

Code No: **R42022****R10****Set No. 1**

IV B.Tech II Semester Supplementary Examinations, April - 2018

**ADVANCED CONTROL SYSTEMS**

(Electrical and Electronics Engineering)

**Time: 3 hours****Max. Marks: 75****Answer any FIVE Questions**  
**All Questions carry equal marks**

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- 1 a) Show that the solution to the homogenous state equation  $\dot{x}(t) = Ax(t)$  is unique. [8]  
b) State equation of a control system is given by  
$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -5 & 7 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$
Obtain the state transition matrix. [7]
- 2 a) Write the observability tests for continuous time invariant systems? [7]  
b) Consider the system  $x(k+1) = \begin{bmatrix} 1 & k \\ 0 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 2 \\ k \end{bmatrix} u(k)$  Is this system controllable at  $k=0$ ? [8]
- 3 a) Write a short note on multi variable Nyquist plot. [7]  
b) Explain the effect of poles and zero in MIMO systems. [8]
- 4 a) Explain the popular nonlinearities. Derive the describe function of relay with dead zone. [10]  
b) List out the properties of nonlinear systems. [5]
- 5 a) State and explain the Lyapanov's instability theorem. [7]  
b) State stability in the sense of Lyapunov? Explain in terms of an example. [8]
- 6 a) Explain necessary conditions for the design of state feedback control through pole placement. [8]  
b) Describe the effect of state feedback on controllability. [7]
- 7 a) Explain the control and state variable inequality constraints. [7]  
b) Find the extremals for the functional  $J(x) = \int_0^1 [x^2(t) + \dot{x}^2] dt; x(0) = 1, x(1) \text{ free}$ . [8]
- 8 Write short note on the following:  
a) Optimal controller design using LQG framework  
b) Linear quadratic optimal regulator (LQR) problem formulation [15]