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BHARATIYA VIDYA BHAVAN'S

SARDAR PATEL COLLEGE OF ENGINEERING

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Examination

June 2017

Maximum Marks: 100 **Q. P. Code:** **Duration: 4 Hrs**

Class: **F.Y. M. Tech. (Mechanical) Thermal Engineering** Semester: **II**

Program: **M. Tech. (Mechanical) Thermal Engineering**

Name of the Course: **Experimental Analysis and Instrumentation**

Course Code: **MTTH202**

Master file.

Instructions:

1. **Attempt any five questions.**
2. **Draw neat diagrams wherever necessary.**
3. **Assume suitable data if necessary.**

Q. No.		Max. Marks	CO No.	Module No
1 (a)	Only draw neat self-explanatory labeled sketches of (i) Film coefficient transducer (ii) Radial heat conduction apparatus (iii) Saybolt viscometer (iv) Thermal conductivity comparator	10	2	5, 6
(b)	A strain gauge is bonded to a beam which is 0.1 m long and has a cross sectional area of 4 cm^2. The unconstrained resistance and gauge factor of the strain gauges are 240 Ω and 2.2 respectively. On the application of axial load the resistance of the gauges changes by 0.013 Ω. If the modulus of elasticity for steel is $207x10^9$ N/m^2, calculate (i) The change in length of the steel beam (ii) The amount of force applied to the beam.	10	2	4
2 (a)	A single strain gauge having resistance of 130 Ω is mounted on a steel cantilever beam at a distance 0.12 m from the free end. The beam dimensions are 25 cm (length) x 2.0 cm (width) x 0.3 cm (depth). An unknown force F applied at the free end produces a deflection of 11.8 mm of the free end. If the change in gauge resistance is found to be 0.145 Ω, calculate the gauge factor. Deflection of the free end $\delta = FL^3/3EI$. Take Young's modulus for steel as $200x10^9$ N/m^2 Also derive the equation of the limiting error in determination of the unknown force F.	10	1	6
(b)	With illustrative example explain digital to analog converters and its significance.	10	3	7
3	With neat sketches explain (i) Laser Doppler anemometer (ii) Capillary tube viscometer (iii) Sling psychrometer (iv) Ionization gauge	20	2	4, 6
4 (a)	With neat sketches explain operational amplifier and its various modes	10	3	7

(b)	A thermometer, idealized as a first-order system with a time constant of 2.2 seconds, is suddenly given an input of 160^0C from 0^0C. What will be the reading of the thermometer after 1.2 seconds?	05	2	4
(c)	While measuring speed of a steam turbine with stroboscope single line images were observed for stroboscope setting of 3000, 4000 and 5250 rpm. Calculate the speed of the turbine.	05	2	3
5 (a)	A Venturimeter is to fitted in a horizontal pipe of 0.15m diameter to measure a flow of water which may be anything up to 240m^3/hour. The pressure head at the inlet for this flow is 18m above atmospheric and the pressure head at the throat must not be lower than 7m below atmospheric. Between the inlet and the throat there is an estimated frictional loss of 10% of the difference in pressure head between these points. Calculate the minimum allowable diameter for the throat.	08	2	4
(b)	Following are the different applications/systems/processes wherein the temperature measurement is essential; i) Processor of the computing system ii) Temperature of ceramic in heat treatment process iii) Cryogenic systems Students shall select the appropriate thermometers for the above applications and explain their working principle with neat sketches.	12	3	4
6 (a)	Smartness in the utilities and system is presently been possible due to technological growth. Concept to implement smartness is being promoted by the various government initiatives such as smart cities etc. Based on the knowledge gain in the course 'Experimental Analysis and Instrumentation" and from other allied courses students shall propose at least one sensor and one measurement system that can be used in the home in a step to make smart home. Also provide a brief architecture of use of the sensor and measurement system and benefits that can be attained with its use. Support your idea with neat sketches and explanation.	8	4	1 to 7
(b)	In a rotating cylinder viscometer, the radii of the cylinders are 32 mm and 30 mm and the outer cylinder is rotated steadily at 200 rpm. For a certain liquid filled in the annular space to a depth of 80 mm, the torque produced on the inner cylinder is $1.2x10^{-4}$ Nm (considering viscous friction at the bottom plane also). Bottom plane of the inner cylinder is separated with plane of outer cylinder by distance1mm and filled with same liquid. Calculate the viscosity of the liquid.	12	2	6
7 (a)	Explain working of McLeod gauge; with step by step neat labeled diagram (explain working in at least three steps supported by sketch). Derive the equation for measuring the pressure by Mcleod gauge in terms of design and process parameters	10		
(b)	Transfer function of a measurement system under study is of second order. If for such a measurement system under study natural frequency, ω_n= 10 rad/sec, damping ratio, ζ=0.8. tolerance = 5% and reference input in Laplace domain, R(s)=1/s, then find (a) Rise time (b) Peak Overshoot (c) time for second undershoot (d) Peak time (e) settling time (f) Number of oscillations before it settles.	10	1	2