BITS, PILANI – DUBAI CAMPUS

I SEM 2013 – 2014

Course Code: INSTR F311 **Date: 02.01.2014**
Course Title: EIIT **Max Marks: 60**
Duration: 3 hours **Weightage: 30%**
Component: COMPREHENSIVE EXAMINATION (CLOSED BOOK)
Note: This question paper has 10 questions and 4 pages. Answer all questions, Assume suitable data if required.

1(a) Design an ammeter to measure 100mA using a 60μA PMMC meter movement with internal resistance 5KΩ. [2M]

(b) In the circuit shown in Fig.1, the voltage across the resistor of value 25kΩ is to be measured first by using a voltmeter of sensitivity of 2kΩ/V and then with a voltmeter of sensitivity of 20kΩ/V. Calculate the reading of the voltmeter in each case and the percentage error in the measurement. [3M]

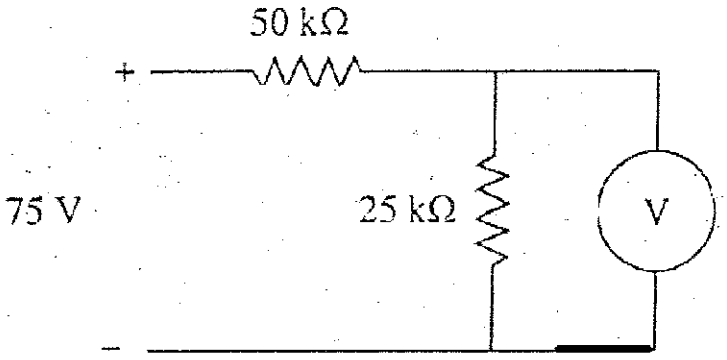

Fig.1

2 (a) Most manufacturers specify their DMMs as 3 ½ digit and 4 ½ digit etc. what is meant by half digit part of Specification? Explain with an example .Write only key points in your answer. [2M]

(b) Calculate the time interval (TI) measurement resolution of the signal shown in Fig.2.Let the input channel noise be 60μV. The input frequency is 500 kHz and the gate time is 1s.The ±1 count error is 100 ps. [3M]

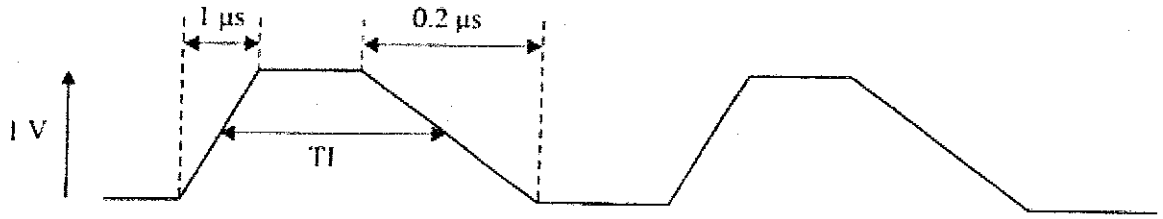

Fig.2

P.T.O

3 (a) what is delay line in an oscilloscope? Explain the use of delay line used in a Cathode ray oscilloscope. [3M]

(b) When Time-base is switched off and the oscilloscope is switched to XY mode of operation. V_1 is connected to the x-input with sensitivity of 0.2V/cm and V_2 is connected to the Y input with sensitivity 0.4V/cm. The resulting ellipse is shown in Figure 3. Calculate the phase shift between V_1 and V_2. [2M]

