

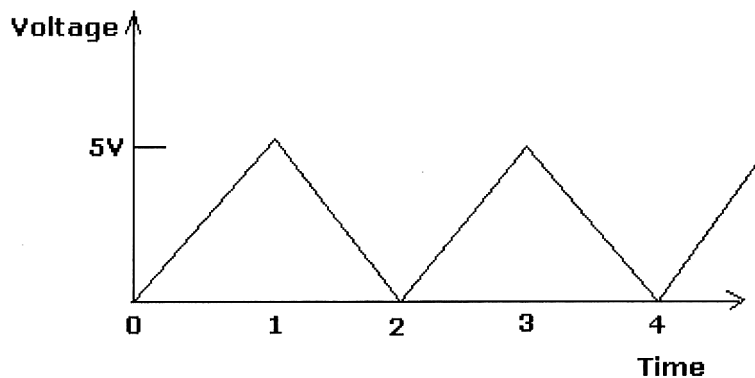
B.E. (Inst. & Electronics Engg.) Examination 2023
Second (2nd) Year Second Semester
Subject: Measurements and Electronic Instrumentation
Time: 3 hours, Full Marks 100

Group A: 50 Marks

Answer any five questions

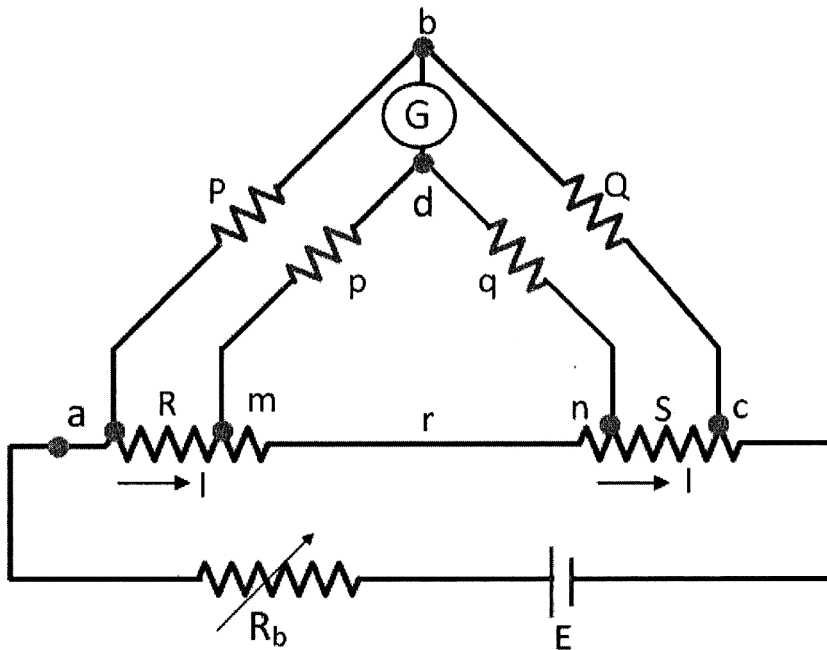
1. a) A PMMC voltmeter with a resistance of 20Ω gives a full-scale deflection of 120° when a potential difference of 100 mV is applied across it. The moving coil has dimensions of $30 \text{ mm} \times 25 \text{ mm}$ and is wound with 100 turns. The control spring constant is $0.375 \times 10^{-6} \text{ N-m/degree}$. Find the flux density in the air gap. Find also the dimension of copper wire of coil winding if 30% of the instrument resistance is due to coil winding. The specific resistance of copper is $1.7 \times 10^{-8} \Omega\text{m}$. 5
- b) A slidewire potentiometer is used to measure the voltage between the two points of a certain dc circuit. The potentiometer reading is 1.0 volt. Across the same two points when a $10000 \Omega/\text{V}$ voltmeter is connected, the reading on the voltmeter is 0.5 volt of its 5 -volt range. Calculate the input resistance between two points. 5
2. A triangular waveform as shown in the figure below is applied to the following voltmeters: 10
 - (i) Full-wave rectifying type ac voltmeter
 - (ii) Half-wave rectifying type ac voltmeter
 - (iii) Peak-response voltmeter
 - (iv) True RMS meter
 - (v) DC voltmeter.

What would be the reading displayed on each voltmeter and obtain the percentage error in each case?



