

**St. Joseph's College (Autonomous)**  
**M.Sc. Physics, I Semester**  
**Mid-Sem Examination, August 2016**  
**PH- 7415, Experimental Physics**

**Time-1hour 30 min.**

**Max.Marks-35**

*This paper has no parts and two printed pages.*

*Each question carries 7 marks.(7x5=35)*

*Answer any 5 questions including first question which is compulsory.*

1. a) The voltage of a circuit is measured by a voltmeter having an input impedance comparable with the output impedance of the circuit. Will this cause any error in the measurement of voltage? Explain. (1)  
 b) What are dummy strain gauges used for? (1)  
 c) Why are capacitive transducers normally used for dynamic measurements instead of static measurements? (1)  
 d) Arrange the following temperature transducers i) In decreasing order of their sensitivity  
 ii) In increasing order of their range of operation.  
 RTD, thermocouple, thermistor (2)  
 e) Why are the two secondary windings of an LVDT connected in differential configuration? (1)  
 f) Should accuracy be an inherent characteristic of a precision instrument? Comment. (1)
2. The input voltage of an op-amp differentiator is a positive going ramp which starts at  $t=0$  and varies from  $-5V$  to  $+5V$  in  $5\mu s$  and then it changes to negative going ramp from  $+5V$  to  $-5V$  in next  $5\mu s$ . Determine the output voltage of the differentiator. The values of feedback resistor and capacitor are  $2.2k\Omega$  and  $0.0005\mu F$  respectively. The values of input resistor and capacitor are  $100\Omega$  and  $0.011\mu F$ . Draw the input and output waveforms. (7)
3. a) A  $10,000\Omega$  variable resistance has a linearity of  $0.1\%$  and movement of contact arm is  $320^\circ$ .  
 i) Determine the maximum displacement deviation and maximum resistance deviation.  
 ii) If the instrument has to be used as potentiometer with a linear scale of  $0$  to  $1.6V$ , determine the error voltage.  
 b) If a  $0-10 A$  ammeter has a guaranteed accuracy of  $1\%$  of full scale deflection then what is the limiting error while it reads  $2.5 A$ .  
 c) You put  $35.0 mL$  of water in a graduated cylinder. Then you carefully slide in a mineral sample and note that the water level rises to  $38.2 mL$ . Removing and drying the mineral sample, you find its mass as  $12.653 \pm 0.003 g$ .  
 i) What's the density of this mineral?  
 ii) Find the relative and absolute precision for your density.  
 iii) Could it be a diamond ( $d = 4.0 g/cc$ )? Why (not)? (2+2+3)
4. A strain gauge has a resistance of  $120\Omega$  and a gauge factor of  $2$  is subjected to a strain of  $(20+10\sin 314t) \times 10^{-6}$ . Find the change in the output voltage when the strain gauge is connected in potentiometric circuit having equal resistances initially and an input voltage of  $6V$ . (Start with the relation showing that output voltage is linearly related to change in gauge resistance).  
 a) If a capacitor is connected in one of the output leads and an AC voltmeter of infinite impedance is connected across the output terminals then what is the reading on the voltmeter?  
 b) If the maximum expected change in resistance of the gauge with the applied load is

$30 \times 10^{-6} \Omega$  then what is the %change in the measured voltage? (3+2+2)

5. Draw and explain the working of instrumentation amplifier as air flow detector. (7)
6. Explain how Diaphragm gauge is used to measure pressure? What are the factors on which measured pressure depends? (7)
7. a) Why is Platinum the most preferred material to make RTD?  
 b) What causes self-heating in RTD and how can it be controlled?  
 c) What material properties should one consider while choosing the material for making a thermocouple? Compare the performance of E, J, K and N thermocouples by studying the graphs given below and arrange them in the increasing order of their stability. Give reasons for your answer. (1+2+4)

