

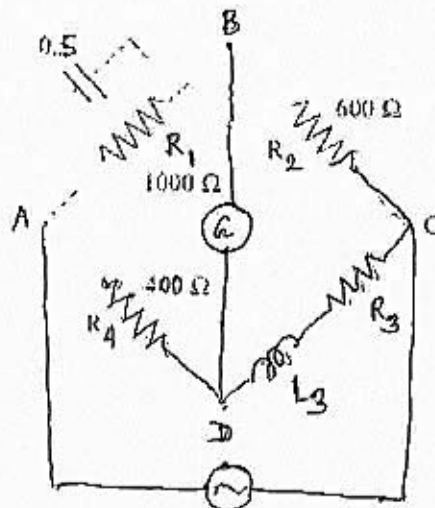
BX/IEE/PC/B/T/226

B.E. (Inst. & Electronics Engg.) Examination 2022  
Second (2<sup>nd</sup>) Year Second Semester  
Subject: Measurements and Electronic Instrumentation  
Time: 3 hours, Full Marks 100

Group A: 50 Marks

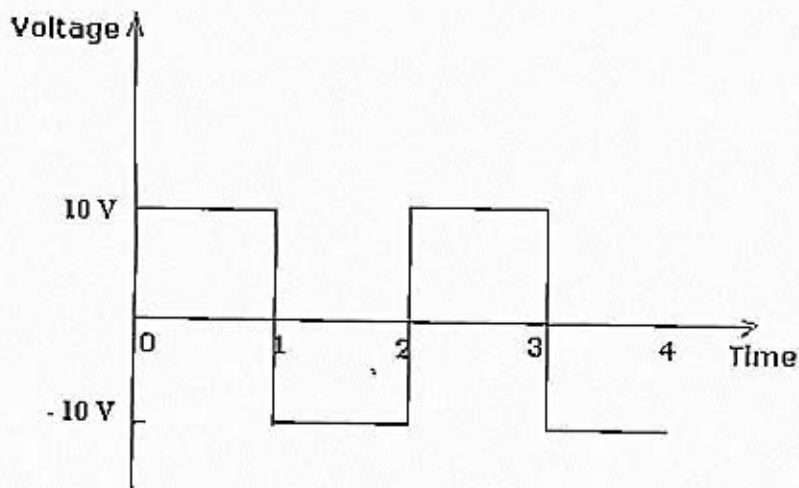
Answer any five questions

1. With a schematic circuit diagram, explain the working principle of a dual slope integrating type ADC. Why it is used in a digital multimeter? 10
2. A basic slide-wire potentiometer has a working battery voltage of 3.0 volts with negligible resistance. The resistance of the slide-wire is  $400\ \Omega$  and its length is 200 cm. A 200-cm scale is placed along the slide wire. The slide-wire has 1 mm scale divisions and it is possible to read up to  $1/5$  of a division. The instrument is standardized with 1.018 volt standard cell with sliding contact at the 101.8 cm mark on scale. Calculate (a) Working current (b) Resistance of series rheostat (c) Measurement range (d) Resolution of the instrument.  $2.5 \times 4 = 10$
3. a) A moving-coil voltmeter has a resistance of  $100\ \Omega$ . The scale is divided into 150 equal divisions. When a potential difference of 1 V is applied to the terminals of the voltmeter, a deflection of 100 divisions is obtained. Explain how the instrument could be used for measuring up to 300 V. 5  
b) The arms of an a.c. Maxwell bridge are arranged as follows: AB is a non-inductive resistance of  $1,000\ \Omega$  in parallel with a  $0.5\ \mu\text{F}$  capacitor, BC is a non-inductive resistance of  $600\ \Omega$ , CD is an inductive impedance (unknown) and DA is a non-inductive resistance of  $400\ \Omega$ . If balance is obtained under these conditions, find the value of the resistance and the inductance of the branch CD. 5

