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KC-6225

B. E. - II (Sem. III) (Instrumentation & Control) Examination

November / December – 2012

IC-304-IC : Measurement & Instruments

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ B. E. - II (SEM. III) (INSTRUMENTATION & CONTROL)

Name of the Subject :

☛ **Measurement & Instruments-IC 304 IC**

☛ Subject Code No. : 6 2 2 5 ☛ Section No. (1, 2,.....) : 1&2

Seat No. :

Student's Signature

(2) Attempt all questions.
(3) Figures to the right indicate marks.
(4) Answer of two sections must be written in separate answer books.

SECTION - I

1 (a) Give the answers in brief : **10**

(1) The breaking torque provided by a permanent magnet in a single phase energy meter is proportional to the : **1**

(a) square of the flux of the permanent magnet
(b) speed of the meter
(c) distance of the permanent magnet from the centre of the revolving disc
(d) all of the above

(2) Which meter has the highest accuracy in the prescribed limit of the frequency range ? **1**

(a) PMMC
(b) Moving iron
(c) Electrodynamometer
(d) Rectifier

(3) In electrodynamometer type of wattmeters, the inductance of pressure coil ckt produces error **1**

(a) which is constant irrespective of the power factor of the load

(b) which is higher at low power factors

(c) which is lower at low power factors

(d) none of the above

(4) In spring controlled moving iron instruments, the scale is **1**

(a) uniform

(b) cramped at the lower end and expanded at the upper end

(c) expanded at the lower end and cramped at the upper end

(d) cramped both at the lower end and upper end

(5) The power consumption of PMMC instrument is typically about **1**

(a) 0.25 W to 2 W

(b) 0.25 mW to 2 mW

(c) 25 μW to 200 μW

(d) none of the above

(6) A voltmeter has a resistance of 2000 Ω. When it is connected across dc ckt its power consumptions is 2 mW. Suppose this voltmeter is replaced by a voltmeter of 4000 Ω resistance, the power consumption will be **1**

(a) 4 mW

(b) 1 mW

(c) 2 mW

(d) None of the above

(7) Define : **2**

(i) Current sensitivity and

(ii) Voltage sensitivity with respect to galvanometer.

(8) Give two important advantages and disadvantages each of dynamometer type instruments. **2**

(b) Explain the construction and working of d'Arsonval galvanometer. Derive the torque equation. 8

2 (a) With the help of neat diagram, explain the working principle of a repulsion type of moving iron instrument. 8

(b) The inductance of a moving iron ammeter is given by the expression : 8

$$L = \left(12 + 5\theta - 2\theta^2\right) \mu H$$

Where θ is the angular deflection in radians from zero position.

Determine :

(i) the spring constant

(ii) the angular deflection in radians for a current of 10 A if the deflection for a current of 5A is 30°.

OR

2 (a) With neat connections and vector diagrams explain how power can be measured with three ammeters in a single phase ac ckt. 8

(b) A 50V range spring controlled electrodynamic voltmeter has an initial inductance of 0.25 H, the full scale deflection torque of 0.4×10^{-4} Nm and full scale deflection current of 50 mA. 8

Determine the difference d.c. and 50 Hz a.c. readings at

(1) 50 V and

(2) 25 V if the voltmeter inductance increases uniformly over the full scale of 90°

3 Give answers of any two : 16

(1) Describe with sketch the working of single phase energy meter. Discuss the friction compensation and creep prevention in an energy meter.

(2) Describe with a neat sketch the construction and working principle of a dynamometer type single phase power factor meter.

(3) Derive equation for ratio and phase angle errors of a current transformer.

SECTION - II

4 (a) Give the answers in brief : **10**

(1) In case of potential transformers **1**

(a) the phase angle error is always positive

(b) the phase angle error is always negative

(c) the phase angle error is usually zero

(d) the phase angle error is positive when secondary winding voltage reversed leads the primary winding voltage and is negative when secondary winding voltage reversed lags behind the primary winding voltage

(2) When secondary winding of a potential transformer is suddenly open circuited with primary winding excited **1**

(a) large voltages are produced in the secondary winding which may be a safety hazard to the operating personnel.

