N.B. : (1) Question No. **1** is **compulsory**.
   (2) Attempt any **four** question from remaining.
   (3) Assume **suitable** data wherever **required** but **justify** the same.

Q.1 **A.** Explain generalized measurement system elements with block diagram and with function of each. Also identify various elements of a measurement system involving thermocouple for monitoring temperature of a chemical process.   08

B. Define the following: 06
   i) Drift   ii) Span
   iii) Range   iv) Limits
   v) Deviation   vi) Tolerance

C. Explain the purpose of sine bar, its limitations and precautions to be taken while using it.   06

Q.2 **A.** What are desired, modifying and interfering inputs? Explain with example of each. Also suggest the methods to minimize the effect of modifying and interfering inputs.   08

B. While measuring the speed of a steam turbine with a stroboscope, stationary images were observed for the three consecutive stroboscope settings of 3000, 4000 and 5250 flashes per minute. Calculate the rotational speed of turbine.   07

C. Write a note on wringing of slip gauges.   05

Q.3 **A.** A resistor has a normal value of $10\Omega \pm 0.1\%$. A voltage, V is applied across the resistor of resistance R and the power consumed is calculated in two ways, 1) $P = V^2/R$ 2) $P = V.I$ where I is the current passing through the circuit. Calculate the uncertainty and power consumed in each case when the measured values of V and I are V=100Volt $\pm$ 1%, I=10Amp $\pm$ 1%. Comment on result.   10

B. Define fit and classify it depending upon the actual limits of hole or shaft. Give example of each type of fit.   06

C. Explain the stroboscopic method of angular velocity measurement.   04

Q.4 **A.** Calculate the dimensions of plug and ring gauges to control the production of 50 mm shaft and hole pair of H_7d_8 as per *I.S.* specification. The following assumptions may be made: 50 mm lies in diameter step of 30 and 50 mm and the upper deviation for shaft 'd' is given by $-16\ D^{0.44}$ and lower deviation for hole 'H' is zero. Tolerance unit in microns is $i = 0.45\sqrt[3]{(D + 0.001D)}$ and $IT6 = 10i$ and above $IT6$ grade the tolerance magnitude is multiplied by 10 at each fifth step.   10

B. Define gauge factor of a strain gauge and also derive an expression for it.   10

Q.5 **A.** Explain the followings: 12
   i) Piezoelectric pressure sensors.   ii) Bridgman gauge   iii) Pyrometers.

B. Explain in brief various possible types of errors on gears. Also explain with neat sketch the use of Parkinson gear tester.   08

Q.6 **A.** Explain following forms of thread gauges,   09
   i) Plug screw gauges   ii) Ring screw gauges.   iii) Caliper gauges.

B. Write notes on thermodynamic temperature scale and IPTS.   05

C. What are the different types of errors encountered in a measurement system?   06

Q.7 **A.** Write notes on any four of the followings: 20
   i) Thermal conductivity gauge for vacuum measurement.
   ii) Nozzle flapper transducer.
   iii) Tachogenerators.
   iv) Auto-collimator.
   v) Strain gauge based accelerometer.