

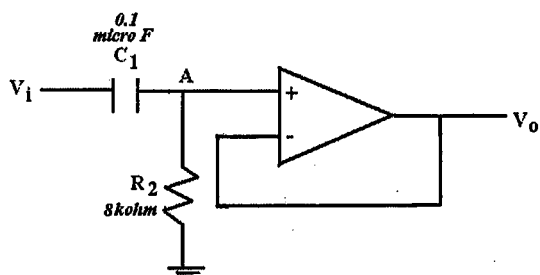
B.E.E. (EVENING) 3RD YEAR 1ST SEMESTER EXAMINATION, 2019

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-I	Marks
Answer any two		
1. a)	Prove that Butterworth poles are situated on an s -plane unit circle.	(10+15=25)
b)	The transfer function of an electrical filter circuit is given as follows: $H(s) = \frac{15s^2}{s^2 + 4549s + 10349030}$ Realize the above transfer function using an active filter circuit. Find the pass-band gain and cut-off frequency.	
2. a)	What are <i>Rounding off</i> and <i>Truncation</i> type Analog to Digital converters (ADCs)?	6
b)	Explain the operation of successive approximation type ADC for 3 bits.	8
c)	Obtain a 4-bit binary representation of an analog signal value of 12.5 V using successive approximation type ADC. Reference voltage is 14 V. Find out the conversion time in seconds and quantization error in volts. The clock frequency is 2kHz.	7
d)	What are gain and offset errors of ADC?	4
3. a)	Explain the principle of operation of switched capacitor circuit. What are the main advantages of such circuits in IC technology?	6+4
b)	Derive the transfer function of a band pass filter using switched capacitor representation (Draw necessary circuit realization).	10
c)	Draw the Switched capacitor implementation of the following circuit. Assume switching frequency is 1kHz. <div style="text-align: center;">  </div>	5
4.	Write notes on any <i>two</i> <ol style="list-style-type: none"> a) Operation of a 3 bit unipolar R-2R ladder network based DAC b) Linear model of phase locked loop (PLL) c) State variable Filter d) Storage Oscilloscope 	(12½X2=25)

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(1st / 2nd-Semester/Repeat/Supplementary/Annual/Bi-Annual)

SUBJECT: - ELECTRICAL INSTRUMENTATION

Time: ~~Two hours~~/Three hours/~~Four hours~~/ Six hours

Full Marks 100
(50 marks for each part)

Use a separate Answer-Script for each part

PART II		Marks
1.	<p>Answer Question:1 and any TWO from the rest:</p> <p>Answer any four :</p> <p>a) For LVDT , the PSD converts the AC signal into bipolar DC signal –Justify .</p> <p>b) Why variable dielectric type capacitive sensor is suitable for measurement of thickness?</p> <p>c) Why temperature compensation is needed for strain gauge bridge?</p> <p>d) In vibration sensing using spring-mass accelerometer , how acceleration and velocity components can be measured from displacement signal?</p> <p>e) Why bidirectional flow rate measurement through a pipe , two pairs of ultrasonic trans-receivers are used ?</p>	4X5=20
2.	<p>a) An LVDT has an output of 6V rms when the core moves 0.4×10^{-3} mm. Determine the sensitivity of L.V.D.T.A 10V voltmeter with 100 divisions is used to read the output. The above arrangement is used in a pressure transducer for using diaphragm which is deflected through 0.5×10^{-3} mm by a pressure of 100 N/m^2. Determine the sensitivity and resolution of the overall instrument.</p> <p>b) A steel cantilever is 0.25 m long , 20 mm wide and 4 mm thick .i) Calculate the value of deflection at the centre when a force of 25 N is applied at free end . The modulus of elasticity for steel is 200 GN/m^2. ii) An LVDT with a sensitivity of 0.5</p>	

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	<p>V/mm is used . The voltage is read on a 10V voltmeter having 100 divisions. Two tenth of a division can be read with certainty. iii) Calculate the minimum and maximum value of force that can be measured with this arrangement.</p> <p>c) Illustrate a scheme for measuring the dynamic displacement using LVDT sensor showing necessary block diagram.</p>	4+6+5
3.	<p>a) Explain with the help of equivalent circuit diagram, the difference between charge amplifier and voltage amplifier to be used for piezoelectric sensor.</p> <p>b) Define 'g' and 'd' constants of a piezoelectric crystal . Prove any relation existing between them.</p> <p>c) A quartz crystal has the dimensions of 2 mm x 2 mm x 1 mm with charge sensitivity 21 C/N and young modulus of 8.6×10^{10} N/m² and permittivity of 40.6×10^{-12} F/m. Calculate the values of force, charge and voltage if the crystal is subjected to a strain of 10×10^{-6} m/m.</p>	5+4+6
4.	<p>a) Illustrate a suitable scheme showing arrangement for measurement of torque using shear type torque sensor and column type load cell.</p> <p>b) Explain the working principle of LVDT type accelerometer showing necessary parts</p> <p>c) Explain the difference in working principle for moving magnet and moving coil type velocity sensors.</p>	6+4+5
5.	<p>a) Derive mathematical expression for change in current , change in fluid velocity as input and change in resistance as output for a self heating wire carrying current .</p>	

[Turn over

Ref No: Ex/EE/5/T/311/2019

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	<p>b) Discuss the method of flow rate measurement of liquid flowing through a pipe using.</p> <p>c) Explain how a hot wire anemometer is calibrated</p>	<p>5+5+5</p> <p>6+4+5</p>
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