

**M.E. ELECTRICAL ENGINEERING FIRST YEAR SECOND SEMESTER  
EXAMINATION, 2017**

**SUBJECT: - COMPUTER APPLICATION IN INSTRUMENTATION (MS)**

Full Marks 100

(50 marks for each part)

Time: Three hours

Use a separate Answer-Script for each part

No. of Questions	PART I	Marks
	<i>Answer any two questions</i>	
1. (a)	What is the controllability matrix? For a continuous-time system defined by $\dot{\mathbf{x}} = \mathbf{Ax} + \mathbf{Bu}$ , where each symbol has its usual meaning, derive the <i>Alternative Form of the Condition for Complete State Controllability</i> . How will this condition get modified if the A matrix does not possess distinct eigenvectors?	03+05 +05
(b)	Determine whether the following system is completely observable or not, where each symbol has its usual meaning. $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 2 & 1 & 0 \\ 0 & 2 & 1 \\ 0 & 0 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}, \begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 3 & 0 & 0 \\ 4 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$	05
(c)	In pole placement technique, how can state feedback gain matrix $\mathbf{K}$ be determined using Ackermann's formula?	07
2. (a)	How can model following design of predictive controllers be carried out? How can predictive controllers be utilized to perform feedforward compensation?	06+05
(b)	What is the importance of sliding surface in sliding mode control? How can the design of sliding surface be carried out employing the method of <i>equivalent control</i> ?	04+06
(c)	In designing sliding mode controllers, why does <i>diagonalization method</i> employ a non-singular transformation?	04
3. (a)	What are the strengths of fuzzy control? Describe the schematic representations of PI-type and PD-type fuzzy controllers for both continuous-time systems and discrete-time systems. Describe the operation of a PI-type fuzzy controller for discrete-time systems utilizing a representative fuzzy rule base and triangular membership functions for both inputs and the output.	03+06 +06

Ref No: Ex/PG/EE/T/128B/2017

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No. of Questions	PART I	Marks
3. (b)	In the context of neural networks, differentiate between supervised learning and unsupervised learning. State and prove the <i>Perceptron Convergence Theorem</i> .	04+06
4.	Write short notes on <i>any two</i> of the following:	$12 \frac{1}{2} \times 2$
(i)	Design of minimum order observers.	= 25
(ii)	Chattering in sliding mode control.	
(iii)	Backpropagation learning algorithm in neural networks.	

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No. of Questions	PART-II	Marks																																																
Answer any two		2X25=50																																																
1. a)	How is the limitation of Fourier Transform overcome by Short Time Fourier Transform (STFT)?	3																																																
b)	What are the shortcomings of STFT? Justify the application of Continuous Wavelet Transform (CWT) to overcome them.	4																																																
c)	What is/are "Continuous" in Continuous Wavelet Transform?	2																																																
d)	Explain the terms "scale" and "translation" in CWT.	6																																																
e)	What are the properties of a mother-wavelet?	4																																																
f)	How can you use Wavelet Transform for denoising a signal?	6																																																
2. a)	What is Sensor Fusion? Explain different levels of such a fusion strategy.	10																																																
b)	A Rough Set based decision rule generation system uses a data table as given below. Generate the set of decision rules from this table.	15																																																
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3. a)	What is "model reference adaptive system" in the context of adaptive control?	10																																																
b)	A process, whose dynamics are not well known, is initially at steady state. An input signal is introduced to the system. The sampled values of the input as well as the output response at different time instants are as follows:	15																																																
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Identify the parameters of the process assuming first order model.																																																		

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4.	<b>Write notes on the followings (Any 2)</b>  a) Gain Scheduling Control in the context of adaptive control of a process plant  b) Comparison of different Supervisory Control and Data Acquisition ( SCADA ) system architectures  c) Maximal Discernible (MD) heuristic for Discretization of Decision Table in Rough Set Theory based decision rule generation	$2 \times 12 \frac{1}{2} = 25$
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