

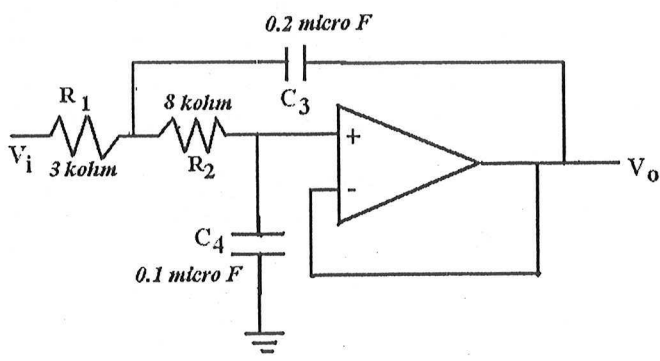
B.E. ELECTRICAL ENGINEERING (PART TIME) 3RD YEAR FIRST SEMESTER
EXAM 2018

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- I II	Marks
Answer Any Two		
1. a)	Prove that Butterworth poles are situated on a <i>s</i> -plane unit circle.	(10+15=25)
b)	Design a low pass maximally flat filter with the following specifications: a) 3 dB cut-off frequency (ω_c) = 1500 rad/s. b) maximum attenuation in the pass band is 0.5 dB for $\omega \leq 0.5\omega_c$ rad/s. c) minimum attenuation in the stop band is 20 dB for $\omega \geq 4\omega_c$ rad/s d) pass band gain = 2	
2. a)	Explain the operation of a successive approximation type A/D converter for 3-bits.	8
b)	A four bit unipolar Successive Approximation type ADC has an offset error of + 1/4 LSB. Reference voltage is +14 volts. Find the output for input voltage 9.75 V <u>with</u> and <u>without</u> offset error.	8
c)	Explain the offset and non-linearity error of DAC.	9
3. a)	Why the state variable filters are called universal filters?	2
b)	Derive the transfer function of a band pass filter using state variable representation (Draw necessary circuit realization).	10
c)	Draw the Switched capacitor implementation of the following filter circuit. Assume switching frequency is 1kHz.	5
		
d)	Explain the operation of a 3 bit unipolar R-2R ladder network based DAC	8
4. a)	How PLL can be used for frequency demodulator?	6
b)	What are Lock Range and Capture Range of a PLL?	10
c)	Develop a linear model of PLL.	9

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No. of Questions	PART II	Marks
	<p>[Two marks are reserved for appropriate answers] Answer any three questions</p> <p><i>Answer any four.</i></p>	
1. (a)	When an LVDT is used in conjunction with phase sensitive detector , it can measure the displacement and direction of motion .----Justify the statement	8+8=16
(b)	Derive the expression of transfer function and voltage sensitivity per unit of core displacement of LVDT, when its secondary is connected with meter load.	
2. (a)	Explain the working principle of diaphragm capacitive sensor. Derive the expression between input (pressure) and output (capacitance)	6+6+4
(b)	A displacement capacitance sensor uses a differential arrangement with two outer plates which are fixed and a central plate which is movable and 10 mm from each fixed plate, when no displacement is applied. A voltage of 1000V rms is applied across the fixed plates. Find the differential output voltage if a displacement of 0.01 mm occurs to the central plate, Find also the sensitivity of the sensor.	
(c)	Compare the sensitivities of variable displacement and variable area type capacitive sensors.	
3. (a)	What are the different deformation modes of piezoelectric sensor?	6+6+4
(b)	With reference to the equivalent circuit of piezoelectric sensor under load condition, derive the expression of frequency domain transfer function considering voltage as output and displacement as input.	
(c)	A quartz crystal has the dimensions of 2 mmX2 mmX1 mm with charge sensitivity 21C/N and Young's modulus of 8.6×10^{10} N/m ² and permittivity of 40.6×10^{-12} F/m. Calculate the values of force ,	

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	charge and voltage , if the crystal is subjected to a strain of 10×10^{-6} m/m.	6+4+6
4. (a)	Derive the expression for change in resistance as output with respect to change in self heating current and change in surrounding fluid velocity as inputs.	
(b)	Distinguish between constant temperature mode operation and constant current mode operation of hot-wire anemometer, showing appropriate anemometer circuit diagram.	8+8=16
5.(a)	Explain the principle of Doppler frequency shift effect when ultrasonic acoustic wave is incident and reflected by the solid particles carried by the moving fluid through a pipe.	
(b)	Illustrate scheme for volumetric flow rate measurement using Transit type ultrasonic trans-receiver.	
(c)	Explain why multiple echoes are produced in Pulse echo type ultrasonic level sensor.	6+5+5=16