(b) the large voltage so produced may rupture the insulation.

(c) the primary winding draws only the no load current.

(d) none of the above

(3) During the retrace time, the electrons forming the horizontal beam. **1**

(a) Move from left to right on the screen

(b) Move from right to left on the screen

(c) Move from bottom to top on the screen

(d) Move from top to bottom on the screen

(4) A vertical amplifier for a CRO can be designed for **1**

(a) only a high gain

(b) only a broad bandwidth

(c) a constant gain time bandwidth product

(d) all of the above

(5) The advantages of Hay's bridge over Maxwell's inductance capacitance bridge is because **1**

(a) Its equations for balance do not contain any frequency term

(b) It can be used for measurement of inductance of high Q coils

(c) It can be used for measurement of inductance of low Q coils

(d) none of the above

(6) In a Kelvin's double bridge, two sets of readings are taken when measuring a low resistance, one with the current in one direction and other with the direction of the current reversed. This is done to **1**

(a) Eliminate the effect of contact resistance

(b) Eliminate the effect of resistance of leads

(c) Correct for changes in battery voltage

(d) Eliminate the effect of thermo-electric emfs.

(7) Give two important disadvantages of Maxwell's bridge. **2**

(8) Define : **2**

(i) Phosphorescence

(ii) Persistence.

(b) With the help of block diagram, explain the working of digital storage oscilloscope. **8**

5 (a) Describe the working of dual trace oscilloscope with a neat diagram. **8**

(b) (i) A bridge consist of the following : **4**

Arm ab - a chock coil having a resistance R_1 and inductance L_1

Arm bc - a non-inductive resistance R_3

Arm cd - a mica condenser C_4 in series with a non inductive resistance R_4

Arm da - a non-inductive resistance R_2

when this bridge is fed from a source of 500 Hz, balance is obtained under following conditions :

$R_2 = 2410\ \Omega; R_3 = 750\ \Omega; C_4 = 0.35\ \mu F; R_4 = 64.5\ \Omega;$

The series resistance of capacitor is = 0.4 Ω. Calculate the resistance and inductance of the choke coil. The supply is connected between a and c and detector between b and d.

(ii) A sheet of bakelite 4.5 mm thick is tested at 50 Hz between electrodes 0.12 m in diameter. The Schering bridge employs a standard air capacitor C_2 of 106 pF capacitance, a non-reactive resistance R_4 of $1000/\pi\ \Omega$ in parallel with a variable capacitor C_4, and a non-reactive variable resistance R_3. Balance is obtained with $C_4 = 0.5\ \mu F$ and $R_3 = 260\ \Omega$. 4

Calculate the capacitance, power factor and relative permittivity of sheet.

OR

5 (a) What do you understand by delay line ? Explain different types of delay lines. 8

(b) In a low voltage Schering bridge designed for the measurement of permittivity, the branch ab consists of two electrodes between which the specimen under test may be inserted; arm bc is a non-reactive resistor R_3 in parallel with a standard capacitor C_3 arm cd is a non-reactive resistor R_4 in parallel with a standard capacitor C_4; arm da is a standard air capacitor of capacitance C_2. Without the specimen between the electrodes, balance is obtained with the following values; $C_3 = C_4 = 120\ pF$, $C_2 = 150 = pF$, $R_3 = R_4 = 5000\ \Omega$. With the specimen inserted, these value become; $C_3 = 200 pF, C_4 = 1000 pF, C_2 = 900 pF$ and $R_3 = R_4 = 5000\ \Omega$. In each test, $\omega = 5000\ rad/s$. Find the relative permittivity of the specimen. 8

6 Attempt any two : **16**

(a) With the help of diagram explain how capacitance can be measured by the use of Schering bridge.

(b) Describe briefly how the following measurements can be made with the use of CRO :

(a) frequency

(b) phase angle

(c) voltage

(c) Draw the diagram of electronic multi meter an explain its working.