Name : ....

Eighth Semester B.Tech. Degree Examination, November 2015
(2008 Scheme)
08.801 : ADVANCED CONTROL THEORY (E)

Time : 3 Hours | Max. Marks : 100

***Instruction** : Answer **all** questions from Part **A** and **one full** question from **each** Module of Part **B**.*

PART – A

1. A single input system is described by the following state equation $\dot{x} = \begin{bmatrix} -1 & 1 & 0 \\ 1 & -5 & 0 \\ 0 & 1 & -2 \end{bmatrix} x + \begin{bmatrix} 5 \\ 1 \\ 0 \end{bmatrix} u,\ y = [1\ 0\ 1]x + u$. Determine the transfer function of the system.

2. Transform the following system $\dot{x} = \begin{bmatrix} 0 & 1 \\ -0.5 & 1.5 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u,\ y = [0.6\ 1]x$ into diagonal form.

3. Determine whether the system $\dot{x} = Ax + bu$, $y = cx$ with $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}, b = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ and $c = [1\ 0\ 0]$ is observable.

4. Show that state space representation of a system is not unique.

5. State sampling theorem.

6. Determine the stability of the system with characteristic equation $z^4 + 0.25 = 0$ by Jury's test.

7. Determine the transfer function of zero order hold circuit.

P.T.O.

8. Determine the singular points for the system $\dot{x}_1 = \sin(x_2),\ \dot{x}_2 = x_1^2$.

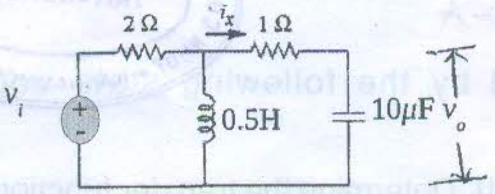
9. Distinguish between stability and asymptotic stability.

10. What is describing functions ? **(10×4=40 Marks)**

PART – B

Module – I

11. a) Derive the state space model of the system shown below. Also determine the poles of the system thus obtained. **10**



b) Convert the following system into statespace Jordan canonical form. Also sketch the realization of the system $\frac{Y(s)}{U(s)} = \frac{2s}{(s+1)^2 (s+2)}$. **10**

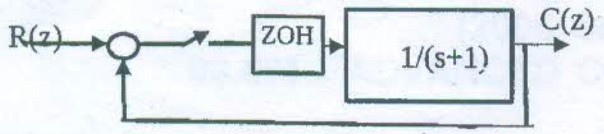
12. a) The system described by the equations $\dot{x} = \begin{bmatrix} 1 & 0 \\ 0 & 0.5 \end{bmatrix} x + \begin{bmatrix} 2 \\ 1 \end{bmatrix} u,\ y = [1\ 2]x$ is excited by u (t) = 1 for all $t \geq 0$ with initial condition x (0) = $[1\ 2]^T$. Find the output y (t). **8**

b) List the properties of state transition matrix. **4**

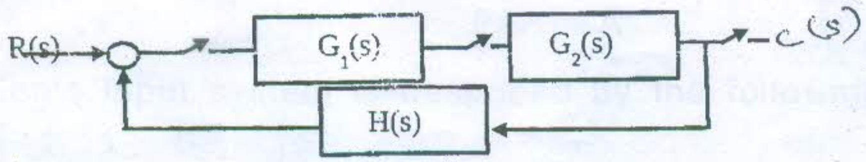
c) A single input system is described $\dot{x} = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -2 & 0 \\ 0 & 1 & -3 \end{bmatrix} x + \begin{bmatrix} 10 \\ 1 \\ 0 \end{bmatrix} u$. Design a state feedback controller which places the closed loop poles at $-1 \pm j2, -6$. **8**

Module II

13. Determine the unit step response of the system shown below with sampling time 0.1s. **20**



14. a) Determine the pulse transfer function for the negative feedback system shown below with sampling time Ts. **8**

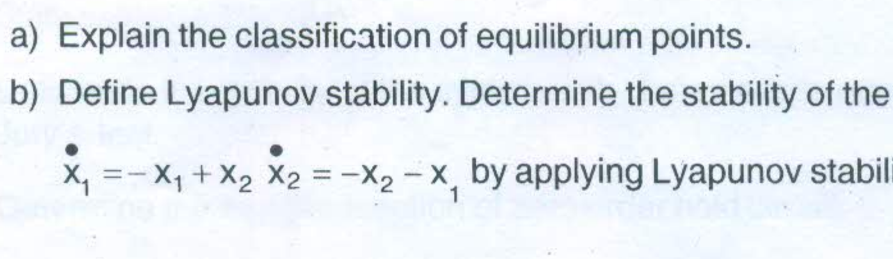


b) Apply Routh Hurwitz criterion to determine the stability of the system with characteristic equation $z^5 - 0.2z^4 - 1.23z^3 - 2.139z^2 - 1.1584z - 0.46848 = 0$. **12**

Module – III

15. What is Limit Cycle ? Determine whether the following system exhibits limit cycle. If the system exhibits limit cycle determine its frequency, amplitude and stability. Derive the expressions used. **20**

functions



16. a) Explain the classification of equilibrium points. **8**

b) Define Lyapunov stability. Determine the stability of the system $\dot{x}_1 = -x_1 + x_2$ $\dot{x}_2 = -x_2 - x_1$ by applying Lyapunov stability. **12**
