B. E. ELECTRICAL ENGINEERING SECOND YEAR SECOND SEMESTER EXAMINATION - 2019

SUBJECT: - ELECTRICAL INSTRUMENTATION

Full Marks 100
(50 marks for each part)

Time: Three hours

Use a separate Answer-Script for each part

No. of Questions	PART I	Marks
	Answer Q.5 and any two questions from the rest.	
1.	Justify or correct ***any four*** of the following statements with suitable reasons in brief / derivations.	
(a)	**In an LVDT, in its basic form, when the core is symmetrically placed with respect to the two secondary windings, the output voltage is 0 V.**	5×4=20
(b)	**Piezoelectric displacement/force transducers cannot be employed for measurement of a constant input.**	
(c)	**The damping ratio and frequency range of operation of a force balance accelerometer can be conveniently adjusted by altering the seismic mass or the active length of wire of the servo actuator.**	
(d)	**For accurate operation of a constant temperature hot wire anemometer, the hot wire probe must be calibrated at the site of implementation.**	
(e)	**Electromagnetic flowmeters should be used for measurement of fluid flow through those pipes which are made of magnetic material and are conductive in nature.**	
2. (a)	**A capacitor microphone system has been developed using a series combination of the transducer (employs the principle of change of separation between the plates), a DC voltage source of 200 V and a resistance R of 10 MΩ. The output voltage is measured across R. The initial separation between the capacitor plates is 0.02 mm, the overlapping area of two plates is 630 mm^2, and permittivity of free space is 8.86×10^{-12} F/m. Determine the**	09

No. of Questions	PART I	Marks
	steady state gain and the time constant of the system. What will be the low-frequency cut-off value of this system, considering a 5% tolerance band? How can this low-frequency cut-off value be brought down to 10 Hz? *Derive the expressions used.*	
(b)	**Describe the basic characteristics of a capacitive humidity sensor. How can a combination of astable and monostable multivibrators be used in conjunction with such a sensor for direct measurement of capacitance?**	04+07
3. (a)	**A constant current anemometer arrangement is developed for measurement of fluctuation velocity. In its basic form, the transducer has been designed with a unity DC steady-state gain and a bandwidth of 45 Hz, assuming 5% drop from DC steady-state gain. Then the usable bandwidth of the arrangement is extended to 90 kHz by employing two-stage electrical dynamic compensation having a fixed compensation network followed by an adjustable compensation network. Each compensation network is preceded by an AC amplifier to perform perfect steady-state gain compensation of the following compensation network. In the first stage, the amplifier gain is chosen as 125 and R_2, the resistance across which the output of the compensation network is measured, is chosen as 3 kΩ. In the second stage, the R_2 for the compensation network is chosen as 2.5 kΩ. Determine R_1 and C in each stage of compensation where R_1, R_2 and C have their usual meaning. Also determine the AC amplifier gain to be set in the second stage. *Derive the expressions used.***	12
(b)	**Describe the construction of a piezoelectric accelerometer and elucidate its operating principle. Hence show its frequency response characteristics and discuss about its usable frequency range of operation.**	08

No. of Questions	PART I	Marks
4.	**Write short notes on *any two* of the following:**	10+10
(a)	**Transit time ultrasonic flowmeters.**	
(b)	**Transformer double ratio AC bridges.**	
(c)	**Multi-dielectric capacitive sensors for monitoring thickness of dielectric sheets.**	
5. (a)	**Analyze the significance of employing synchronous demodulation technique in conjunction with any appropriate transducer.**	5
(b)	**"A practical charge amplifier circuit can be designed with only a capacitor in the feedback path." – Justify or correct the statement, citing suitable reasons.**	5

Ref No: Ex/EE/T/221/2019

B.E.E. 2ND YEAR 2ND SEMESTER EXAMINATION, 2019

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 any three, 2 marks for well organized answers	
1.	**Justify and/or correct the following statements (any four):**	(4X4=16)
a)	Quantization error is inherent to all ADCs.	
b)	*lock-in-range* and *capture range* of a Phase locked loop (PLL) are same.	
c)	Switched capacitor filters can only be realized for second order.	
d)	3 dB Cut off frequency for both normalized Butterworth and Chebyshev filters are 1 rad/s.	
e)	PLL cannot be used for frequency translation.	
2. a)	Find out the minimum order and ripple factor of a normalized Chebyshev filter with maximum passband ripple attenuation is 0.5 dB and stop band attenuation is minimum 45 dB for $\omega \geq 3.5$ rad/s	4
b)	Find the transfer function of a band pass filter with center frequency 10^3 rad/s. and bandwidth 100 rad/s. with passband gain 8. Hence realize the circuit using VCVS.	12
3. a)	Explain the operation of 3 bit unipolar successive approximation type ADC with a flow chart.	6
b)	Compare the conversion times for 3 bit SAR type and counter type ADC in case of 6.7 V input with V_{ref} =10 V and clock frequency 1kHz.	5
c)	The step size of a 5 bit DAC is 8.2 mV. An offset error of 0.2 mV exists in the DAC. If all zeroes represent 0V without this error, what outputs are produced for input code 10101 with and without this offset?	5
4. a)	How does a PLL achieve "locked condition"? (Explain with proper block diagram and derivation)	9
b)	Develop a linear model for PLL.	7
5.	Write Short notes on any ***two***	(2X8=16)
a)	Representation of Offset and Linearity errors for ADCs and DACs.	
b)	State variable active filters	
c)	Pole locations for Chebyshev filter	