Reg. No. : | | | | | | | | | | | |

Question Paper Code : 80446

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fourth Semester

Electronics and Communication Engineering

EC 2255/EC 46/EE 1256 A/080290023/10144 EC 406 — CONTROL SYSTEMS

(Regulations 2008/2010)

(Common to 10144 EC 406 – Control Systems for B.E. (Part-Time) Third Semester ECE – Regulation 2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is the main advantages of closed loop system over open loop systems?

2. Write the mathematical expressions for step input and impulse input.

3. The closed loop transfer function of a second order system is given by $\frac{400}{s^2+2s+400}$. Determine the damping, ratio and natural frequency of oscillation.

4. Give the steady state errors to a various standard inputs for type-2 system.

5. What is meant by 'Corner frequency' in frequency response analysis?

6. What is Nichols chart?

7. Define Masons gain formula.

8. Define rise time and peak overshoot.

9. Define Nyquist stability criterion.

10. What is gain margin and phase margin?

PART B — (5 × 16 = 80 marks)

11. (a) Derive the transfer function of a RLC series circuit. (16)

Or

(b) With a neat diagram, derive the transfer function of a field controlled dc motor. (16)

12. (a) (i) The unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$. Determine the gain K, so that the system will have a damping ratio of 0.5. For this value of K, determine settling time, peak overshoot and time to peak overshoot for a unit step input. (8)

(ii) A unity feedback system has the forward transfer function $G(s) = \frac{K_1(2s+1)}{s(5s+1)(1+s)^2}$. The input $r(t) = 1(+6t)$ is applied to the system. Determine the minimum value of K_1, if the steady error is to be less than 0.1. (8)

Or

(b) With suitable block diagrams and equations, explain the following types of controllers employed in control systems :

(i) Proportional controller (4)

(ii) Proportional-plus-integral controller (4)

(iii) PID controller (4)

(iv) Integral controller. (4)

13. (a) A robotic arm has a joint control loop transfer function $G_c(s)G(s) = \frac{300\,(s+100)}{s\,(s+10)\,(s+40)}$. Prove that the frequency equals 28.3 rad/s when the phase angle is –180°. Find the magnitude at that frequency. (16)

Or

(b) Derive the transfer function of the compensating network and the type of compensation given in Fig. 13(b) and draw the Bode plot. (16)

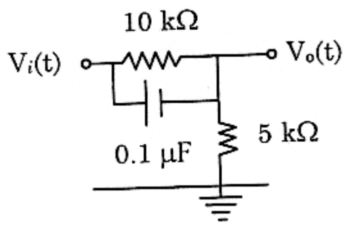

Fig. 13(b)

14. (a) Sketch the root locus for $GH(s)=\frac{k(s+2)(s+3)}{(s+1)(s-1)}$. (16)

Or

(b) The open loop transfer function of a unity feedback control system is given by $G(s)=\frac{k}{(s+2)(s+4)(s^2+6s+25)}$. By applying the Routh criterion, discuss the stability of the closed loop system as a function of K. (16)

15. (a) A system is represented by the state equation $\dot{X}=AX+BU$; $Y=CX$ where $A=\begin{bmatrix}0 & 1 & 0\\ 0 & -1 & 1\\ 0 & -1 & -10\end{bmatrix}$, $B=\begin{bmatrix}0\\ 0\\ 10\end{bmatrix}$ and $C=[100]$. Determine the transfer function of the system. (16)

Or

(b) A system is characterised by the transfer function $\frac{Y(s)}{U(s)}=\frac{3}{s^3+5s^2+11s+6}$ Identify the first state as the output. Determine whether or not the system is completely controllable and observable. (16)

———————