Ref No: Ex/EE/T/414D/2019

B.E. ELECTRICAL ENGG 4TH. YEAR 1ST. SEM. EXAM 2019

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 an 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)	Explain the terms "*scale*" and "*translation*" in CWT.	4
c)	What are the properties of a *mother-wavelet*?	3
d)	Explain Wavelet Transform based denoising of a signal.	6
e)	What are orthonormal bases in the context of Wavelet Transform?	2
f)	Samples of a signal is shown as $f = \{1, 4, 10, 8, 0, 0, 0, 2\}$. ↑ Find Wavelet coefficients after Haar Transform. Show that energy does not change after Haar transform.	7

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B.E. ELECTRICAL ENGG 4TH. YEAR 1ST. SEM. EXAM 2019

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)	Algorithm for computing Continuous Wavelet Transform of a one dimensional signal.	
b)	Direct Digital Synthesis (DDS) based Frequency synthesizer	
c)	Different levels of Sensor fusion	

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B.E. ELECTRICAL ENGINEERING - FOURTH YEAR - FIRST SEMESTER EXAMINATION, 2019

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)	**A DC signal is contaminated by a noise that is a sample realization of an ergodic random process with power spectral density of** $S_X(jf) = 2(1-\|f\|)$ **for** $\|f\| \le 1$ **W/Hz** $= 0$ **otherwise** **The corrupted signal is digitized and then processed by a running linear averager with a window length of 30 samples. Determine the RMS value of the noise component of the output. Derive the expression used.**	9
	OR	
	A resistance temperature detector (RTD) has a nominal resistance of 604 Ω at 0°C. the temperature coefficients of resistance are 0.00518 /°C and 3.28 $\times 10^{-5}$ /°C/°C. The sensor is used to measure temperature over 20 °C to 100 °C in the four-wire ohmmeter mode. Determine the value of the linearizing resistance to be connected in parallel with the RTD for quasi-linearization of the output voltage versus temperature characteristic. Derive the expression used. *Can the same method be employed if the RTD is Pt-100* ? Explain.	9
(b)	**Elucidate with the help of suitable diagrams an appropriate ratiometric method for digital measurement of temperature using look-up table (LUT). What additional feature can be incorporated with LUT to better the performance of the system?**	8
(c)	**A weak periodic signal with known frequency is corrupted by a zero-mean random noise. Explore how the waveshape of the signal can be recovered from the corrupted environment. Give relevant sketches.**	8

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No. of Questions	PART I I	Marks
2. (a)	Bring out clearly the principle of operation of *any appropriate half-flash* analog-to-digital converter (ADC). Give supporting mathematical derivation. Explain the extent to which the slew rate of ADC input would have been sacrificed, if the ADC were not equipped with a front-end track and hold amplifier .	10
(b)	Point out the motivations behind opting for a sigma-delta modulator type ADC. Depict the architecture for such an ADC and explain the working principle with the help of sketches for relevant spectra and mathematical derivations. Indicate the role of the digital decimator in the ADC.	3+10+2
3. (a)	Explain in short the theory of a Rogowski coil current transducer. Under what condition can it be operated in the current-transformer (CT) mode? Explain with mathematical derivation. Indicate clearly the advantages of Rogowski coil (with integrator) over conventional CTs with ferromagnetic core.	5+3+5
(b)	Investigate the possibility (in short) of using a Hall probe as an open loop ratiometric current transducer with digital output. Cite the typical application areas of this current sensor. How can the performance of the current transducer be improved by shifting from the open-loop to the closed-loop variety? Explain.	5+4
(c)	Trace the origin of kT/C noise in electronic circuits.	3
4.	Write short notes on any two of the following.	
(a)	Thermal noise in resistors.	
(b)	Ultrasonic flowmeter using correlation technique.	12 ½
(c)	Real time median filtering.	+12 ½
(d)	Signal-to-Quantization noise ratio of Nyquist ADCs and its improvement using automatic gain-control device.	