Exam No: _____

GANPAT UNIVERSITY

M. TECH SEM- I (Electrical Engineering) REGULAR EXAMINATION NOV-DEC 2015

Subject Code: 3EE103, Advanced Control Systems

MAX. TIME: 3 HRS **MAX. MARKS: 60**

Instructions: (1) This Question paper has two sections. Attempt each section in separate answer book.
(2) Figures on right indicate marks.
(3) Be precise and to the point in answering the descriptive questions.

Section-I

Q1. A Define describing function. Derive the describing function for saturation non-linearity. 06
B Write a short note on asymptotic stability and limit cycles. 04

OR

Q1. A Explain Lyapunov's basic stability theorem. 04
B Investigate the system stability using Lyapunov's stability theorem. 06
1). $\dot{x}_1 = x_2$ and $\dot{x}_2 = -x_1 - x_2^3$.
2) $\dot{x}_1 = x_2$ and $\dot{x}_2 = -x_1 + x_2$.
Lyapunov function $V(x) = x_1^2 + x_2^2$

Q2. A Discuss the delta method of constructing trajectories. 05
B State and explain LaSalle's theorem. 05

OR

Q2. A Discuss design of state feedback controller. 06
B How are singular points classified? 04

Q3. A Discuss with input-output characteristics, all common types of non-linearities. 05
B State and explain the Poincare-Bendixson theorem. 05

Section-II

Q4. A How are the limitations of the conventional transfer function approach overcome by the state space approach. Define state and state variables. 05
B For the electrical system shown in the fig. 1, take i_{L1}, i_{L2} and v_c as the state variables and represent in the state space form. 05

OR

Q4. A Obtain the state space representation for the mechanical system shown in the fig. 2 05
B Find the transfer matrix Y(s)/U(s) for the state model: 05

$\dot{x}_1 = x_2$
$\dot{x}_2 = -6\,x_1 - 5\,x_2 + u$
$y = 2\,x_1 + x_2$

Q5. A What is state transition matrix. Discuss its properties. 05
B Obtain the state space representation of the transfer function given using parallel decomposition. 05

$$\frac{Y(s)}{U(s)} = \frac{2s^2 + 11s + 13}{(s+1)(s+3)^2}$$

OR

Q5. A Explain the principle of duality. 05

B A feedback system has a closed loop transfer function 05

$$\frac{Y(s)}{U(s)} = \frac{10(s+4)}{s(s+1)(s+3)}$$

Give the block diagram representation for the above system using cascade decomposition and represent in the state space form.

Q6. A When is a system said to be completely observable? 05

B Check the controllability of the system given below. 05

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 2 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} u$$

----------END OF PAPER----------

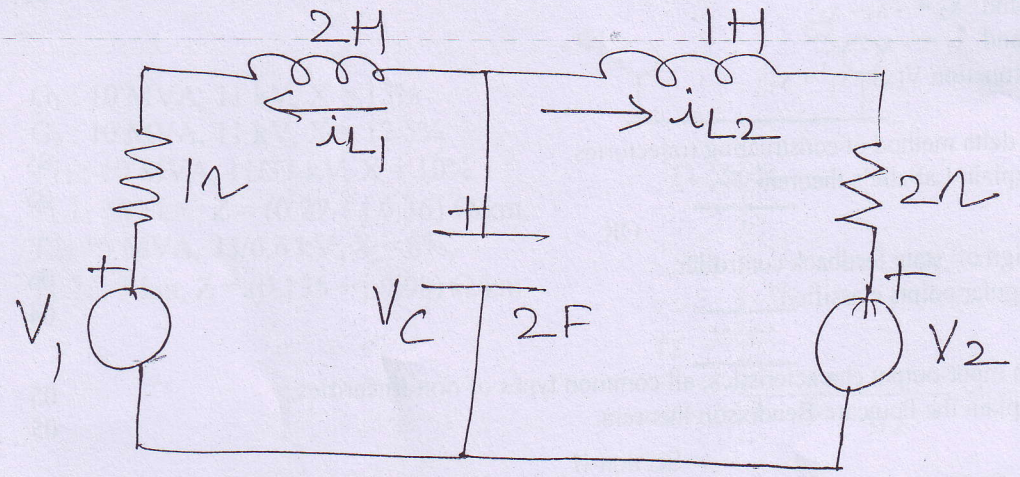

Fig - 1.

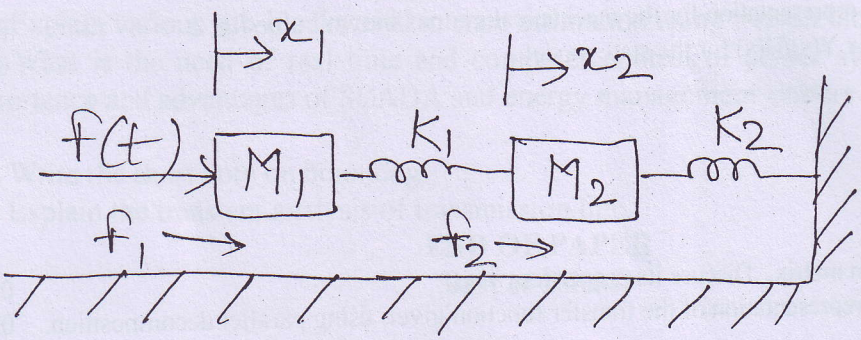

Fig - 2.