Ref. No.: Ex/FET/OE/IEE/T/209/2023

BACHELOR OF ENGINEERING IN

CIVIL ENGINEERING / INFORMATION TECHNOLOGY/

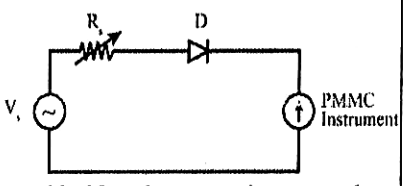
METALLURGICAL AND MATERIAL ENGINEERING

THIRD YEAR SECOND SEMESTER EXAM 2023

SUBJECT: ELECTRONIC MEASUREMENTS: PRINCIPLES AND SYSTEMS

Time: Three Hours **Full Marks: 100**

Answer ANY FIVE questions. Answer in brief. Marks against each question is provided in the brackets.

Q. No.		Marks
1.	(a) The sensitivity of a PMMC instrument is 10 kΩ/V. If this instrument is used in a rectifier-type voltmeter with half wave rectification, what would be the sensitivity? (b) How can one achieve zero adjustment in series type ohmmeter? (c) Comment on the choice of the shape of scale in an analog shunt-type ohmmeter. (d) In general, it is observed that the spring-controlled moving-iron instruments exhibit a square law response resulting in a non-linear scale. How can the same be made almost linear? (e) The scale of a full wave rectifier type average sensing meter is calibrated to read the rms value for ideal sine wave signal (form factor 1.11). Determine the multiplying factor of the meter if it is used to measure the rms value of square waves. (f) A moving coil instrument having a resistance of 10Ω, gives a full-scale deflection when the current is 10 mA. What should be the value of the series resistance, so that it can be used as a voltmeter for measuring potential difference up to 100 V? (g) If a symmetrical square-wire voltage is applied to an average reading diode voltmeter having a scale calibrated in terms of rms value of a sine wave, what will be the error in meter indication? (h) The torque of an ammeter varies as the square of the current through it. If a current of 10 A produces a deflection of 90° what would be the deflection (in degrees) for a current of 5 A when the instrument is gravity controlled?	(2+2+2+2+ 3+3+3+3) = 20
2.	(a) A half wave rectifier type AC voltmeter consists of a series resistance Rs, ideal diode and PMMC instrument as shown in figure. The internal resistance of instrument is 100Ω and full-scale deflection is produced by a DC current of 10 mA. What would be the value of Rs required to obtain full scale deflection with an AC voltage of 100 V (rms), applied to the input terminal?  (b) The internal battery has a voltage of 3 V. It is desired to read half scale at a resistance value of 2000 Ω. Calculate (i) the values of shunt resistance and current limiting series resistance, and (ii) range of values of the shunt resistance to accommodate battery voltage variation in the range 2.7 to 3.1 V. (c) i) What are the necessary conditions for the satisfactory operation of an AC potentiometer? ii) Highlight the advantages, disadvantages of AC potentiometer and highlight the major application area of an AC potentiometer. (d) Write short notes on: i. Measurement of high voltage by dc potentiometer ii. Calibration of low range ammeter	(4+5+6+5) = 20

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3.	(a) Explain the working of Moving Iron instrument and derive the torque equation of the moving iron instrument. OR Explain the construction and operating principle of permanent magnet moving coil instrument. Derive the expression for deflection of PMMC? (b) Explain the working of electronic energy meter.	(15+5) = 20
4.	(a) Elucidate the different elements of Data Acquisition System. (b) What are the different signal-conditioning-units that a data acquisition system contain? (c) A 6-bit D/A converter has a reference voltage of 10 V. Calculate the minimum value of R such that the maximum value of output current does not exceed 10 mA. Find also the smallest quantised value of output current.	(12+5+3) = 20
5.	(a) Describe the different types of errors occurs in measurement with one example. (b) Explain the role of shunt resistor connected across PMMC. (c) Write the specifications of an analog multimeter. (d) Classify different types of recorders.	(10+2+3+5) = 20
6.	(a) Give a concise description of the hardware of a PLC. Draw a block diagram showing in very general terms the main units in a PLC. (b) Briefly comment on the four buses used to transfer binary information from one location to the other. (c) List the advantages of a PLC over relays.	(12+4+4) = 20
7.	(a) Explain the following terms as applied to digital measurement. (i) Resolution (ii) Sensitivity of digital meter (iii) Accuracy specification of digital meters. (b) Write down the comparison between analog and digital multimeter. (c) How many types of digital voltmeters are there? Explain any one of them briefly. (d) i) The measured value of a resistance is 10.25 Ω, whereas its true value is 10.22 Ω. Determine the relative error. ii) A 0-250 V voltmeter has a guaranteed accuracy of 2% of full-scale reading. The voltage measured by the voltmeter is 150 volts. Determine the limiting error in percentage.	(6+5+4+5) = 20