Name: Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Programme Name: B.TECH EE IOT **Semester: VI**
Course Name: Signal Conditioning and Telemetry **Time: 03 hrs**
Course Code: ICEG351 **Max. Marks: 100**

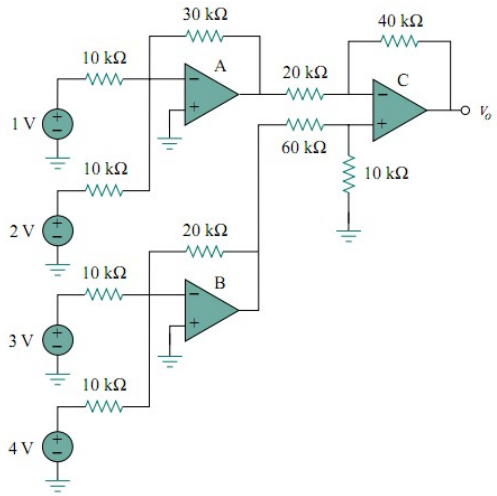
Instructions: Attempt all questions.

SECTION A

S. No.		Marks	CO
Q 1	Draw and explain the operation and circuitry of Full-wave precision rectifier using Op-Amp and diodes.	5	CO2
Q 2	Name any four protocols for serial and parallel data transmission. Also, compare the advantages of serial vs. parallel data transmission.	5	CO4
Q 3	Draw and explain the block diagram of Data Acquisition System considering any Industrial Application.	5	CO4
Q 4	Define the selection criteria of operational amplifiers for any application.	5	CO2

SECTION B

Q 5	(A) Find the full-scale analog output for a 16-bit DAC and its resolution, if $V_R = 10$ V. (B) Find the analog output of an unsigned 10-bit DAC with reference voltage of 10 Volts, if the digital input is B5H. Neglect all loading effects.	10	CO3
Q 6	In the Wheatstone bridge, the values of various arms are P = 1000 Ω, Q = 100 Ω, R = 2005 Ω and S = 200 Ω. The battery has an emf of 5 V and negligible internal resistance. The galvanometer has a current sensitivity of 10 mm/μA and an internal resistance of 100 Ω. Calculate the deflection of galvanometer and the sensitivity of the bridge in terms of deflection per unit change in resistance. a) Calculate Resistance R required to balance the bridge, b) Deviation from the balanced condition ΔR, c) Thevenin equivalent source E_0, d) Thevenin equivalent internal resistance of the bridge R_0, e) Current through the galvanometer I_G, f) Deflection of Galvanometer θ, g) Sensitivity of the Wheatstone bridge S_B.	10	CO1
Q 7	A Kelvin double bridge each of the ratio arms P = Q = p = q = 1 kΩ. The emf of the battery is 100 V and the resistance of 5 Ω is included in the battery circuit. The galvanometer has a resistance of 500 Ω and the resistance of the link connecting the unknown resistance to the standard resistance may be neglected. The bridge is balanced when the standard resistance S	10	CO1

	= 0.001 Ω. a) Determine the value of unknown resistance; b) Determine the current (approximate value) through the unknown resistance R, at balance; c) Determine the deflection of the galvanometer when the unknown resistance R, is changed by 0.1% from its value at balance. The galvanometer has a sensitivity of 200 mm/μA.		
Q 8	A Maxwell's capacitance bridge is used to measure an unknown inductance in comparison with capacitance. The various values at balance; R2 = 400 Ω, R3 = 600 Ω, R4 = 1000 Ω, C4 = 0.5 μF. a) Draw the circuit diagram of the bridge circuit, as mentioned above. b) Formulate the necessary equations for Maxwell's Capacitance Bridge circuit. c) Calculate the values of R1 and L1. d) Calculate the value of storage (Q) factor of coil if frequency is 1000 Hz.	**10**	**CO1**
	SECTION-C		
Q 9	Design a Third-order Unity-gain Bessel High-Pass Filter with the corner frequency (F_C) of 100 KHz. Use the following data for your design: **Bessel coefficients** / **Ai** / **Bi** Filter 1 / a1 = 0.756 / b1 = 0 Filter 2 / a2 = 0.9996 / b2 = 0.4772	**20**	**CO2**
Q 10 A	A Sensor develops output of 10 to 300 mV as the input (measurand) varies from minimum to maximum of range. Develop a signal conditioning scheme with high input impedance, low output impedance and output voltage between 0-10 Volts.	**10**	**CO2**
Q 10 B	Determine the output of the following op-amp circuitry:  	**10**	**CO2**

