Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VI SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: MEASUREMENTS & INSTRUMENTATION [ELE 306]

REVISED CREDIT SYSTEM

Time: 3 Hours 09 MAY 2016 MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.

1A. Define and compare the terms - Accuracy, Precision and Sensitivity with suitable examples. ***(03)***

1B. (i) The Resistance of copper wire is given by $R = R_0[1 + \alpha(\theta - 20)]$ and Resistance of wire measured at 20^0 C is 4Ω ±0.2%. The value of temperature coefficient α is 0.004 Ω/ Ω^0C ±1% and temperature is θ = 25 ± 1% ^{0} C. Find the resistance R and its probable error.

(ii) Given expected voltage value across a resistor is 80V. The measurement is 79V. Calculate,

1. The absolute error and The percentage of error
2. The relative accuracy and The percentage of accuracy

(03)

1C. With a neat sketch, explain in detail the working of an ECG monitoring system. ***(04)***

2A. (i) Derive an expression to determine the ratio of output voltage to input voltage for a linear potentiometer under loaded condition.

(ii) With a neat diagram, explain the working principle of bonded resistance wire strain gauge. A Nickel wire and a Nichrome wire strain gauge with gauge factors of -12.1 and 2 respectively are used to measure a strain on a structural beam. If the resistances of the gauges are 120Ω before application of compressive force, calculate the change in resistance value of gauges resistance after they are strained to 5 micro strains. ***(05)***

2B. (i) A thermistor has a resistance of 3980Ω at the ice point (0°C) and 794Ω at 50°C. The temperature –resistance relationship is given as $R_t = aR_0e^{b/T}$. Calculate the constants **'a'**and **'b'**. Also calculate the range of resistance to be measured in case the temperature varies from 40°C to 100°C.

(ii) Output of an LVDT is connected to a 5V voltmeter through an amplifier with amplification factor of 250. An output of 2mV appears across the terminals of LVDT when the core moves through a distance of 0.5mm. Calculate the sensitivity of LVDT and sensitivity of whole instrument setup. The milli-voltmeter scale has 100 divisions. The scale can be read to 1/5 of a division. Calculate the resolution of the instrument in mm. ***(05)***

3A (i) Explain with a neat diagram the working of a basic Sample and Hold Amplifier. For a sinusoidal input, plot its output graph thereby explaining its working principle with respect to gate pulses.

(ii) Design a Signal Conditioning circuit using OPAMP for interfacing AD590 IC temperature transducer to produce 0V at 0°C and 10V at 100°C. The rate of conversion of AD590 is 1μA/^{0}K. ***(05)***

3B (i) With neat block schematic, explain the operation of Magnetic Isolation of Input-Output Signals, highlighting the importance of modulators/demodulators in this isolation technique.

(ii) Design an instrumentation circuitwhich provides an output voltage V_{out}related to input voltage (V_{in}) as$V_{out} = 3.5V_{in} + 5$. The available components are 35 kΩ (two in number) and 10 kΩ (three in number) in addition to two OPAMPS. ***(05)***

4A A kelvins double bridge has each of the ratio arms P=Q=p=q=1kΩ. The e.m.f of battery is 100V and a resistance of 5Ω is included in the battery circuit. The galvanometer has a resistance of 500Ω and the resistance of the link connecting the unknown resistance to standard resistance may be neglected. Bridge is balanced when standard resistance is 0.001Ω. Determine

i. The value of unknown resistance
ii. The value of current through the unknown resistance at balance.
iii. Deflection of galvanometer when unknown resistance is changed by 0.1% from its value at balance. Galvanometer Sensitivity is 200 mm/μA. ***(03)***

4B A transformer generating primarily magnetic field is located 10cm from a shielding structure. The shielding structure ismade from 1cm thick sheet of copper. Estimate the shielding effectiveness of the structure at 1.5kHz. ***(03)***

4C With a neat sketch, derive an expression for deflecting torque in an electrodynamometer type of instrument connected to a sinusoidal single phase AC supply. ***(04)***

5A Describe the working of Anderson's Bridge for measurement of self-inductance with neat schematic. Also derive an expression for the measurement of inductance. ***(03)***

5B Explain in detail the measurement of phase difference using Lissajous patterns. Mention the factors on which Lissajous patterns are dependent. ***(03)***

5C With neat block schematic, design a virtual single phase digital energy meter to be used as part of home automation. The current is sensed along the phase while the voltage is measured with respect to the neutral. Explain the selection of components and their working. ***(04)***

6A Design a suitable ladder logic that will enable the realization of a 24 hour digital clock which should display as **hours:minutes:seconds**. Explain the design appropriately. ***(03)***

6B Find the output voltage, current, and resolution for a binary weighted resistor DAC of 4 bits-given condition R = 10 kΩ, Rf= 5 kΩ, VR = -10 V. Applied binary word is 1010.

Further, highlight the advantages of R-2R ladder DAC over the binary weighted resistor DAC. ***(03)***

6C What is an Instrument Transformer? Explain with neat diagrams, the working of Current Transformer and Potential Transformer. ***(04)***