Mansoura University
Faculty of Engineering
Electrical Engineering Department
First Year of Electrical Engineering

Electrical Measurements
EE2123
Total Three Hours Time allowed
Wednesday 11/06/2014
60 Marks Score

Answer The Following Questions

Question # 1 (15 Marks)

A- Distinguish briefly between accuracy and precision. **(3 Marks)**

B- Write expressions for Rx and Lx in the following Anderson AC bridge. Arm AB is the unknown inductance (Rx, Lx). Arm BC is a non-reactive resistance R2. DE is a resistance. Arm CD is a non-reactive resistance R4. Arm DA is a non-reactive resistance R3. EC is a capacitor C. EB is the detector and AC is the supply.
Then, calculate Rx and Lx if balance is obtained for R2=R4=400 Ω, R3=500 Ω, r=10 Ω, and C=3μF. **(3 Marks)**

C- An electromagnetic wattmeter has voltage circuit resistance of 8000 Ω and inductance of 63.6 mH which is connected directly across the load carrying 8 A at 50 Hz, voltage of 240 V and power factor of 0.1 lagging. Estimate percentage error in the wattmeter reading caused by the loading and inductance of the voltage coil. **(3 Marks)**

D- Explain with the schematic diagram the speed measurement using photo-electric pickup tachometer. **(3 Marks)**

E- A moving coil voltmeter has a uniform scale with 100 divisions and gives full-scale reading of 500 V. The instrument can read up to $1/10^{th}$ of a scale division with a fair degree of certainty. Determine the resolution of the instrument in volt. **(3 Marks)**

Question # 2 (15 Marks)

A- Compare clearly between: **(6 Marks)**
(i) Direct and indirect methods of measurements.
(ii) Gross and systematic errors in measurements.

B- Draw connection diagram for power measurement in a three-phase load using two-wattmeter method. **(2 Marks)**

C- An ac bridge with terminals A, B, C, D (consecutively marked) has in arm AB a pure resistance; arm BC a resistance of 800 Ω in parallel with a capacitor of 0.5 μF; arm CD a resistance of 400 Ω in series with a capacitor of 1.0 μF; and arm DA a resistance of 1000 Ω. Obtain the value of the frequency for which the bridge can be balanced. Also, calculate the value of the resistance in arm AB to produce balance. **(3 Marks)**

D- Compare between the spring and gravity control methods. Use sketch diagrams as you can. **(4 Marks)**

Question # 3 (15 Marks)

A- Explain with the aid of schematic diagram the elements of measurement system. **(3 Marks)**

B- Show using sketches the constructional features of both types of moving iron instruments. **(4 Marks)**

C- Explain the loading effect due to shunt and series connected instruments. **(4 Marks)**

D- A shaded pole Induction ammeter if calibrated at 50 Hz. It gives a deflection of 105° with a current of 20 A. Determine the deflection or the instrument while measuring 20 A at a frequency of 75 Hz. **(2 Marks)**

E- Schering bridge is used for measuring the loss angle of the capacitor. Explain this sentence. **(2 Marks)**

Question # 4 (15 Marks)

A- State the merits and demerits of the following: **(4 Marks)**
   (i) PMMC instruments   (ii) Hot-wire instruments

B- Compare between the recording and the integrating instruments. **(2 Marks)**

C- State two methods which can be used for measurement of frequency? Explain the working of vibration reed frequency meter with its merits and demerits. **(3 Marks)**

D- The inductance of a moving iron ammeter is $L = (10+5\theta-2\theta^2)$ μH where θ is the angular deflection in radians from zero position. Determine the angular deflection in radians for a current of 10 A if the deflection for a current of 6 A is 40°. Also determine the spring constant. **(3 Marks)**

E- Following readings were obtained in respect of measurement of a capacitor; 1.003, 0.998, 1.005, 0.996, 0.997, 1.008, and 0.994 nF. Calculate the arithmetic mean, the standard deviation, and the probable error of the mean value. **(3 Marks)**

With My Best Wishes
Associate Professor Dr. Ebrahim A. Badran