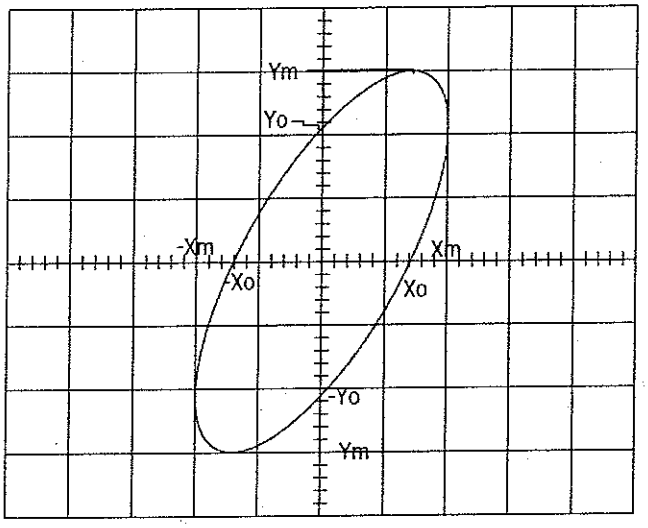

Figure 3

4(a) Connect RTD (Resistance Temperature Detector of platinum type (Pt-100)) in one arm of the Wheatstone DC bridge circuit which has temperature variations of 30°C-90°C. Design a suitable signal conditioning circuit using whetstones bridge and op amp which can give 1-5V output for a temperature range of 30°C-90°C.Use temperature Co-efficient of resistance for RTD ($\propto$) $= 0.0034/°C$. Dissipation Constant of RTD (P_D)=30mW/$°C$. The error due to self-heating of RTD should not exceed 1°C.Assume supply for DC bridge circuit as 5V. Resistance at 0°C(R_0) for platinum type RTD is equal to 100Ω.

(b) what modifications you can do in the above circuit design to get 4-20mA output for a temperature range of 30°C-90°C .Use $\propto = 0.0034/°C$.P_D=30mW/$°C$. The error due to self-heating of RTD should not exceed 1°C.Also draw the necessary circuit diagram for the above specifications. [7M]

5 (a) Use a multiple loop indirect synthesizer to synthesize a frequency of 15.5MHZ from a 10MHZ reference source [2M]

(b) For the two waveforms (A&B)shown in Fig.4 and Fig.5,answer the following:

(i) Draw the frequency spectrum of all waveforms (A and B).

(ii) Combine Waveforms A & B and show the resultant waveforms in time domain and frequency domain [3M]

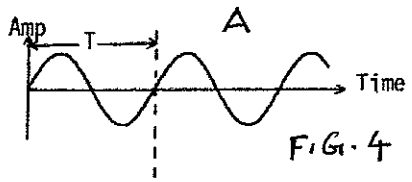

FIG. 4

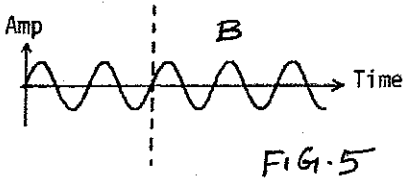

FIG. 5

(c). Calculate the pulse period and the pulse width of 4KHZ rectangular waveform that has 75% duty cycle. [2M]

6(a) A certain binary-weighted input digital to analog converter shown in Fig. 6 has a binary input of 1101. If a logic HIGH=3.0V and logic LOW = 0V. What is V_{out}?

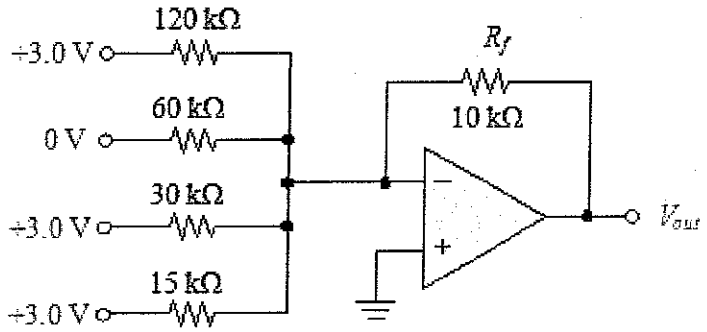

Fig. 6

[2M]

(b) Explain the following with figures:

(i) Transition (rise/fall) time

(ii) Linearity

(iii) Preshoot, overshoot and ringing [3M]

7 (a) Design an instrument to measure the speed of a rotating disc.The display should be in revolutions per minute.

