Ref No: **Ex/EE/PC/B/T/221/2022**

B. E. ELECTRICAL ENGINEERING SECOND YEAR SECOND SEMESTER EXAMINATION - 2022

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 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.	4×05=20
(a)	**In an LVDT, a leading phase angle at the output can be retarded by connecting a C-R high pass filter network at the output.**	
(b)	**The bandwidth of a piezoelectric displacement transducer system can be expanded by choosing a lower time constant.**	
(c)	**When a capacitive transducer is employed for measurement of angular displacement using the principle of change in overlapping area, the sensitivity will be directly proportional to the displacement between the plates and inversely proportional to the radius of the smaller plate.**	
(d)	**In an LVDT, the maximum measurable frequency of core motion is independent of the frequency of the excitation source used.**	
(e)	**For a capacitive liquid level gauge, the sensitivity of the system is inversely proportional to the relative permittivity of the dielectric.**	
2. (a)	**Why does a residual voltage exist in null position of an LVDT? How can null reduction methods be employed in LVDT when (*i*) a centre-tapped voltage source is available and when (*ii*) a centre-tapped voltage source is not available?**	07

[Turn over

No. of Questions	PART I	Marks
(b)	**Why and how phase sensitive demodulation is employed in conjunction with LVDT? Why a low pass filter is employed in this context?**	07
(c)	**Define 'g' and 'd' constants of a piezoelectric sensor, and derive the relation between the two. Also obtain expressions for the charge sensitivity and the voltage sensitivity in Coulomb/m and V/m respectively, in terms of the 'g' and the 'd' constants.**	06
3. (a)	**Describe the operating principle of a capacitor microphone circuit, built using a variable capacitor in series with a DC source and a resistance. The capacitive transducer works as a displacement transducer whose capacitance changes with change in distance between the plates. Derive the transfer function between the output voltage developed and the input displacement applied. Determine the frequency response of this arrangement. How can its frequency range for accurate measurement be enhanced?**	12
(b)	**How can a piezoelectric displacement transducer system be built using a piezoelectric crystal, connecting cables and an amplifier. Derive the transfer function of this system. Can this system be used to measure static displacement?**	08
4.	**Write short notes on *any two* of the following:**	10+10
(a)	**Capacitive transducer with solid dielectric of variable permittivity and air gap between parallel plates.**	
(b)	**Synchronous demodulation technique employed in LVDT.**	
(c)	**Piezoelectric accelerometers.**	

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No. of Questions	PART I	Marks
5.	**Answer any TWO:**	
(a)	**Why and how are transformer ratio bridges employed for measurement of capacitance?**	05
(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.**	05
(c)	**"The direction of core-motion of an LVDT is reflected in the magnitude spectrum of its output voltage." - State clearly whether the statement is true or false. Justify in favour of your argument.**	05

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B.E. ELECTRICAL ENGINEERING 2ND. YEAR 2ND. SEM. EXAM.-2022

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 (3X16+2=50)	
1. a)	Show that poles of Chebyshev filter are situated on an ellipse in s-plane.	6
b)	Realize the filter transfer function with VCVS. $$H(s) = \frac{60 \times 10^7}{s^2 + 3000s + 6 \times 10^7}$$ Identify the attenuation in dB at frequencies $\frac{\omega_c}{2}$ and $2\omega_c$ where ω_c is the cutoff frequency.	10
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)	Explain the operation of Successive Approximation Register (SAR) type Analog to Digital Converter (ADC) with a flow chart.	10
3. a)	What are the advantages of Switched Capacitor circuits for implementing active electrical filters? How can you realize a Band pass filter using Switched Capacitor circuits?	2+6=8
b)	Explain *Lock Range* and *Capture Range* of a Phase Locked Loop (PLL). How can you use a PLL as frequency demodulator?	2+6=8
4. a)	Explain with circuit diagram the operation of an R-2R ladder Digital to Analog Converter (DAC) considering 3 bits.	10
b)	The reference voltage of a unipolar 8 bit DAC is 10V. An offset error of -0.5 LSB exists in the DAC. If all zeroes represent 0V without this error, what outputs are produced for input code 10110101 with and without this offset?	6
5.	Write Short notes on any ***two***	(2X8=16)
a)	Representation of errors for ADCs.	
b)	Linear model of Phase Locked Loop (PLL)	
c)	Active filter realizations using state-variable representation	