Reg. No. :

Question Paper Code : 40527

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
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. Write the force equation for the system shown in Fig. 1.

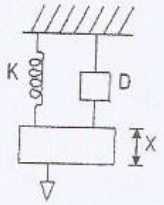

Fig. 1

2. What do you mean by hydraulic system ? Give example.

3. Find the output for the block diagram given below in Fig. 3.

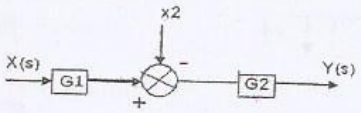

Fig. 3

4. Define open loop system with an example.

5. Name the test signals used in control system.

6. Define rise time for a second order under damped system.
7. Define phase margin and gain cross over frequency.
8. Define the correlation between time and frequency response.
9. Define Digital PID Controller.
10. Write the properties of digital controllers.

PART – B (5×13=65 Marks)

11. a) Write the differential equations for the given mechanical system shown in Fig. 11 (a) and draw an analogous electrical circuit based on force-voltage analogy. (13)

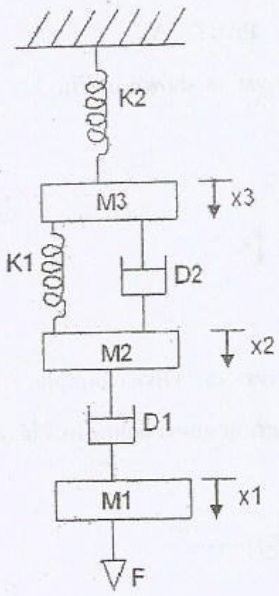

Fig. 11 (a)

(OR)

b) Draw a functional block diagram showing elements of a control system wherein the controlled variable is position θ of a shaft. Identify in feedback loop the sensor, the actuator, how appropriate action is determined (without and with minor-loop feedback) ; and some likely disturbances. (13)

12. a) The block diagram of a closed loop system is shown in Fig. 12 (a). Using the block diagram reduction technique, determine the closed loop transfer function C(s)/R(s). **(13)**

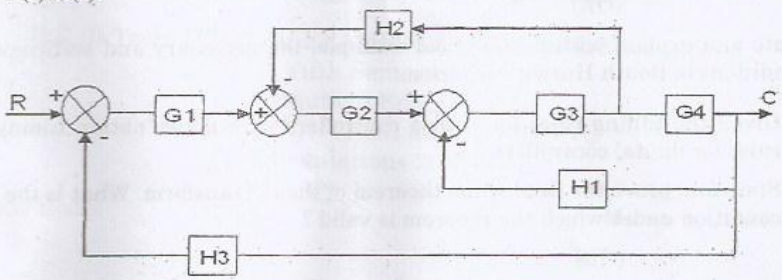

Fig. 12 (a)

(OR)

b) Consider the signal flow graph model of a feedback system shown in Fig. 12 (b). Obtain the response Y(s) to the simultaneous application of the inputs R(s) and W(s) using Mason's gain rule. **(13)**

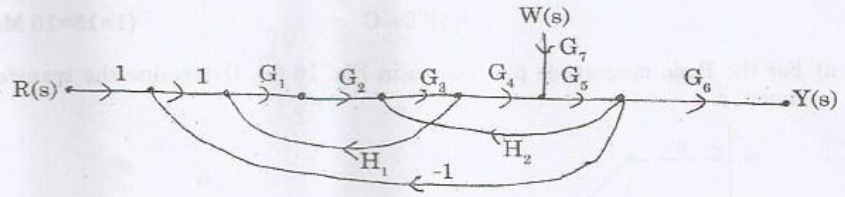

Fig. 12 (b) A signal flow graph model

13. a) Determine the time response specifications and expression for output for unit step input to a system having the system equation as follows :
$d^2y/dt^2 + 5\,dy/dt + 16y = 9x$. Assume zero initial conditions. **(13)**

(OR)

b) The transfer function of a first-order process is given by : **(13)**

$$\frac{Y(s)}{R(s)} = G(s) = \frac{1}{zs+1}$$

i) Find the unit-impulse response. **(3)**
ii) Find the unit-step response. **(3)**
iii) Find the unit-ramp response. **(3)**
iv) Find the response to sinusoidal input A sinωt. **(4)**

Identify the steady state and transient components of the response in each case.

14. a) Sketch the root locus for the system G(s) H(s) given below and comment on stability. (13)

G(s) H(s) = K (s + 4) (s + 5)/(s + 3) (s + 1), K > 0.

(OR)

b) State and explain with a numerical example, the necessary and sufficient conditions of Routh Hurwitz criterion. (13)

15. a) i) Given the tuning rules for analog controllers, how do we obtain tuning rules for digital controllers ? (6)

ii) State and prove the final value theorem of the Z-Transform. What is the condition under which the theorem is valid ? (7)

(OR)

b) A sampled data system is described by the transfer function,

$$M(z) = \frac{Y(z)}{R(z)} = \frac{1}{z^2 + a_1 z + a_2}; \; a_1 = -\frac{3}{4}, a_2 = \frac{1}{8}$$

Find the response y(k) to the input i) r(k) = δ(k), ii) r(k) = μ(k). (13)

PART – C (1×15=15 Marks)

16. a) For the Bode magnitude plot shown in Fig. 16 (a). Determine the transfer function. (15)

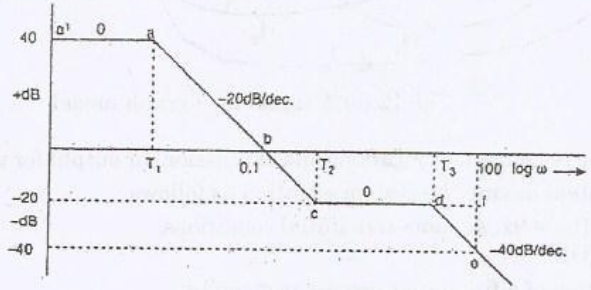

Fig. 16(a)

(OR)

b) For a certain control system, G(s) H(s) =K/s(s + 2) (s + 10). Sketch the Nyquist plot and determine the range of values of K for stability. (15)