(b) Draw a suitable circuit for function generator using op amps which can generate, square waveform, triangular waveform and sine wave form. Draw the necessary waveforms at output of each op amp. [3M+4M]

8 (a) Name the layers in the OSI network model.
(b) What is HART? Explain the advantages of HART protocol.
(c) Differentiate between RS 422 and RS 423 interface standards.
[2M+3M+3M]

9. Name the bridge that is used for the measurement of permittivity of a dielectric. For Fig.7, without dielectric specimen between plates of Cs, balance is obtained with values C_1 =100pF,C_3=120pF,R_1=R_2=5kΩ.With the specimen inserted between plates of Cs, values for balance become C_1=100pF,C_3=900pF,R_1=R_2=5KΩ, ω=5000rad/sec.Find the relative permittivity of the specimen. Comment on the dissipation factor before and after the insertion of the specimen. [4M]

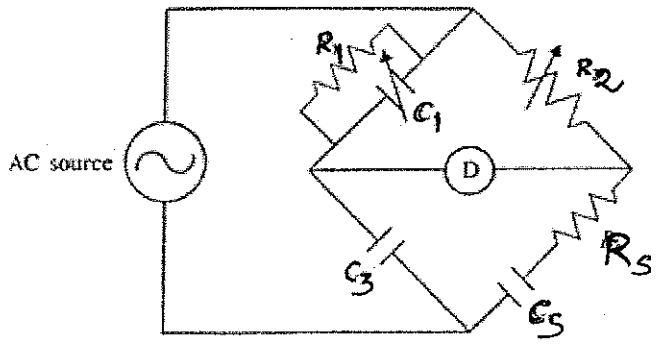

Fig.7

10. (a)The distortion caused by the third harmonic is found to be 4.33% by using a wave analyzer.The total harmonic distortion when measured with a distortion analyzer is found to be 4.5%.If the rms value of the fundamental is 20V and if only the third and fifth harmonic are present, what is the rms value of the fifth harmonic? [3M]

(b) Determine the total harmonic distortion for the power amplifier.The total collector current is given by the expression:

$$i_c = (2.5)(2 + V_{in})^3$$

where the input V_{in} (in mV) = 10sinωt. Given $sin3\theta = 3sin\theta - 4sin^3\theta$. [4M]

where $\theta = \omega t$.

END

I SEM 2013-2014
BITS PILANI, DUBAI CAMPUS
III YEAR EIE

Course Code: INSTR F311 Date: 31.10.2013
Course Title: EIIT Max Marks: 15
Duration: 50 Minutes Weightage: 15%
Component: TEST 2 (Open Book)

Note: This question paper has 5 qustions. Answer all Questions. Assume suitable data if required.

1. Determine the total harmonic distortion for a power amplifier .In a power amplifier, the output current(in mA) is related to the input voltage by the equation

$$Ic = (2+v_{in})^3 - 5v_{in}^3$$

Where the input $v_{in} = \sin(\omega t)[in\ volts]$ is applied. Determine the Total Harmonic distortion. Given $sin\ 3\ \omega t = 3\ sin\omega t - 4\sin^3 \omega t.$ [4M]

2. Design a suitable Signal conditioning circuit for the following specifications:
(i) Connect RTD (Resistance Temperature Detector of platinum type (Pt-100)) in one arm of the wheatstone DC bridge circuit which has temperature variations of 50°C-90°C. Design a suitable signal conditioning circuit using whetstones bridge and op amp which can give 0-4V output for a temperature range of 50°C-90°C Use temperature Co-efficient of resistance for RTD $(\propto) = 0.0034/°C$. Dissipation Constant of RTD (P_D)=30mW/$°C$. The error due to self-heating of RTD should not exceed 1°C.Assume supply for DC bridge circuit as 5V. Resistance at 0°C(R_0) for platinum type RTD is equal to 100Ω.
(ii) what modifications you can do in the above circuit design to get 1-5V output for a temperature range of 50°C-90°C .Use $\propto = 0.0034/°C$.P_D=30mW/$°C$. The error due to self-heating of RTD should not exceed 1°C.Also draw the necessary circuit diagram for the above specifications.

