Ref No: **Ex/EE/T/221/2018**

B. E. ELECTRICAL ENGINEERING SECOND YEAR SECOND SEMESTER - 2018

SUBJECT: - ELECTRICAL INSTRUMENTATION

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 three questions	
1.	**Justify or correct *any four* of the following statements with suitable reasons in brief / derivations,.**	$4\times4\frac{1}{2}=18$
(a)	**In an LVDT, synchronous demodulation can be deployed only when it is preceded by a phase-compensation circuit.**	
(b)	**For piezoelectric sensors, the charge sensitivity in μC/mm is a material property, while the voltage sensitivity in mV/mm depends on the sensor material as well as on sensor dimensions.**	
(c)	**The calibration of transit-time ultrasonic flowmeters is independent of the temperature of the flowing liquid.**	
(d)	**In *variable air-gap* capacitive displacement transducers with composite dielectric, increase in sensitivity is achieved at the cost of linearity.**	
(e)	**Electromechanical force-balance accelerometers cannot be used for static measurement.**	
2. (a)	**Elucidate the principle of operation of a thermal anemometer employing feedback. Develop the complete block diagram description of the system. Derive the expression for the frequency response of the system and point out its merit over the constant-current variety.**	**12**
(b)	**How can phase compensation be carried out in LVDTs using R-C network? Explain with derivation.**	**4**

[Turn over

No. of Questions	PART I	Marks
3. (a)	**A variable air-gap differential capacitor arrangement has three identical, parallel electrodes. The upper and the lower electrodes are fixed in position. The central electrode is free to move in the direction of each fixed electrode. The nominal separation between the moving electrode and each of the fixed electrodes is 5 mm.** **The moving electrode is connected to the inverting input of an op-amp. The non inverting input is connected to ground. The lower fixed electrode is connected to the output pin. An AC source of 1 V is connected between the upper fixed electrode and ground. A resistor is also connected in the feedback path, but its influence can be ignored for all practical purposes. Sketch the circuit. If the output voltage is 1.2 V, determine the magnitude and the direction of displacement of the moving electrode. *Derive the expressions used.***	**10**
(b)	**Bring out clearly the advantages of charge amplifier circuits used in conjunction with piezoelectric sensors, over the buffer amplifier circuits. Give relevant derivations and sketches.**	**6**
4. (a)	**Point out why pulsed excitations are preferred over sinusoidal excitations for electromagnetic flowmeters. Point out in details how the measurements are carried out with unipolar and bipolar pulsed excitations.**	**8**
(b)	**Why is a circuit employing rectifiers used for processing the signals from LVDT? With appropriate sketches, explain how such a circuit makes the functioning of the LVDT truly meaningful.**	**8**
5.	**Write short notes on *any two* of the following:**	**8+8**
(a)	**Bourdon tubes and bellows.**	
(b)	**Null method of measurement using transformer coupled AC bridges.**	
(c)	**Capacitive sensor based on change in permittivity of dielectric.**	

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B. ELE ENGG. 2ND. YEAR 2ND. SEM. EXAM.-2018

SUBJECT: - ELECTRICAL INSTRUMENTATION

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 all questions (1 to 4). Each question has an alternative. 2 marks for well organized answers (12 x 4 + 2 = 50)	
1.	Show that poles of Butterworth filter are on *s*-plane circle, whereas Chebyshev poles are situated on an ellipse in s-plane.	12
OR	OR	
1.	Realize the filter transfer function with VCVS. $$H(s) = \frac{500s^2}{s^2 + 3000s + 6 \times 10^7}$$ Identify the attenuation in dB at frequencies $\frac{\omega_c}{2}$ and $2\omega_c$ where ω_c is the cutoff frequency.	12
2. a)	The input resistance and capacitance of a Cathode Ray Oscilloscope (CRO) are 1.0 μF and 2.0 MΩ. What is the matched capacitance of the probe for proper compensation assuming 10kΩ probe resistance? Explain necessary formula.	6
b)	What are the functions of time base generator and Trigger in a Cathode Ray Oscilloscope (CRO)?	6
OR	OR	
2. a)	How can you measure phase difference and frequency ratio of two sinusoidal voltage waveforms using a CRO?	6
b)	Briefly explain the operation of a Digital Storage Oscilloscope.	6
3.	What are the advantages of Switched Capacitor circuits for implementing active electrical filters? How can you ralize a Band pass filter using Switched Capacitor circuits?	4+8
OR	OR	
3.	Derive a linear model of Phase Locked Loop (PLL). How can you use a PLL as frequency demodulator?	6+6
4. a)	Explain the operation of unipolar Dual Slope type ADC and comment on its conversion time compared to successive approximation type ADC.	6
b)	What are Gain, Offset and Linearity errors for DAC.	6
OR	OR	
4. a)	Explain the operation of SAR typr ADC with a flow chart.	6
b)	Compare the conversion times for 3 bit Successive Approximation (SAR) type, counter ramp type and Dual Slope type ADC with 7.7 V input and V_{ref} =12 V and clock frequency 1kHz.	6