Ref. No. Ex/EE/5/T/522D/2017(OLD)

B. Electrical Engg.(Part Time) 5th Year Second Semester Examination, 2017(old)

Advanced Instrumentation-II

Time: Three Hours **Full Marks: 100**

(50 Marks for each part)

Use a separate Answer Script for each Part

PART-I

Answer *Any Two* Questions

Q.1 a) Explain the principle of duality. **5**

b) Prove that the state observer gain matrix $\mathbf{K_e}$ is the conjugate transpose of state feedback gain matrix $\mathbf{K}$ i.e. $\mathbf{K_e} = \mathbf{K}^*$. **5**

c) The system state and output equations are defined by

$$\dot{\mathbf{x}} = \mathbf{Ax} + \mathbf{Bu}$$

$$\mathbf{y} = \mathbf{Cx}$$

Where $\mathbf{A} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix}$, $\mathbf{B} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

By using state feedback control $u = -Kx$, it is desired that the closed loop poles at $s_1 = -2-j4$, $s_2 = -2+j4$ and $s_3 = -10$. Determine the state feedback gain matrix K. **15**

Q.2 a) Briefly discuss the characteristics of penetrant materials used in liquid inspection testing . **7**

b) How flaw at right angles to the surface of the part (test object) can be detected by ultrasonic testing? **6**

[Turn over

c) Explain with neat sketch the principle of operation of non destructive eddy current testing method. Also mention the different types of sensors used in this testing. **12**

Q.3 a) What is ultrasonic transducer? Briefly discuss the design characteristics of this type of transducer. What is couplant? **5+2**

b) Define controllability and observability of a linear dynamic system. **10**

c) The system is given as

$$\begin{bmatrix}\dot{x_1}\\ \dot{x_2}\end{bmatrix} = \begin{bmatrix}1 & 1\\ 2 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u,$$

Prove that the system is completely state controllable. **8**

Q. 4. Write short notes on (any two):

i) Magnetic particle Testing

ii) Radiographic Testing

iii) Full order state observer **(12.5*2)**

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B.ELE.ENGG. (EVENING) 5TH YEAR 2ND SEMESTER EXAMINATION, 2017 (OLD)

SUBJECT: - ADVANCED INSTRUMENTATION – II

Time: Three hours

Full Marks 100
(50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART II	Marks
	Answer any TWO questions.	
1. (a)	Draw the block diagram and describe the operating principle of an *M*-weight adaptive digital FIR filter. How can the method of steepest descent be employed for adapting these filters?	13
(b)	Describe in detail the operating principle of Widrow-Hoff LMS algorithm. Show that an *M*-weight digital FIR filter, adapted using this algorithm, requires a total of 2*M* number of additions and 2*M* number of multiplications.	12
2. (a)	Prove that in discrete Wiener filters, under some special considerations, the optimal filter gain is given by $H(\omega)=\frac{S_{ss}(\omega)}{S_{ss}(\omega)+S_{nn}(\omega)}$, where each symbol has its usual meaning.	12
(b)	Describe in detail how can recursive least square algorithms be developed for adaptive filters utilizing the concepts of Kalman gain vector, *a priori* error and *a posteriori* error?	13
3. (a)	What is the key essence of designing predictive controllers? How can predictive controllers be designed using model following design philosophy?	12
(b)	What are the drawbacks of deadbeat controllers designed using direct synthesis method? How can Dahlin's controller be designed to overcome these drawbacks?	05
(c)	Demonstrate in detail how can ringing take place in digital controllers in presence of a complex conjugate pole pair in the transfer function of the controller.	08

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SUBJECT: - ADVANCED INSTRUMENTATION – II

Time: Three hours

Full Marks 100
(50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART II	Marks
4.	Write short notes on ***any two*** of the following:	$12\frac{1}{2}\times 2 = 25$
(i)	Adaptive noise cancellers.	
(ii)	Normalized LMS algorithm and correlation LMS algorithm for designing adaptive digital filters.	
(iii)	Point processing techniques for image enhancement.	