

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: M. TECH/PRE-PHD
BRANCH: EEE

SEMESTER: II
SESSION: SP/2023

SUBJECT: EE579 INDUSTRIAL INSTRUMENTATION AND CONTROL

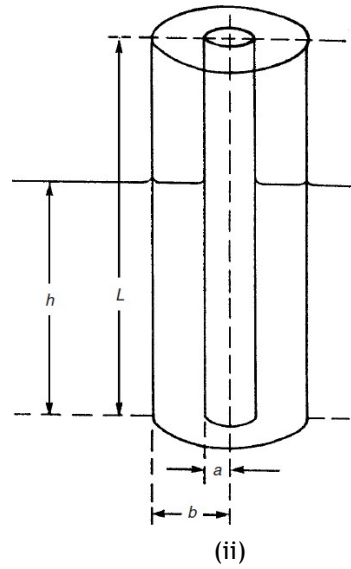
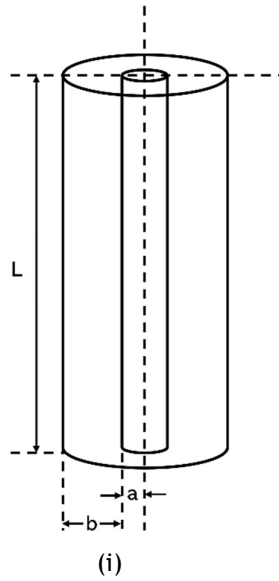
TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
-

	CO	BL
Q.1(a) Differentiate between RS-232 and IEEE 488 interface for data transmission.	[3]	1 4
Q.1(b) A Sallen-and-Key high pass active filter having a quality factor of 10 is used for eliminating high frequency noise signals above 50 kHz. (i) Design the filter in equal R and equal C form by appropriately choosing the components. Draw the circuit diagram and derive the transfer function. (ii) Calculate the percentage error in the cut-off frequency obtained for your design.	[7]	1 6
Q.2(a) Explain the undesirable static characteristics of an instrument.	[5]	2 2
Q.2(b) Temperature change in a mercury in glass thermometer is modeled by $\tau \frac{dy(t)}{dt} + y(t) = Kx(t)$ where, y(t) is the temperature measured by the thermometer, x(t) is the input environmental temperature, $\tau = 2$ sec is the time constant, and $K = 1$ is the static sensitivity. (i) For a step change in input temperature as $x(t) = 2u(t)$, evaluate and comment on the nature of temperature change of the thermometer. (ii) Calculate the percentage error in measurement of temperature at $t = 5$ sec. (iii) Evaluate the steady state error of the system.	[5]	2 3
Q.3(a) An equal percentage valve delivers 10 gallons per minute (gpm) of water when the valve is 40% open. When the valve is 50% open, the flow rate increases to 15 gpm. Estimate the flow rate through the valve when it is 60% open. Assume that the pressure drop across the valve remains constant.	[4]	3 3
Q.3(b) The pH of a liquid in a tank is to be maintained at neutral. Design a split range control using exclusive valve sequencing to achieve neutral pH with proper explanation. Justify whether complementary valve sequencing is useful for this case.	[6]	3 2 5 6
Q.4(a) Explain the operation of an electromagnetic flowmeter.	[5]	4 2
Q.4(b) The capacitance of a cylindrical capacitor as shown in fig. (i) is given by $\frac{2\pi\epsilon_0 L}{\ln(b/a)}$. This device is now used for measurement of the water level in a tank (fig. (ii)) where h is the level of water. (i) Derive the relation between the level of water and the measured capacitance. (ii) If $b/a = 2$, find the water level when the measured capacitance is 100pF. Assume $\epsilon_0 = 8.85 \times 10^{-12}$ F/m and relative permittivity of water as 81.	[5]	4 3



- Q.5(a) A smart pressure transmitter is used to measure pressure of the range 200 - 1000 bar. [5] 5 2
 List the equipment required for calibration of the transmitter and describe the calibration steps.
- Q.5(b) Explain the operation of a device capable of measuring very low pressure. [5] 5 2

.....27/04/2023.....E