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## B.Tech. Degree III Semester Regular/Supplementary Examination in Naval Architecture and Ship Building November 2023

### 20-215-0304 INSTRUMENTATION (2020 Scheme)

Time: 3 Hours

Maximum Marks: 100

**Course Outcome**

On successful completion of the course, the students will be able to:

- CO1: Understand the basics of instrumentation, standards, calibration and errors in measurement.  
 CO2: Understand the basic working principle and classification of transducers for measurement of displacement, strain, force and pressure.  
 CO3: Explain the working principle, construction and features of various temperature measuring instruments  
 CO4: Explain the working principle, construction and features of various pressure, flow and humidity measuring instruments.  
 CO5: Explain the concepts and terminology of digital instrumentation.

Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze, L5 – Evaluate, L6 – Create

PO – Programme Outcome

#### PART A (Answer *ALL* questions)

		(5 × 4 = 20)	Marks	BL	CO	PO
I.	(a) Describe static performance parameters in measurements.		4	L1	1	1
	(b) Explain function the unbonded type strain gauge with diagram.		4	L2	2	1
	(c) State and explain thermo electric laws.		4	L1	3	1
	(d) Explain any one method of measurement of high pressure.		4	L2	4	1
	(e) List out advantages and disadvantages of digital instruments.		4	L1	5	1

#### PART B

		(5 × 16 = 80)	Marks	BL	CO	PO
II.	(a) How errors in instruments are classified? Explain in detail.		10	L2	1	1
	(b) The output power of a rotating shaft is measured by a dynamometer. The relationship for output power is:		6	L3	1	1

$$P = \frac{2\pi \times 9.81 \times FLN}{t \times 10^6} \text{ kW}$$

Where:  $F$  force applied in (N),  $L$  length of the torque arm in (mm),  
 $N$  number of revolutions during time  $t$ , and  $t$  time for test run in seconds. And the test results were:

$$F = 4.58 \pm 0.2 \text{ kg}$$

$$L = 397 \pm 1.3 \text{ mm}$$

$$R = 1202 \pm 1 \text{ revolutions, } t = 60 \pm 0.5 \text{ s}$$

The errors are limiting errors. Determine the magnitude of power and magnitude of limiting error in the computed power.

OR

(P.T.O.)

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		Marks	BL	CO	PO
III.	(a) Explain Static and Dynamic characteristics of instruments in detail.	10	L2	1	1
	(b) A power transformer was tested to determine losses and efficiency. The input power was measured as 3,650 W and the delivered output power was 3,385 W, with each reading in doubt by +10 W. Calculate: (i) the percentage uncertainty in the losses of the transformer (ii) the percentage uncertainty in the efficiency of the transformer.	6	L3	1	1
IV.	(a) Explain the different working principles of inductive transducers with respect to the varying parameters.	10	L2	2	1
	(b) A parallel plate capacitive transducer uses plates of area 500 mm <sup>2</sup> which are separated by a distance of 0.2 mm. (i) Calculate the change in capacitance if a linear displacement reduces the distance between the plates to 0.18 mm. Also, calculate the ratio of per unit change of capacitance to per unit change of displacement. (ii) If a mica sheet of 0.01 mm thickness is inserted in the gap, calculate the value of the original capacitance and change in capacitance for the same displacement. Also, calculate the ratio of per unit change of capacitance to per unit change in displacement. The dielectric constant of mica is 8.	6	L3	2	1
OR					
V.	(a) Explain the construction and working principle of a linear voltage differential transformer (LVDT). Explain how magnitude and direction of the displacement of core of an LVDT is detected. List out the advantages and disadvantages of LVDT.	10	L2	2	1
	(b) An LVDT has an output of 6 V when displacement is $0.4 \times 10^{-3}$ mm. If a 10 V voltmeter with 100 scale divisions is used to read the output, 2/10 division can be evaluated with this. (i) Calculate the voltmeter's resolution. (ii) Calculate the sensitivity of LVDT.	6	L3	2	1
VI.	Describe the method of measurement of temperature with use of: (i) RTD (ii) Thermistors (iii) Thermocouple. List out their advantages and limitations.	16	L2	3	1
OR					
VII.	Describe the construction and working of (i) total radiation pyrometers (ii) infrared pyrometer (iii) disappearing filament optical pyrometer.	16	L2	3	1

(Continued)

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VIII.	Explain the construction and working of a U tube manometer with a neat diagram. List out the advantages and disadvantages. What are the properties of manometric fluid?	16	L3	4	1
<b>OR</b>					
IX.	(a) Explain the construction and working principle of electromagnetic type flow meter.	8	L3	4	1
	(b) With neat sketches explain the liquid level measurement using ultrasonic method and hydrostatic pressure head.	8	L3	4	1
X.	What is the need of analog to digital conversion (ADC)? Explain Successive Approximation type ADC in detail. What are the advantages and disadvantages of Successive Approximation type ADC?	16	L2	5	1
<b>OR</b>					
XI.	Write short notes on	16	L2	5	1
	(i) Light Emitting Diodes				
	(ii) Liquid Cristal Display				
	(iii) Cathod Ray Tube.				

Bloom's Taxonomy Levels

L1 = 12%, L2 = 56%, L3 = 32%.

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