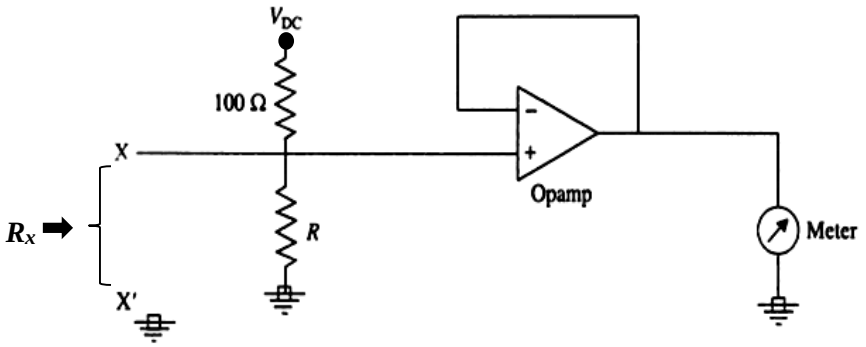
BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
First Semester 2023-2024
End-semester exam (Closed Book)
INSTR F311-Electronic Instruments and Instrumentation Technology

Time: 180 Minutes **Max Marks:80** **Date 11.12.2023**

1) An electronic ohmmeter circuit used with a basic PMMC meter having 100 µA full-scale deflection current and 1 kΩ internal resistance as shown in **Figure 1**. The unknown resistance R_x is connected across terminals XX'. Calculate the value of V_{dc} and R so that the half-scale deflection reading corresponds to 75 Ω. Consider the op-amp as an ideal one and the meter shows full-scale deflection when the unknown resistance R_x across terminals XX' is infinity. **[6+6]**

Figure 1



2) An astable multivibrator shown in **Figure 2** has R_1= 20 kΩ, R_2= 6.2 kΩ, R_3= 5.6 kΩ and C= 0.4 µF. The saturation voltages (V_o=$V_{o(sat)}$) are at ±12 V. Calculate the frequency of the square wave output when **(i)**V_{ref} = 0 V and **(ii)**V_{ref} = 4 V. **[6+6]**

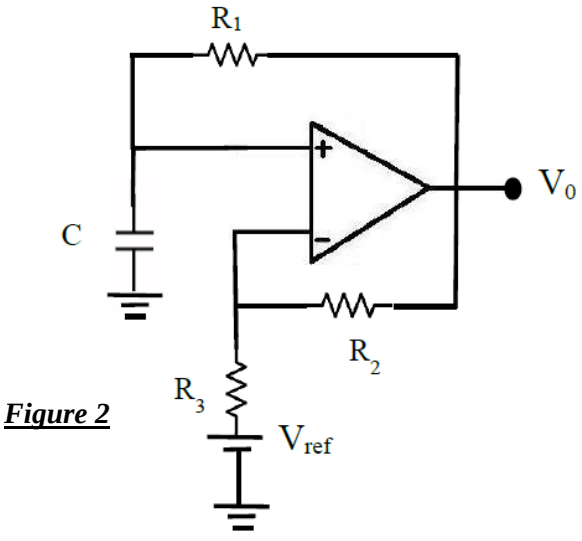


Figure 2

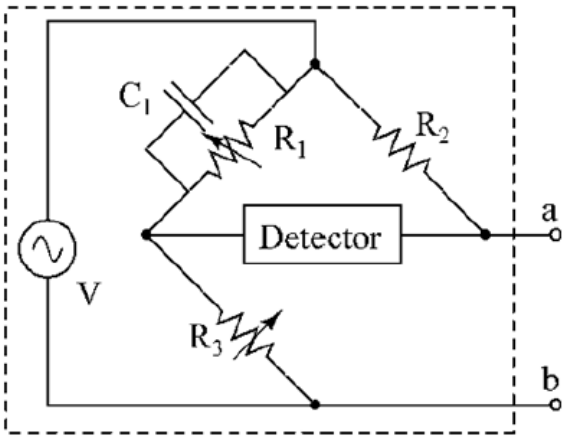


Figure 3

3) An inductance measurement bridge circuit shown in **Figure 3** has C_1= 0.01 µF, R_1= 470 kΩ, R_2= 5.8 kΩ, and R_3= 100 kΩ. A coil is connected across the a-b terminals to measure the impedance of that coil. Derive the balanced condition for this bridge, and find out the inductance and internal resistance of that coil. Also, calculate the quality factor of that coil at 10 kHz source frequency. **[5+3]**

4) An uncompensated spring-controlled dynamometer wattmeter reads 250 W with DC currents of 1 A and 0.05 A in its current and potential coils respectively. Calculate this wattmeter reading when the current coil current is $10\sin(\theta+15^0)+5\sin(3\theta)$ ampere and the potential coil voltage is $500\cos(\theta-30^0)+800\sin(2\theta+45^0)$ volt. Also, calculate the potential coil circuit resistance assuming it is purely resistive. **[6+4]**

5) Describe the operation of a microprocessor-based ramp-type DVM with a block diagram and its operating waveform with neat sketches. **[10]**

6) A PMMC meter with an internal resistance of 75 Ω and full-scale current of 100 μA is used to construct a multirange ammeter with a rotary switch as shown in **Figure 4**. Find R_1, R_2, R_3 and R_4. **[8]**

7) **(a)** A voltage signal of frequency 100 Hz is fed to the horizontal deflection plates of a CRO. An unknown voltage signal of 1 V is fed to the vertical deflection plates. These two signals generate a Lissajous pattern as shown in **Figure 5**. Calculate the frequency of that unknown voltage signal, which is fed to the vertical deflection plates. **[4]**

(b) Explain with a block diagram how an electronic counter is used for period measurement. **[6]**

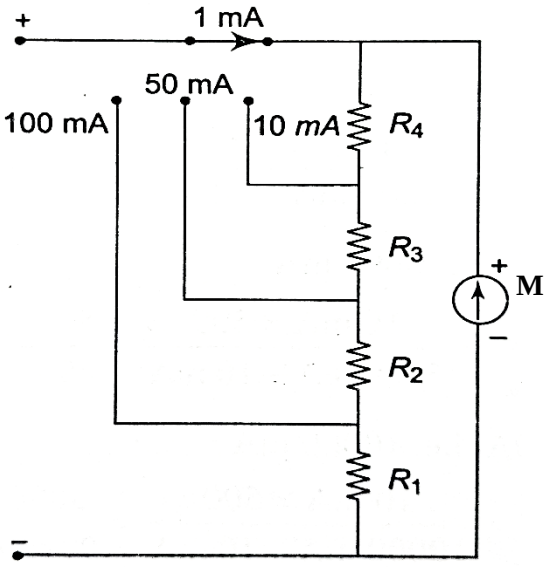


Figure 4

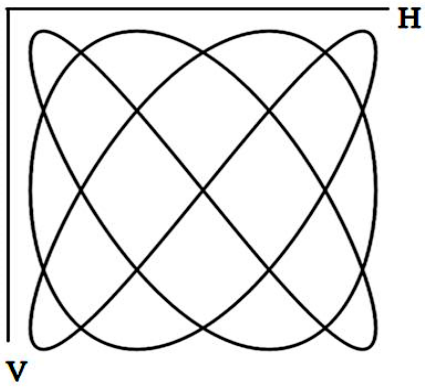


Figure 5

8) **(a)** Explain in detail the layers in the Open System Interconnection (OSI) network model. **[5]**

(b) State some examples of hazardous locations that are classified under Class I, Class II, and Class III respectively. **[5]**

**********End of the paper**********