BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

First Semester 2022-23

Automation and Control (MF F 315)

End Semester Examination

Open Note book

Max. Time: 3 Hrs

Max Marks= MM 37 (20%)

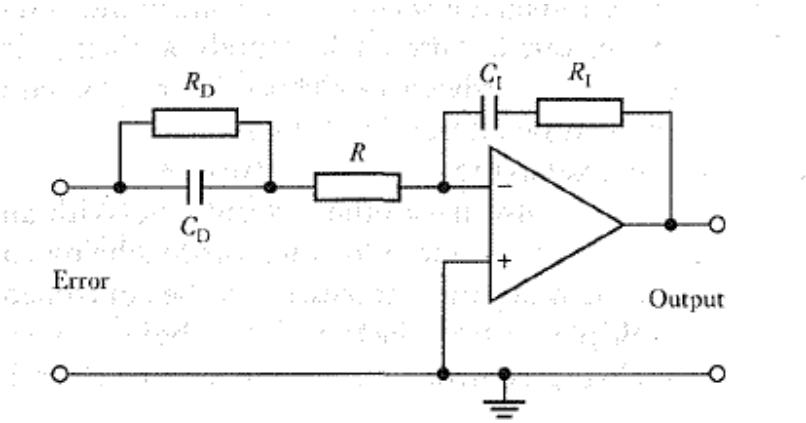
Name:	**ID No.**	**Date:**

Note: **Write RELEVANT CALCULATION and answer in the space provided against each part of question in the question paper itself. Use Answer script for initial or rough work. Submit both question paper and answer script in the end. Do not write answer using pencil.**

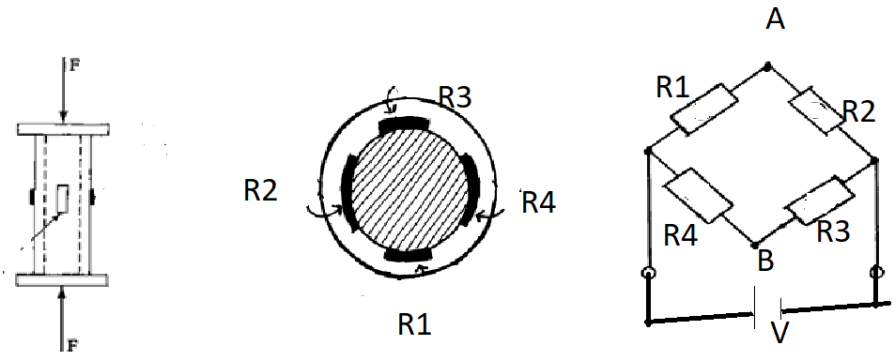
Q1. Design a RC band stop filter such that it cutoffs frequency ranging from 10^5 to 10^8 Hz, Draw schematic of the same as active filter. Also draw how its bode plot would look in dB vs Log(Hz). Given that you can use 10K ohm resistors only no restriction on capacitor values. [8]

Q2. A 5 track absolute rotatory encoders (with grey coding) connected to a motor shaft. Motor shaft is such that encoder output is all bit zero initially. -Motor is given supply for a short duration such that its shaft now rotates by 130 degrees. Find the encoder output now in this new position. [5]

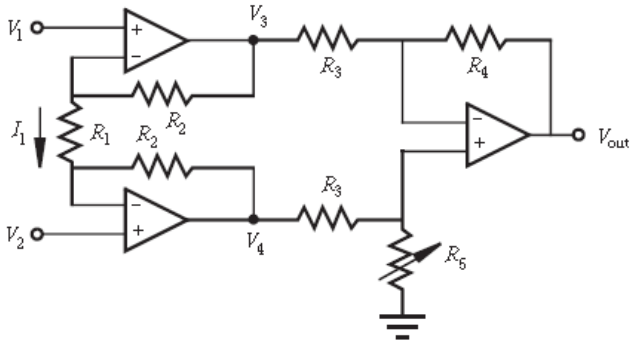
Q3. Determine transfer function of following circuit. Given R_D= 100 ohm, C_D= 200 µF, R= 200 ohm,R_1= 300 ohm. C_1=100 µ F. [7]



Q4. (a) A hollow-cylinder load cell of the type shown below has an outside diameter of 25.4 mm and a wall thickness of 1.01 mm It is made of aluminum with a modulus of elasticity of 69 GPa and Poisson's ratio of 0.3. What axial force is necessary to produce an axial stress of 138 MPa? For this load calculate change in resistance caused in all four gauges. Draw rhe whear stone bridge and mention which resustance is under tension or compression along with there NEW CHANGED resistance values, Calculate potential available at point A and B and potential difference across A and B, DO NOT USE DIRECT FORMULA for this calculatingV_{AB}. R1=R2=R3=R4=120 ohms and have a gage factor of 2.06, V=10 V. [17]



(b) When the above voltage is applied across the instrumentation amplifier shown below, Determine V_{out}, R1= 100 ohm, R2= 200 ohm, R3= 100 ohm, R4= 200 ohm.



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Sol

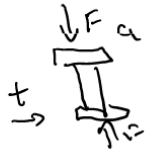
Q2 →

$\sigma = \frac{F}{A}$

$138 \times 10^6 = \frac{F}{\frac{\pi}{4}(25.4^2 - 23.38^2)}$

$F = 77.39 \times 10^{-6} \times 138 \times 10^6$

$= 10.679\ KN$ [1M]



$\varepsilon_a = \frac{\sigma}{E} = \frac{138 \times 10^6}{69 \times 10^9}$

$= -2000\ \mu strain$ [1M]

-2000×10^{-6}

transverse strain =

$\varepsilon_t = -0.3 \times -2000$

$= 600\ \mu strain$ [1M]

axial gauges R_2 and R_4

Change in ΔR given by $\Delta R/R = G_f \varepsilon_a$

$\Rightarrow \Delta R_a = 120 \times 2.06 \times -2000 \times 10^{-6}$ [1M]

$= -0.494\ \Omega$ ← [1M]

$\Rightarrow R_2 = R_4 = 119.506\ \Omega$

For transverse Resistors R_1 and R_3

$\Delta R_t = 120 \times 2.06 \times 600\ \mu$ [1M]

$= 0.14832\ \Omega$ ←

$R_1 = R_3 = 120.14832$ ← [1M]

$V_A = 10 \times \frac{R_2}{} \ 10V = 10 \times \frac{119.506}{}$

$R_1 + R_2$ 239.65432

$= 4.986599031472 \Leftarrow [\Omega]$

Can be swapped

$V_B = 10 \times \frac{R_3}{R_1 + R_2} = 10 \times \frac{120.14832}{239.65432}$

$= 5.013400968528 \Leftarrow [\Omega]$

$V_B - V_A = 26.8019\ mV \Leftarrow [V]$ {ignore sign}