers design in detail. (13)

PART – C (1×15=15 Marks)

16. a) Draw the schematic of the position control system described below : (15)

Two potentiometers are used as error detector with θ_R driving the reference shaft and the load shaft driving the second potentiometer shaft. The error signal is amplified and drives a D.C. Servomotor armature. Field current of the motor is kept constant. The motor drives the load through a gear.

Draw the block diagram of the system and obtain the closed loop transfer function. Find the natural frequency, damping factor, peak time, peak overshoot and settling time for a unit step input, when the amplifier gain $K_A = 1500$. The parameters of the system are as follows :

Potentiometer sensitivity Kp = 1 V/rad

Resistance of the armature $R_a = 2$ ohm.

Equivalent moment of Inertia at motor shaft = $J = 5 \times 10^{-3}$ kg-m^2

Equivalent friction at the motor shaft = $B = 1 \times 10^{-3}$ NW/rad/sec

Motor torque constant = $K_T = 1.5$ N m/A

Gear ratio n = 1/10

Motor back e.m.f. constant = $K_b = 1.5$ V/rad/sec.

(OR)

b) Consider a system $G_c(s)\dfrac{k_v}{s(s+1)}$ and the specifications are e_{ss} for a velocity input should be less than 0.1 phase margin should greater than 40 degree. Design phase lead compensator. (15)

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