B. Power Engineering 3rd Year 1st Sem Supplementary Examination, 2017 (Old)
Electrical Measurement and Instrumentation (Old)

Times : Three hours   Answer any *five* questions

Full Marks: 100

1. (a) Describe the construction of ballistic galvanometer and derive the expression of deflection of the same. Also draw the deflection curve.   5+5+2

   (b) A moving coil galvanometer has a coil wound upon a former of non-conducting material. The current sensitivity of the instrument is 0.002mm/μA at 1m and the undamped period time is 5 sec. If the torque is 0.074m/A, calculate the control torque of the suspension, the moment of inertia of the moving system and the total circuit resistance which critically damps the instrument. The effect of air damping is neglected.   8

2. (a) Define ratio error and phase angle error.

   (b) A ring core current transformer with a nominal ratio of 500/5 and a bar primary has secondary resistance of 0.6 Ω and a negligible secondary reactance. The resultant of magnetizing and iron loss components of the primary current associated with full load secondary current of 5A in a non-inductive burden of 1.0 Ω is 2.5 A at a power factor of 0.3. Calculate the true ratio and phase angle error of the CT on full load. Calculate also the total flux in the core assuming a frequency of 50 Hz. Derive the equations used to solve the problem.   4+16

3. (a Discuss how Wheatstone bridge is modified for measurement of low resistance. Derive the expression of unknown resistance of the modified bridge.   8

   (b) In an Anderson Bridge for measurement of inductance the arm *AB* consists of unknown impedance with inductance L and R, a known variable resistance in arms *DE* and *BC*, fixed resistance of 600Ω each in arms *CD* and *DA* and a condenser with fixed capacitance of 1μF in arm *CE*. The ac supply of 100 V is connected across *A* and *C*, the detector is connected between *B* and *E*. If the balance is obtained with a resistance of 400 Ω in the arm *DE* and a resistance of 800Ω in the arm *BC*, calculate the value of unknown R and L. Derive the expression used.   12

4. (a) Differentiate between Gravity Control and Spring Control.   5

   (b) Describe with a diagram the working of a PMMC type instrument.   7

   (c) A PMMC instrument has a coil of dimension 15mm×12mm. The flux density in the air gap is $1.8×10^{-3}$Wb/m^2 and the spring constant is $0.14×10^{-6}$ Nm/rad. Determine the number of turns required to produce an angular deflection of 90 degrees when a current of 5mA is flowing through the coil   8

5. (a) Derive the torque equation for Moving Iron Instruments.   8

   (b) The law of deflection of a moving iron ammeter is given by $I = 4\theta^n$ ampere where θ is the deflection in radian and n is a constant. The self inductance when the meter current is zero is 10mH. The spring constant is 0.16 N-m/rad. Determine an expression for self inductance of the meter as a function of θ and n. With $n = 0.75$, calculate the meter current and the deflection that corresponds to a self inductance of 60mH.   12

6. (a) Explain the working of Fluid Friction Damping with a diagram? Give its advantages and disadvantages   10

   (b) What are the requirements of Shunt and Multiplier?   4

   (c) A moving coil instrument gives a full-scale deflection for a current of 20mA with a potential difference of 200mV across it. Calculate:

      i) Shunt required for using it as an ammeter to get a range of 0-200A.

      ii) Multiplier required for using it as a voltmeter of range 0-500V   6

7. Write short notes on any two of the following:

                                                                                 2×10
   i)   High voltage Schering bridge
   ii)   AC Potentiometer
   iii)   Electrodynamometer Type Instruments
   iv)   Moving Iron Instruments