Department of Electrical and Electronics Engineering
Mar Athanasius College of Engineering, Kothamangalam
(Government Aided Autonomous Institution)

Second Sessional Examination – October 2026
EET401 Advanced Control Systems - S7 EA & EB

Time: 1.5 Hrs. Max Marks: 40

Answer all questions from Part A and Part B

Part A [4*3 =12 marks]

1. Find out the controllability of the given system **(CO3)**

$$\dot{\mathbf{x}}(t) = \begin{bmatrix} -1 & 1 & 0 & 0 & 0 \\ 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & -2+j & 0 \\ 0 & 0 & 0 & 0 & -2-j \end{bmatrix} \mathbf{x}(t) + \begin{bmatrix} 0 & 1 \\ 3 & 0 \\ 1 & 0 \\ 0 & 0 \\ 1 & 2 \end{bmatrix} \mathbf{u}(t)$$

2. Illustrate the concepts of duality referred to controllability and observability. **(CO3)**
3. Explain any two common physical nonlinearities. **(CO4)**
4. What are the assumptions used for the analysis of nonlinear system using harmonic linearization? **(CO4)**

Part B [2*14 = 28 marks]

5. a) For the system given obtain the state space model and check its observability

$$G(S) = \frac{S^2+5S+4}{S^3+6S^2+11S+6}$$ (6 Marks) **(CO3)**

b) Consider a linear system described by the transfer function. (8 Marks) **(CO3)**

$$\frac{Y(S)}{U(S)} = \frac{10}{S(S+1)(S+2)}$$

Design a feedback controller with state feedback so that the closed loop poles are placed at (-2), (-1+j1) and (-1-j1).

6. a) Explain any three characteristics of the nonlinear system. (6 Marks) **(CO4)**
   b) Derive the describing function of Relay nonlinearity. (8 Marks) **(CO4)**

CO 3: Ability to design the state feedback controller and observer for the LTI System.
CO 4: Ability to apply the describing function approach and phase plane approach for assessing the performance of nonlinear systems.

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Mould technically competent and morally strong Engineers

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