Ref No: EE/T/415.4/2017(S)

B. ELE ENGG. 4TH. YEAR 1ST. SEM. EXAM.-SUPPLE 2017

SUBJECT: - ELECTIVE - I (ADVANCED INSTRUMENTATION - I)

Time: Three hours | **Full Marks 100**
(50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART-I	Marks
	Answer any two	**2X25=50**
1. a)	Draw a schematic of a digital vector voltmeter using synchronous detection technique. A phase-locked frequency synthesizer provides all internal references from a common reference source. Explain the principle of operation of such voltmeter.	10
b)	Explain the operation of Lock-in-amplifier.	8
c)	A digital frequency synthesizer employs a 8 MHz crystal oscillator and gives a 128 step-sinusoid. Determine the maximum and minimum output frequency if the number of fractional bit is 3. Also find out the frequency control word for these cases.	7
2. a)	A Rough Set based decision rule generation system uses a data table as given below. Generate the set of decision rules from this table. Also comment on *Reduct* and *Core* values in this case.	10

Objects	Condition Attributes			Decision Attribute
	A	B	C	
U_1	1	0	1	0
U_2	0	1	1	0
U_3	1	1	1	1
U_4	1	1	0	1
U_5	1	0	0	1
U_6	0	1	0	1
U_7	0	0	1	0
U_8	0	0	0	0

b)	Describe different architectures of Supervisory Control and Data Acquisition (SCADA) Systems.	10
c)	What are the advantages and disadvantages of Spread Spectrum Radio based deployment of a SCADA system?	5
3. 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. What is the importance of the factor $\frac{1}{\sqrt{\lvert s \rvert}}$ in CWT? (all symbols carry their usual meaning)	4+2
e)	What are the properties of a *mother-wavelet*?	4
f)	Explain the algorithm for computing Continuous Wavelet Transform of a signal.	6

[Turn over

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B. ELE ENGG. 4TH. YEAR 1ST. SEM. EXAM.-SUPPLE 2017

SUBJECT: - ELECTIVE - I (ADVANCED INSTRUMENTATION - I)

Time: Three hours **Full Marks 100**
(50 marks for each part)

Use a separate Answer-Script for each part

4.	Write notes on any *two*	$(2X12\frac{1}{2}$ =25)
a)	Wavelet Transform based denoising technique	
b)	Direct Digital Synthesis (DDS) based Frequency synthesizer	
c)	Different levels of Sensor fusion	
d)	Bayesian Inference based feature classification	

Ref No:Ex/EE/T/415.4/2017(S)

BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING 4TH YEAR -1ST SEMESTER (SUPPLEMENTARY) EXAMINATION, 2017

SUBJECT: - ADVANCED INSTRUMENTATION -I

Time: Three hours

Full Marks 100
(50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART I I	Marks
	ANSWER ANY *TWO* QUESTIONS	
1.(a)	**Introduce the concept of power spectral density of random processes. State and prove Wiener-Khintchine-Einstein theorem.**	4+9
(b)	**"The discrete-time linear averager is a notch filter in which the nulls occur at several frequencies across the frequency band."** **Starting from the difference equation model of a linear averager, derive the expression and give relevant sketch to justify or correct the above statement.**	12
2.(a)	**A WSS random process $X(t)$ has a root -mean-square value of 3 units. Examine whether or not each of the following can be its autocorrelation function (ACF).** *(i)* $R_X(\tau) = 9\tan^{-1}(\tau)$ *(ii)* $R_X(\tau) = 6\exp\left[-2\tau^2 - \lvert\tau\rvert\right]$ **Prove any property/ properties of ACF used for this purpose.**	8
(b)	**"A suitable property of correlation function can be utilized to devise an ultrasonic flowmeter."--------- Explain with relevant sketches. Derive any property of correlation function used for this purpose.**	12
(c)	**Write down the fundamental expression for the one-sided power spectral density (PSD) of Johnson noise voltage in resistors. What is the value of the PSD at zero frequency? Why can the noise be treated as white noise for practical purposes? Explain.**	5

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No. of Questions	PART I I	Marks
3. (a)	Explain in details, how the signal-to-quantization noise ratio can be improved by using oversampling type analog-to-digital converter without noise-shaping. Use necessary mathematical derivations and relevant sketches.	15
(b)	Elucidate the sources of errors in full Flash analog-to-digital converters. Point out clearly how the increase in resolution of such ADCs, result in escalation of the errors.	10
4.	Write short notes on *any two* of the following. (a) Subranging ADCs. (b) Recovery of the time-period information of a weak periodic signal contaminated by a zero-mean random noise, by correlation technique.. (c) Stationarity and ergodicity of random processes. (d) Real-time median filters.	12 ½ + 12 ½