[5M]

3. Compute the frequency and the peak amplitude of the circuit shown in Figure 1. Also draw the necessary waveforms at v_o' and v_o. Assume Vsat = ±15V. [2M]

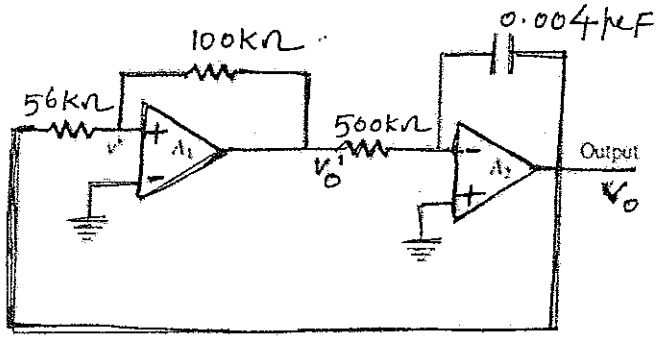

Figure 1

P.T.O

4. Draw a schematic of an op amp based RC phase shift oscillator. The phase shifting network is made of 3 identical RC sections. The op amp has a maximum input bias current of I_b**=50nA**. Assume that the maximum current through the feedback resistor R_f = **100**I_b and the supply voltage for op amp is ±**12V**. Design the oscillator circuit for an output frequency of **4KHZ.** Determine all component values required. [2M]

5. The four arms of the wheatstone bridge(Fig.2) have the following resistances: AB=1000Ω, BC= 1000Ω,CD =120Ω,DA=120Ω. The bridge is used for strain Measurement and supplied from 5V ideal battery. The galvanometer has sensitivity of 1mm/μA with internal resistance of 200Ω.Determine the deflection of the galvanometer if arm DA increases to 121 Ω and arm CD decreases to 119Ω.

[2M]

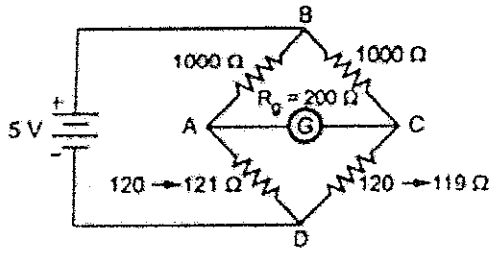

Fig. 2

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I SEM 2013 – 2014

Course Code: INSTR F311
Course Title: EIIT
Duration: 50 Minutes
Component: TEST 1 (Closed Book)

Date: 30.09.2013
Max Marks: 15
Weightage: 15%

Note: This question paper has Seven questions. Answer all the questions

1. Figure 1 shows a simple circuit of R_1 and R_2 connected to a 150V dc source. If the voltage across R_2 is to be measured by voltmeters having
   (i) a sensitivity of 1000Ω/V and
   (ii) a sensitivity of 20,000Ω/V

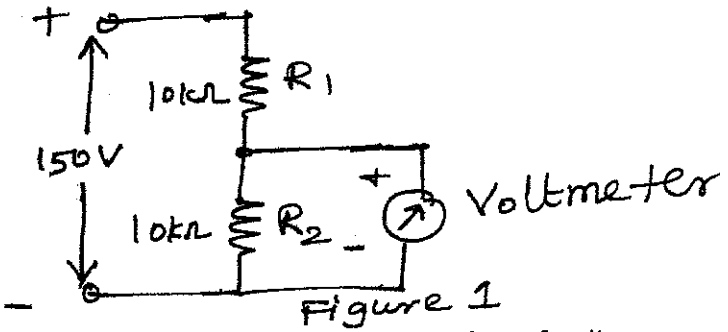


Figure 1

Find which voltmeter will read the accurate value of voltage across R_2. Both the meters are used on the 50 V range. Comment on your answer. [3M]

2. (i)Why a DC ammeter cannot read alternating currents? Write only key points in your answer.
   (ii) List out any two advantages of PMMC. Write only key points in your answer

.[3M]

3. Draw the block diagram of Electronic ac voltmeter [1M]

4. A voltmeter having a resistance of 145KΩ on its 150V range, indicates a voltage of 100V when connected across an unknown resistance R.A milliammeter in series with the resistance indicates a current of 5mA flowing through the resistor. Draw the equivalent circuit for the above specifications and find the following
   (i) What is the apparent value of R?
   (ii) What is the true value of R?
   (iii) What is the error due to loading? [3M]

5. Explain what the ohms-per-volt sensitivity rating of an analog voltmeter means. Many analog voltmeters exhibit a sensitivity of 20 kΩ per volt. Is it better for a voltmeter to have a high ohms-per-volt rating, or a low ohms-per-volt rating? Why? Write only key points in your answer. [2M]