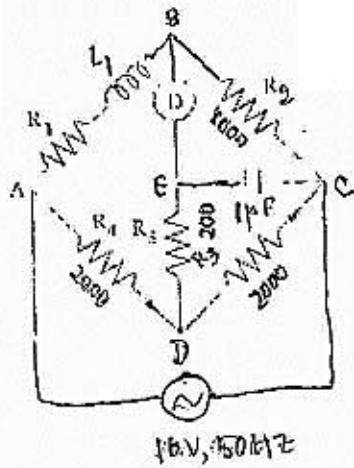


4. A square waveform as shown in the figure below is applied to the following voltmeters: 10
- (i) Half-wave rectifying type ac voltmeter
  - (ii) True RMS voltmeter
  - (iii) DC voltmeter.

What would be the reading displayed on each voltmeter. Obtain the percentage error of the half-wave rectifying type ac voltmeter with respect to the true rms value?



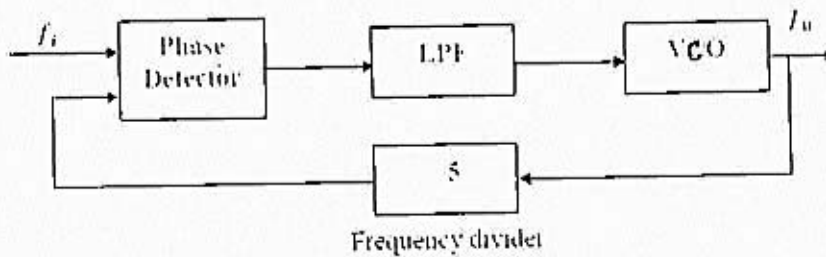
5. a) Design an attenuator to be used with an electronic voltmeter. The total impedance of the attenuator is  $1\text{ M}\Omega$  and it will have ranges 1V, 2V, 5V, 10V, 20V. The maximum voltage that can be applied to the voltmeter is 1 V. 5
- b) With a sketch, explain the working principle of a moving iron (attraction) type voltmeter. How this type of voltmeter can be used for measurement of ac signals? 5
6. a) How is a megger used for measurement of insulation resistance? 5
- b) Briefly describe a current transformer (CT). Why the secondary of a CT cannot be kept open? 5
7. The figure in the next page gives the connection of Anderson's bridge for measuring the inductance  $L_1$  and resistance  $R_1$  of a coil. Find  $R_1$  and  $L_1$ , if balance is obtained when  $R_3 = R_4 = 2000\text{ ohms}$ ,  $R_2 = 1000\text{ ohms}$ ,  $R_5 = 200\text{ ohms}$  and  $C = 1\mu\text{F}$ . 3+2
- 10



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 5kHz. Find the value of  $f_i$ .

- c) What are Lissajous figures and how are they obtained in a Cathode Ray Oscilloscope? 4
9. Explain with a diagram the triggering section of an oscilloscope. 10
10. a) Derive the transfer function of the equivalent circuit of a 10:1 attenuator probe and an oscilloscope input. Obtain the condition when it becomes an all-pass filter. How is this probe tuned in an oscilloscope? 8
- b) What is an active probe and when it is used? 2

11. a) Discuss with a diagram the scheme of measurement of frequency of a signal using direct counting method. 6  
b) The periods of 1 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

**Group C: 15 Marks**  
**Answer any five questions**

12. What is the role of ground plane in a PCB? Why the power line and signal lines are kept perpendicular to each other? 3
13. What is common impedance ground line and why it is a source of interference signal? 3
14. Why twisted pair cables are used for high speed data transmission? Write the full forms of UTP and STP. 3
15. 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
16. What is a ground loop? Why it is to be avoided? 3
17. Name the factors upon which the capacitively coupled and inductively coupled interferences are increased. 3

**Group D: 5 Marks**

18. Write a short note on virtual instrumentation. 5