Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VI SEMESTER B.TECH ELECTRICAL & ELECTRONICS ENGINEERING MAKEUP EXAMINATIONS JULY 2016

SUBJECT: MEASUREMENT AND INSTRUMENTATION [ELE 306]

REVISED CREDIT SYSTEM

01 JULY 2016

MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitable assumed.
- 1A. What is virtual instrumentation? Highlight the main difference between traditional and virtual instruments. (use virtual thermometer as an example)
- 1B. Three resistances have ratings as $37 \Omega \pm 5\%$, $75 \Omega \pm 1\%$ and $50 \Omega \pm 3\%$. Determine the magnitude and limiting error in ohms and percentage of the total resistances when all are connected in A) series and B) parallel.
- 1C. Briefly explain the static and dynamic characteristics associated with an Instrumentation system. (04)
- 2A. A capacitive displacement transducer uses a differential arrangement with two outer plates which are fixed and a central plate which is moveable. The distance between the fixed and the moveable plates is 5 mm when no displacement is applied. A voltage of 1000 V RMS is applied across the fixed plates. Determine the differential output voltage if a displacement of 0.01 mm is applied to the central plate. Also find the sensitivity of the transducer.
- 2B. Explain with neat schematics and accompanying graphs, how capacitive transducers can be used for sensing applications by variations in:
 - i. Distance between the plates
 - ii. Overlapping area
- 2C. i. An LVDT has an output of 6V RMS when the displacement is 0.4×10^{-3} mm. Determine the sensitivity of the instrument in V/mm. A 10V voltmeter with 100 scale divisions is used to read the output. Two tenths of division can be estimated with ease. Find the resolution of the voltmeter. The above arrangement is used in a pressure transducer for measurement of deflection of a diaphragm. The diaphragm is deflected through 0.5×10^{-3} mmby a pressure of 1000N/m². Find the sensitivity and resolution of this instrument.
 - ii. A strain gauge is bonded to a steel beam 0.1 m long and has a cross-sectional area of $4cm^2$. Young's modulus of elasticity for steel is 207 GN/m². The strain gauge has an unstrained resistance of 240 Ω and a gauge factor of 2.20. When the load is applied, the gauge's resistance changes by 0.013 Ω . calculate the change in length of the steel beam and the amount of force to be applied.
- 3A What is the importance of signal conditioning in Measurements and Instrumentation? In general explain any four functions of a Signal conditioning circuit.
- 3B Draw the circuit of, 3 OpAmp Instrumentation amplifier and derive an expression to determine its output voltage.
- 3C i. Explain the working of R-2R ladder DAC with neat schematic. Derive the expression for its output voltage.
 - ii. Prove that analog output voltage corresponding to the binary input 0001 in a R-2R DAC logic is $V_{out} = -1/16$ Vs.

2016

KNOWLEDGE IS POW





Time: 3 Hours

(03)

(03)

(03)

(03)

(04)

(03)

(03)

(04)

| 4A | Derive the equation for measurement of an unknown low resistance using Kelvins Double Bridge method using suitable circuit diagram. | (03) |
|----|---|------|
| 4B | With neat circuit diagram, explain the two methods of determining the low value of resistance via the Ammeter-Voltmeter method. Derive the final expression for the true value of unknown | |
| | resistance. | (03) |
| 4C | Explain the measurement of self-inductance using neat schematic of Anderson's Bridge | (04) |
| 5A | Explain in detail the measurements of frequency using Lissajous patterns. Mention the factors on which Lissajous patterns are dependent. | (03) |
| 5B | In an electrodynamometer instrument the total resistance of voltage coil circuit is $8.2k\Omega$ and mutual inductance changes from (-173µH) at zero deflection to (+175µH) at full scale deflection of 95°C. If 100V potential difference is applied across voltage circuit, current of 3A at a power factor of 0.75 is passed through current coil. What will be the deflection if the spring constant is | |
| | 4.63X10 ⁻⁶ N-m/rad. | (03) |
| 5C | What is Instrument Transformer? Highlight the three main differences between current | |
| | transformer and potential transformer. | (04) |
| 6A | Inductance of moving coil ammeter with full scale deflection of 90° at 1.5A is given by an expression $L = (200 + 40\theta - 4\theta^2 - \theta^3) \mu H$ where, θ is the deflection in radians from zero | |
| | position. Estimate the angular deflection of pointer for a current of 1A. | (03) |
| 6B | Design a suitable ladder logic based control for a simple direct-on-line starter system of a 3 | |
| | indicator lighta Europein the design suitably. | (02) |
| 60 | Mith appropriate L/O waveforme as well as ladder diagrams, explain. | [03] |
| UL | i ON delay timer | |
| | | |

ii. OFF delay timer

(04)