6. Trace the current through the following rectifier circuit (Figure 2) at a moment in time when the AC source's polarity is positive on right and negative on left as shown. Be sure to designate the convention you use for current direction (conventional current flow):

[1M]

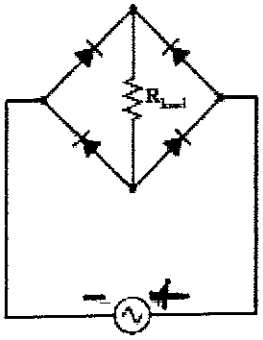
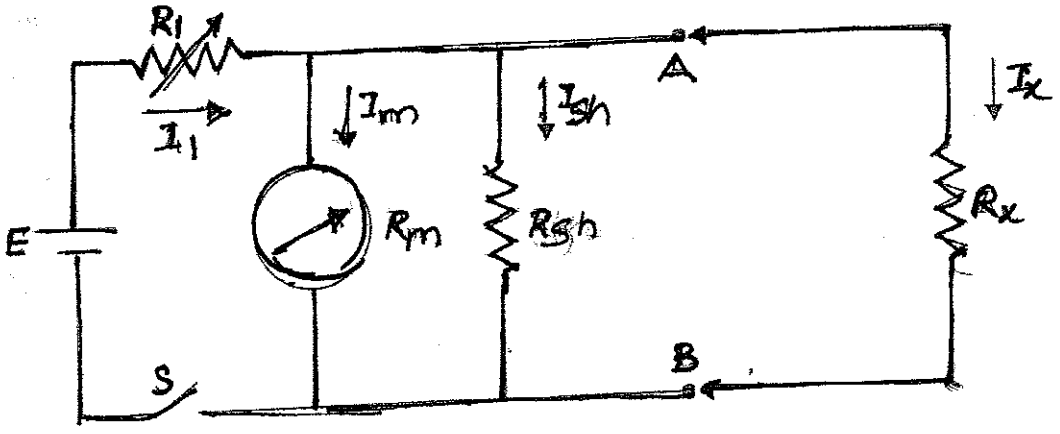


Figure 2

Also, mark the polarity of the voltage drop across R_{load}.

7. For the circuit shown in Figure 3, a 1mA meter measurement with an internal resistance of 40Ω is to be used. The battery voltage is 3V. Half wave deflection would be 0.5Ω. Calculate the values of R_1 and R_{sh}.



[2M]

Figure 3

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I SEM 2013-2014
QUIZ 1 (CLOSED BOOK)

Course Code: INSTR F311
Course Title: EIIT
Duration: 20 minutes

Date: 10.10.13
Max Marks: 08
Weightage: 8%

Name: ..... **ID No:** ..... **Sec / Prog:** .....
Instructions: Write your answers in the blank space provided after each question.

1. The practical use of binary-weighted digital-to-analog converters is limited to: [0.5M]

   A. R/2R ladder D/A converters

   B. 4-bit D/A converters

   C. 8-bit D/A converters

   D. op-amp comparators

   ANS-----

2. Draw the block diagram of successive approximation type of ADC [0.5M]

3. List out the disadvantage of flash type analog to digital converter. Write only key points in your answer [1M]

4. A binary-weighted digital-to-analog converter has a feedback resistor, R_f, of 12 kΩ. If 50 μA of current is through the resistor, the voltage out of the circuit is.....

[0.5M]

5. Given a 4 bit DAC with 1V full scale voltage and accuracy ±0.5%. Find its resolution and accuracy in terms of voltage. [1M]

6. What is aliasing? How to prevent aliasing. Write only key points in your answer. [1M]

7. What is the purpose of using sample and hold circuits in analog to digital converters? [0.5M]

8. What is the difference between 31/2 digits and 41/2digits in DMM? Write only key points in your answer. [1M]

9. Suppose an analog-digital converter IC ("chip") inputs a voltage ranging from 0 to 5 volts DC and converts the magnitude of that voltage into an 8-bit binary number. How many discrete steps are there in the output as the converter circuit resolves the input voltage from one end of its range (0 volts) to the other (5 volts)? How much voltage does each of these steps represent? [1M]

10. List out main components in the front panel of typical Digital Multimeter. [1M]

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