Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

V SEMESTER B.TECH (MECHANICAL/IP ENGG.) END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: METROLOGY & MEASUREMENTS [MME 3104]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.
- Draw neat sketches wherever is required.

1A. Explain three stages with functional elements of a generalized measurement system. **03**

1B. What are the advantages of having secondary transducer element along with the primary transducer element? **02**

1C. State and explain Taylor`s principle of gauge design. **02**

1D. Design GO and NO GO limit plug gauges for checking a hole having a size of $50^{(0.00,\ 0.05)}$ mm. Assume the gauge maker`s tolerance to be equal to 10% of work tolerance and provide wear allowance equal to 10% of gauge maker`s tolerance. **03**

2A. Derive the equation to measure unknown high pressure with a neat sketch of Bridgeman gauge. **03**

2B. A diaphragm type of pressure transducer gives a central deflection of 0.2 mm when a pressure of 1.2×10^6 N/m^2 is applied. An electromechanical device namely, linear variable differential transducer (LVDT) converts the input displacement of pressure transducer in to voltage and has a sensitivity of 60 V/mm. Determine the overall sensitivity of the pressure gauge in V/(N/m^2) and determine the unknown pressure when the output voltage of 2.5V is observed on the scale. **02**

2C. Explain with help of a plot how straightness of a machine guide way is assessed using an autocollimator. **03**

2D List the slip gauges to be wrung together to produce an overall dimension of 72.3685mm using two protection slips of 2.5mm size and M112 gauge set. **02**

3A. Explain with neat sketch the method of measurement of temperature with resistance thermometer and also derive the sensitivity of the device. **03**

3B. Differentiate between systematic type and random type instrument errors. **02**

3C. Between two mating parts of 100 mm basic size, the actual interference fit is to be from 0.05 mm to 0.012 mm. The tolerance for hole is the same as the tolerance for the shaft. Find the size of both the shaft and the hole on (a) hole basis unilateral system and (b) shaft basis unilateral system. **03**

3D What is best-size wire? Calculate the diameter of the best-wire for an M 20 x 2.5 mm screw. **02**

4A. For a metallic resistance strain gauge prove that the gauge factor should be a function of Poisson's ratio alone. **03**

4B. For strain measurement, a Wheatstone bridge circuit is used in which one gauge each is connected in the limbs of the bridge. These gauges have been mounted on the fixed end of a mild steel cantilever (500 mm long x 50 mm wide x 15 mm deep) and are connected electrically to form a full-bridge configuration. The nominal resistance of each gauge is 100 Ω, the gauge factor is 2.0. The bridge supply voltage is 6 V and the measuring instrument has an infinitely high internal resistance. If a unit kg of mass is applied at the free end of the cantilever, calculate the sensitivity of the system in mV/kg. Take, modulus of elasticity for mild steel = 200 GN/m^2. **02**

4C. Derive an expression for effective diameter of screw thread by two-wire method, which depends on the diameter of the wires, dimension over the wires, the pitch and angle of the screw thread. **03**

4D Explain briefly the following: (i) Primary texture (ii) Secondary texture. **02**

5A. A mild steel shaft is used to connect a motor drive to a constant load torque. To measure this torque, a resistance strain gauge with resistance of 120 Ω and gauge factor of 2, is mounted on a shaft with its active axis at 45º to the shaft axis. Shear modulus of mild steel is 8 x 10^{10} N/m^2. Shaft diameter is 3 cm and change in gauge resistance due to load is 0.2Ω. Find the load torque. **02½**

5B. Explain with neat sketch how the torque & power can be measured using cradled dynamometer. **02½**

5C. Explain the following methods of quantifying surface roughness: (a) Rz value (b) RMS value. **02**

5D Calculate the limits of tolerance for a 30 mm shaft and a hole pair designated by H7/g9. The fundamental tolerance is calculated by the following equation:

$$i = 0.45\sqrt[3]{D} + 0.001D$$

The following data is given: **03**

(a) Upper deviation of shaft = - 2.5 $D^{0.34}$

(b) 30 mm lies in the diameter steps 18 and 30 mm

(c) IT7 = 16i

(d) IT9 = 40i