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Course Name: Signal Conditioning and Telemetry **Time: 03 hrs**
Course Code: ICEG351 **Max. Marks: 100**

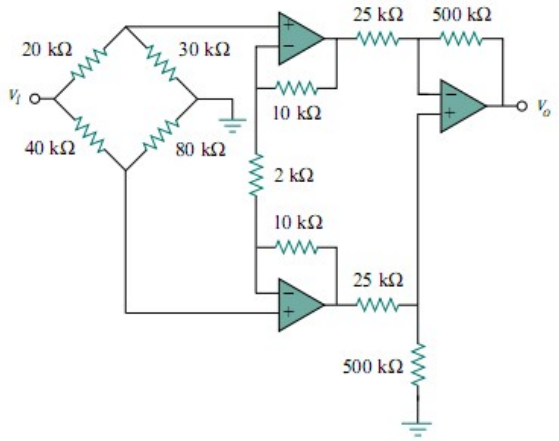
Instructions: Attempt all questions.

SECTION A

S. No.		Marks	CO
Q 1	Draw and explain the telemetry architecture for small, medium and longer distances showing all components involved along with their details.	**5**	**CO4**
Q 2	Name any four protocols for serial and parallel data transmission. Also, compare the advantages of serial vs. parallel data transmission.	**5**	**CO4**
Q 3	Draw and explain the block diagram of Data Acquisition System considering any Industrial Application.	**5**	**CO4**
Q 4	Draw and explain the working of 4-20 mA Current Loop in Analog Telemetry.	**5**	**CO4**

SECTION B

Q 5	(A) Find the full-scale analog output for a 16-bit DAC and its resolution, if $V_R = 10$ V. (B) Find the analog output of an unsigned 10-bit DAC with reference voltage of 10 Volts, if the digital input is B5H. Neglect all loading effects.	**10**	**CO3**
Q 6	A highly sensitive Galvanometer can detect a current as low as 0.1 nA. This galvanometer is used in a Wheatstone bridge as a detector. The resistance of Galvanometer is negligible. Each arm of the bridge has a resistance of 1 KΩ. The input voltage applied to the bridge is 20 V. Calculate the smallest change in the resistance which can be detected. The resistance of the Galvanometer can be neglected as compared with the internal resistance of the bridge.	**10**	**CO1**
Q 7	A four terminal resistor of approx. 50 μΩ resistance was measured with the help of a Kelvin's double bridge having the following components: Standard resistor = 100.03 Ω, inner ratio arms = 100.31 Ω and 200 Ω, outer ratio arms = 100.24 Ω and 200 Ω, resistance of the link connecting the standard resistance and the unknown resistance = 700 μΩ. Calculate the value of the unknown resistance.	**10**	**CO1**
Q 8	In a Maxwell inductance bridge, arm AB consists of a coil with inductance L1 and resistance r1 in series with a non-inductive resistance R. Arm BC and coil CD are each a non-inductive resistance of 100 Ω. Arm AD consists of a standard variable inductor (L) of 32.7 Ω. Balance is obtained when L2 = 47.8 mH and R = 1.36 Ω. a) Draw the circuit diagram of the bridge circuit, as mentioned above. b) Formulate the necessary equations for Maxwell's Inductance Bridge circuit. c) Find the Resistance and inductance of the coil in the arm AB.	**10**	**CO1**

<table>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="4">SECTION-C</td></tr>
<tr><td>Q 9</td><td>Design a <u>Fifth-order Unity-gain Butterworth Low-Pass Filter</u> with the corner frequency (F_C) of 60 KHz. Use the following data for your design:
<table><tr><th>Butterworth coefficients</th><th>Ai</th><th>Bi</th></tr><tr><td>Filter 1</td><td>a1 = 1</td><td>b1 = 0</td></tr><tr><td>Filter 2</td><td>a2 = 1.6180</td><td>b2 = 1</td></tr><tr><td>Filter 3</td><td>a3 = 0.6180</td><td>b3 = 1</td></tr></table></td><td>20</td><td>CO2</td></tr>
<tr><td>Q 10 A</td><td>A Sensor develops output of 20 to 200 mV as the input (measurand) varies from minimum to maximum of range. Develop a signal conditioning scheme with high input impedance, low output impedance and output voltage between 0-5 Volts.</td><td>10</td><td>CO2</td></tr>
<tr><td>Q 10 B</td><td>Figure shown below is an instrumentation amplifier driven by a bridge. Find the output voltage (Vo) if the input voltage (Vin) is 200 mV. Also, find the gain (Vo/Vin) of the shown amplifier.
 
</td><td>10</td><td>CO2</td></tr>
</table>