

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur (GIET University)



B. Tech (Sixth Semester - Regular) Examinations, April 2026 23BMEPC36003 - Mechanical Measurement and Metrology (Mechanical Engineering)

Time: 3 hrs

Maximum: 60 Marks

Answer ALL questions
(The figures in the right hand margin indicate marks)

PART – A**(2 x 5 = 10 Marks)**Q.1. Answer **ALL** questions

	CO #	Blooms Level
a. Define measurement and classify them.	CO1	K1
b. Define error? Classify different types of error in the measurement process.	CO2	K2
c. Explain the working principle of POT.	CO3	K1
d. Explain the working of pressure thermometers.	CO4	K1
e. Explain Taylor's principle of gauge design.	CO5	K1

PART – B**(10 x 5 = 50 Marks)**Answer **ALL** the questions

	Marks	CO #	Blooms Level
2. a. Describe the functional elements of a measuring system with neat sketch.	5	CO1	K3
b. Explain static characteristics of measurement system.	5	CO1	K3
(OR)			
c. Define error in measurement and distinguish them.	5	CO2	K3
d. Describe dynamic characteristics for measuring instruments in time domain analysis	5	CO2	K3
3.a. Explain the basic principles of LVDT, its construction, applications and limitations through diagrams?	5	CO3	K3
b. A parallel plate capacitive transducer has two plates of area 25 cm ² and separated by 0.5 mm, due to applied displacement, the plate separation reduced to, 0.4 mm Calculate:			
i. initial capacitance,	5	CO6	K3
ii. Final capacitance,			
iii. Change in capacitance.			
Take permeability of free space is $8.854 \times 10^{-12} \text{ F/m}$			
(OR)			
c. Explain the working of variable reluctance transducer, also explain its merits and demerits.	5	CO3	K3
d. In a potentiometer transducer the potentiometer has total resistance of 30 k Ω for a total wiper travel of 150 mm. During a measurement the wiper moves between. 20 mm to 60 mm over the potentiometer. If the voltmeter of 20 k Ω is used to read the output voltage of the transducer, then find out the error due to loading effect at two measuring points. If the error due to loading effect in the above experiment is to be kept within $\pm 3\%$, then, what should be the resistance of the voltmeter.	5	CO6	K4
4.a. Discuss the working of a Bourdon gauge with a neat sketch.	5	CO4	K3

b.	Discuss the working principle of thermocouple. What are the advantages and limitations of thermocouple sensors?	5	CO3	K3
(OR)				
c.	List all the gauges used for low pressure measurement and briefly discuss about their working.	5	CO4	K3
d.	A single strain gauge having resistance of $130\ \Omega$ is mounted on a steel cantilever beam at a distance of 0.18 m from the free end. An unknown force F applied at the free end produces a deflection of 14 mm of the free end. The change in gauge resistance is found to be $0.157\ \Omega$. The beam is 0.29 m long with a width of 25 mm and a depth of 3.5 mm. The young's modulus for steel is $210\ \text{GN/m}^2$. Calculate the gauge factor.	5	CO6	K4
5.a.	Differentiate between dynamometer and load cell for measurement of forces.	5	CO4	K2
b.	A surface profile is measured over an evaluation length of $L=10\ \text{mm}$. The deviations (in μm) of 10 equally spaced points from the mean line are recorded as: $h_1 = +4, h_2 = -3, h_3 = +5, h_4 = -6, h_5 = +2, h_6 = -4, h_7 = +3, h_8 = -2, h_9 = +6, h_{10} = -5$. Calculate Arithmetic Mean Roughness (R_a), Root Mean Square Roughness (R_q), Ten-point Height Roughness (R_z), Maximum Peak-to-Valley Height (R_t).	5	CO5	K3
(OR)				
c.	With a schematic diagram, explain the working of a Servo controlled dynamometer.	5	CO4	K2
d.	Differentiate between CLA method and RMS method of roughness measurement	5	CO5	K2
6.a.	Define tolerance? Explain unilateral and bilateral systems of tolerance.	5	CO5	K2
b.	Design the hole and shaft for 20H7f8 fit, with given $i = 0.45\sqrt[3]{D} + 0.001D$ microns, upper deviation of shaft is $-5.5D^{0.41}$ and 20 mm falls in the diameter steps of 18 to 30 mm. (Note IT7 = 16i and IT8 = 25i)	5	CO5	K5
(OR)				
c.	Define fits and with the help of neat sketches, explain different types of fits.	5	CO5	K2
d.	Using the results obtained from 6 (b), design the plug and ring gauges as per IS specifications. Assume gauge tolerance = 10% of part tolerance, wear allowance is 10% of gauge tolerance.	5	CO5	K5

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