[Turn over

3. a) A low-value resistor was measured with the help of a Kelvin's double bridge with the following components: Standard resistor (S) = 98.02Ω , inner ratio arms (p)= 98.022Ω and (q)= 202Ω , outer ratio arms (P) = 98.025Ω and (Q)= 201.96Ω , resistance of the link connecting the standard resistance and the unknown resistance, $r = 600\mu\Omega$. Calculate the value of the unknown resistance (R). 5



Kelvin Double Bridge

- b) Design an attenuator to be used with an electronic voltmeter. The total impedance of the attenuator is $1\text{ M}\Omega$ and it will have ranges 1V, 2V, 5V, 20V, 50V. The maximum voltage that can be applied to the voltmeter (after attenuation) is 1 V. 5
4. a) Discuss with a diagram the scheme of measurement of frequency of a signal using direct counting method. 6
 b) The periods of 10 ms and 1 sec. are to be measured with a frequency meter (in direct counting mode) with the time base error of 1 ppm. Calculate the time base error in each case. 4
5. The four arms of a bridge network are made up as follows: AB, a resistor of 50Ω in parallel to an inductor of 0.1H , BC a resistor of 100Ω ; CD an unknown resistor with a parallel with an unknown capacitor C; DA a resistor of 1000Ω . A 50 Hz signal is applied across AC. Find R and C when a vibration galvanometer is undeflected. 10
6. The four arms of an 'ac' bridge are:
 arm 'ab': an imperfect capacitor C_1 with an equivalent resistance of r_1 .
 arm 'cd': a noninductive resistance R_4
 arm 'bc': a noninductive resistance R_3
 arm 'da': an imperfect capacitor C_2 with an equivalent series resistance of R_2 .

A supply of 50Hz is applied between 'a' and 'c' and the detector is connected between 'b' and 'd'.

At balance, $R_2=5.5 \Omega$, $R_3=2000\Omega$, $R_4=2850\Omega$, $C_2=0.5\mu F$.

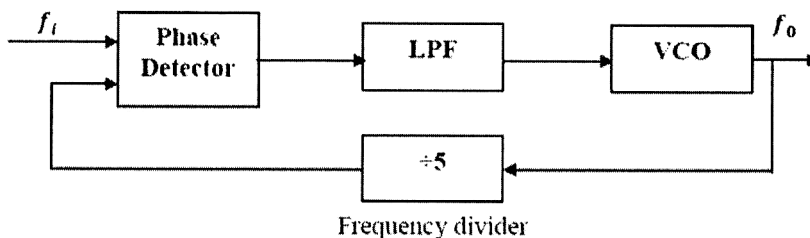
Calculate the value of C_1 and r_1 and the dissipation factor of this capacitor. 10

7. a) What is the significance of a '½' digit in a 3½ digit voltmeter? What is 'electrical zero' correction and how is it done in a digital voltmeter? With a schematic/circuit diagram, explain how power line frequency rejection is done in dual slope A/D converters? 1+2+3
- b) With a diagram, explain how power is measured using an electrodynamic type wattmeter. 4

Group B: 30 Marks

Answer any three questions

8. a) Explain the principle of operation of phase detector using a XOR gate. 4
- b) The figure shows a phase locked loop. 2



The output frequency f_0 is locked at 10 kHz. Find the value of f_i .

- c) Explain the principle of function of a current transformer. 4
9. In an oscilloscope, what is the function of the trigger section? Explain the generation of trigger pulse and the role of trigger level control 10
10. Why a coaxial cable is used in an oscilloscope probe. Derive the transfer function of the equivalent circuit of a 10:1 attenuator probe and an oscilloscope input. How is the probe tuned? 2+6+2
11. a) Give an example when the signal is required to be ac coupled?
 b) Explain the Lissajou figures with a few examples.
 c) What is an active probe?
 d) When do we need to keep the volt/div setting of a channel in the uncalibrated position? 3+3+2+2

Group C: 15 Marks
Answer any three questions

12. Explain the data frame of RS232C. What are the roles of the CTS, RTS and DTR and DSR lines. 3+2
13. Why twisted pair cables are used for high speed data transmission? Mention the methods of elimination of inductively coupled interference. 2+3
14. Why a small capacitor is connected between V_{CC} and ground pins of a digital IC and why the input impedance of a circuit cannot be made indefinitely high? 3+2
15. Explain the handshaking signals used for data transmission using IEEE 4888. 5

Group D: 5 Marks

16. What is a virtual instrument? Mention the advantages. 5