**BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) FIFITH YEAR
FIRST SEMESTER SUPPLEMENTARY EXAM 2024**

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	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 using digital synthesis technique.	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
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

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

[Turn over

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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 $\dfrac{1}{\sqrt{|s|}}$ 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
4.	Write notes on any *two*	$(2 \times 12\frac{1}{2} = 25)$
a)	Wavelet Transform based denoising technique	
b)	Direct Digital Synthesis (DDS) based Frequency synthesizer	
c)	Different levels of Sensor fusion	

Ref. No.: Ex/EE/5/T/512D/2024(S)

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Question No.	PART II	Marks
	ANSWER ANY *TWO* QUESTIONS	
1. (a)	Point out the advantages of Rogowski coil current transducer in comparison with conventional current transformer with ferromagnetic core.	15
(b)	With the help of a sketch and mathematical derivations, explain the principle of self-integrating type Rogowski coil.	10
2. (a)	A thermistor with negative temperature-coefficient of resistance is fed from a constant current source and the voltage across the sensor is measured. How can the value of the resistance to be connected in parallel with the thermistor for linearization of the output voltage versus temperature characteristic, be calculated? Derive the expression used.	15
(b)	Investigate the possibility of using a Hall probe as an open loop current transducer without any ferromagnetic core. How can the performance of the transducer be improved by introducing a ferromagnetic core?	7+3
3. (a)	Bring out the working principle of a diode based temperature transducer. What is the demerit of this sensor? How can you use two matched transistors to implement a 'Proportional-To-Absolute Temperature' (PTAT) sensor? Give details.	5+3+7

[Turn over

[4]

Question No.	PART II	Marks
(b)	How can a single transistor be used to implement a PTAT sensor for monitoring the temperature of processors? Elaborate.	10
4.	Write notes on any two of the following.	
(a)	Electrostatic shielding of Rogowski coil current transducer.	
(b)	Closed loop Hall effect current transducer..	12 ½ +12 ½
(c)	Linearizing arrangement for resistance temperature detectors (RTD).	