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Roll No. | | | | | | | | | | |

**UG (Full Time) End-Semester Examinations April/May 2024**

EE 5691– **INTRODUCTION TO CONTROL SYSTEMS**

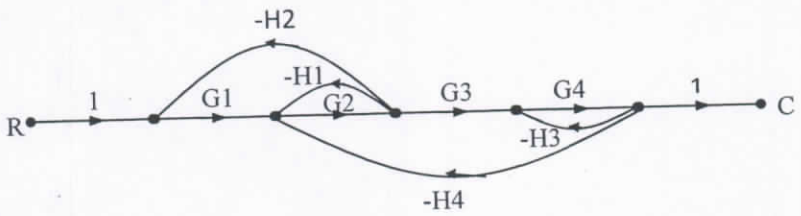
Time: 3 Hours | Answer ALL Questions | Max. Marks 100

**PART- A (10 x 2 = 20 Marks)**

| Q.No | Questions | Marks |
|---|---|---|
| 1. | Discuss various classification of systems | 2 |
| 2. | Define transfer function and discuss its poles and zeros | 2 |
| 3. | Define the type and order of a control system | 2 |
| 4. | What is centroid and how is it derived? | 2 |
| 5. | Define decade and octave range of frequency | 2 |
| 6. | Define gain crossover frequency and phase margin | 2 |
| 7. | How the imaginary roots are obtained from Routh-Hurwitz Criterion? | 2 |
| 8. | Describe the difference between absolute and relative stability | 2 |
| 9. | Explain the concept of state and state variables | 2 |
| 10. | State the properties of state transition matrix | 2 |

**PART- B (5 x 13 = 65 Marks)**

(Restrict to a maximum of 2 subdivisions)

| Q.No | Questions | Marks |
|---|---|---|
| 11. | a) Find the overall gain C/ R for the signal flow graph shown in Fig11.   (Fig 11) | 13 |
| | **OR** | |
| | b) Convert the signal flow graph shown in Fig11 in to a block diagram and use block diagram reduction technique to find the overall gain C/R. | 13 |
| 12. | a) Derive the step response of a II order underdamped system and therefrom obtain rise time, peak time, settling time and peak overshoot. | 13 |
| | **OR** | |
| | b) A unity feedback system has the loop transfer function $G(s) = k(s+3)/[(s(s+4)(s+5)(s^2+2s+2)]$. Sketch the Root Locus showing all the relevant points. Find the breakaway point and imaginary axis crossover point. | 13 |

| | | |
|---|---|---|
| 13. | a) Sketch the polar plot for a control system whose loop transfer function is $G(s) = k/[(s-1)(s+2)]$ for k=1 and 2. | 13 |
| | **OR** | |
| | b) Sketch the Bode plots for a control system whose loop transfer function is $G(s) = 500(s+2)/[s(s+1)(s+5)(s+20)]$. Determine GM and PM. | 13 |
| 14. | a) Determine the range of k over which the following characteristic polynomials belong to stable systems.<br>1. $s^3+6s^2+11s+k$ 2. $S^4+5s^3+9s^2+20s+k$ | 13 |
| | **OR** | |
| | b) Sketch the Nyquist plot for a unity feedback system whose open loop transfer function is $G(s) = 20/[s^2(s+2)(s+4)]$. Examine the closed loop stability. | 13 |
| 15. | a) A Closed loop system is described by the differential equation:<br>$d^2y/dt^2+2dy/dt+3y=4u$<br>where u is the input and y is the output. Choosing proper state variables, determine a state model consisting of state equation and output equation. | 13 |
| | **OR** | |
| | b) For a control system having transfer function $C(s)/R(s)=5/[s(s+1)(s+2)]$. Obtain the state equations and hence the state transition matrix. Also write the expression for the output c(t) if the input r(t)=u(t). | 13 |

**PART- C (1 x 15 = 15 Marks)**

(Q. No 16 is Compulsory)

| Q.No | Questions | Marks |
|---|---|---|
| 16. | A proportional-derivative feedback control system has forward path t.f. $G(s)=16/s(s+0.8)$ and feedback path t.f. $H(s)= 1+ks$. Determine the value of k such that the damping ratio is 0.5. With this value of k, obtain the rise time, overshoot, peak time and settling time. | 15 |