Reg.No. ____________

Karunya UNIVERSITY

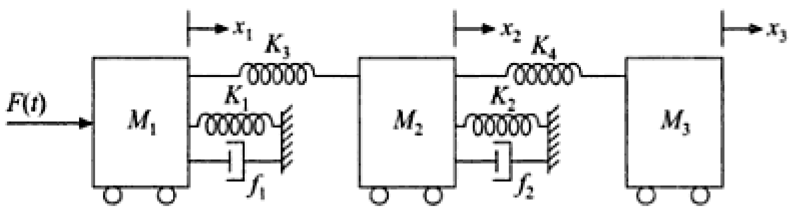
(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

End Semester Examination – Nov/Dec – 2016

		Semester :	**2016-17 ODD**
Code :	**14EI3005**	**Duration :**	**3hrs**
Sub. Name :	**Advanced control system**	**Max. marks :**	**100**

ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)

Q. No.	Sub Div.	Questions	Course Outcome	Marks
1.	a.	Consider the mechanical system given below. Model the system and derive the transfer function in terms of $X_3(s)$ and F(s) 	CO1	15
	b.	What are the essential elements of control systems	CO1	5
		(OR)		
2.	a.	Write the steps involved in mathematical model of a process.	CO1	5
	b.	Obtain the mathematical model in state space of a permanent magnet stepper motor from its principles.	CO1	15
3.	a.	Solve the equation $\frac{dy}{dx} = 1 - y$ with the initial condition x = 0, y = 0 using modified Euler's method and tabulate the solutions at x = 0.1, 0.2 and 0.3. Compare the result with the results of the exact solution	CO2	10
	b.	Find y (0.1) by Taylor series method if $y' = x^2 y - 1$; y(0) = 1.	CO2	10
		(OR)		
4.	a.	Consider $u^1=-2tu^2$ where u(0)=1 with h=0.2 on the interval [0,0.6]. Solve the initial value problem given above. Use 4th order RK method.	CO3	20
5.	a.	Give a short note on the relationship between controllability and observability.	CO2	5
	b.	The state model of a system is $\begin{pmatrix} \dot{x}1 \\ \dot{x}2 \\ \dot{x}3 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{pmatrix} \begin{pmatrix} x1 \\ x2 \\ x3 \end{pmatrix} + \begin{pmatrix} 0 \\ 2 \\ 0 \end{pmatrix} [u]$ Convert the state model to controllable phase variable form	CO3	15
		(OR)		
6.	a.	Solve the given differential equation using Taylor series. $\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 6tx = 0$; While its initial conditions are x(0) = 1 and $\frac{dx(0)}{dt} = 1$	CO2	12

	b.	Write short notes on phase planes and phase trajectories.	CO1	**4**
	c.	Briefly explain principle of linearization.	CO1	**4**
7.	a.	Define the terms controllability and observability.	CO3	
	b.	A single-input system is described by the following state equation $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -2 & 0 \\ 2 & 1 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 10 \\ 1 \\ 0 \end{bmatrix} u$. Design a state feedback controller which will give closed-loop poles at -1+j2, -1-j2, -6.	CO2	**20**
		(OR)		
8.	a.	1. Consider the system defined by: $\dot{x} = Ax + Bu$ Where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$ By using state-feedback control $u = -Kx$, it is desired to have the closed-loop poles at $s = -2 \pm j4, s = -10$. Determine the state-feedback gain matrix K.	CO2	**15**
	b.	Consider a system $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -5 & 2 & 1 \\ 0 & 0 & 1 \\ -1 & -4 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$ Output: $y = x_1$ Is the system controllable?	CO3	**5**
		<u>Compulsory:</u>		
9.	a.	Comment on the significance of Lyapunov Stability.	CO3	**10**
	b.	Explain in brief about Lyapunov Stability theorems	CO3	**10**

ALL THE BEST