# Indian Institute of Technology (Indian School of Mines) Dhanbad

## Question Paper

Examination: II B Tech (Common) (Sections A, B, C & D) Monsoon Mid Semester — Time: 2 Hours

Discipline: Mechanical Engineering (Manufacturing) — Total Marks: 32

Subject: Manufacturing Process (MEI 102) — Session: 2022- 23

### Part I

1) Define the following terms: (i) Accuracy (ii) Precision (iii) Calibration (iv) Lay **- 4 x 0.5 marks = 2 marks**

2) GO/NO-GO ring gauge is needed to inspect the diameter of a shaft that is 50.00 +/- 0.20 mm. A wear allowance of 3% of the entire tolerance band is applied to the GO side. Determine the nominal size of GO gauge. **- 2 marks**

3) Explain Surface finish with neat and clean diagram mentioning waviness and lay alongwith Ra value. **- 2 marks**

4) A slip gauge of 20.000 mm length was used to determine precision and accuracy of mechanical vernier micrometer having range 0-20 mm and least count 0.001 mm after setting zero error. Reading are 20.001 mm, 19.998 mm, 20.002 mm, 19.999 mm and 20.000 mm respectively. Find $\sigma_T$ and $\sigma_{X\,Bar}$. **- 2 marks + 2 mark = 4 marks**

### Part II

1. A cube shaped casting solidifies in 5 minutes. What will be the solidification time (in minutes) for a cube of same material, which is 8 times heavier than the original casting? **- 3 marks**

2. The height of the down sprue is 175 mm and its cross section at the base is 200 $mm^2$. The cross sectional area of the horizontal runner is also 200 $mm^2$. Assuming no losses, indicate the correct choice for the time (in seconds) required to fill a mould cavity of volume 106 $mm^3$. (Use g = 10 $m/s^2$) **- 3 marks**

3. A mould having dimensions 100 mm x 90 mm x 20 mm is filled with molten metal through a vertical gate with height 'h' and cross sectional area 'A' and the mould filling time is 'T1'. The height is now quadrupled and the cross sectional area is halved. The corresponding filling time is 'T2'. What is the ratio of T2/T1? **- 4 marks**

### Part III

1) Classify various metal forming processes with the aid of a chart. **- 2 marks**

2) Differentiate tangibly between bloom, billet, plate, sheet strip and foil. **- 2 marks**

3) Represent with diagrams of different classes of extrusion. **- 2 marks**

4) The Flow Curve of aluminium strength coefficient =175 MPa, strain hardening exponent=0.20. In the forming operation, the final true strain is 0.75. Determine the instantaneous flow stress and the average flow stress that the material experienced at the strain. **- 2 mark**

5) Austenitic stainless steel has a flow curve with strength coefficient =1200 MPa, strain hardening exponent = 0.40. A tensile strength specimen with a gauge length of 100 mm stretched to a length of 145 mm. Determine the instantaneous flow stress and the average flow stress that the material experienced at the strain. **- 2 marks**

6) An ECM operation is to be used to cut a hole into the plate of aluminium that is 12 mm thick. The hole has a rectangular cross section of 10 mm X 30 mm dimension. ECM accomplished at a current =1200 amp. Efficiency = 95%. Determine the feed rate and the time required to cut through the plate. For aluminium consider the specific removal rate = 3.44 X $10^{-2}$ $mm^3$/amp-s. **- 2 marks**

Hint : $Y_f = K\,(e)^n$ Average $Y_f = \frac{e^n}{n+1}$

Part I

**Question No. 1: Answer**

(i) **Accuracy** is quantitative measure of amount of closeness of the measured values to the true value.

(ii) **Precision** is quantitative measure of amount of closeness of the measured values to the average value.

(iii) **Calibration** is the procedure used to establish a relationship between the values of the quantities indicated by the measuring instrument after repair/readjustment/setting and the corresponding values realized by standards at the same level or at the higher level under specified conditions.

(iv) **Lay** is the direction of the predominant surface pattern generated by the cutting tool.

**Question No. 2: Answer**

Go Gauge side diameter = 50.00+ 0.20 =50.20 mm, NO GO Gauge side diameter = 50.00- 0.20 =49.80 mm

The entire tolerance band = Total tolerance = +0.20- (-0.20) = 0.40 mm.

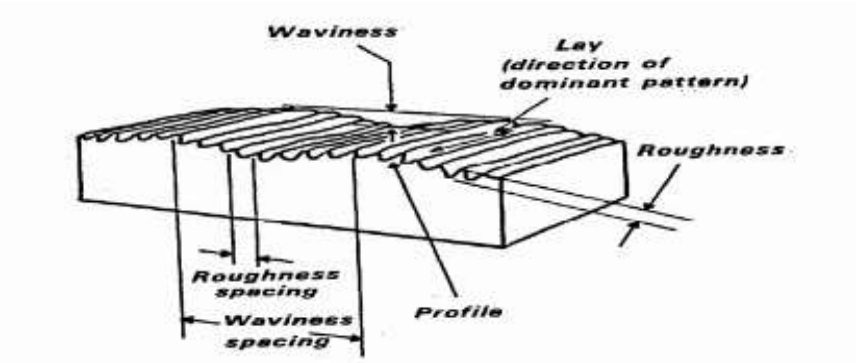
3% of the entire tolerance band =0.03 x 0.40 = 0.012 mm

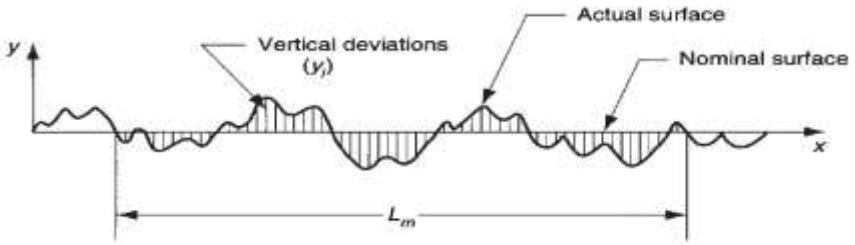
Then the nominal size of GO Gauge = 50.20- 0.012 = 50.188 mm to compensate for wear.

**Question No. 3: Answer**

$$R_a = \int_0^{L_m} \frac{|y|}{L_m}\, dx$$

$$R_a = \sum_{i=1}^{n} \frac{|y_i|}{n}$$




**Question No. 4: Answer**

Standard deviation ($\sigma$) = $\sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{(n-1)}}$

$\sigma_T = \sqrt{\frac{\sum_{i=1}^{n}(x_i - T)^2}{n-1}}$

$\sigma_{\bar{x}} = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$

Given: True value = 20.000 mm

By calculation $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{100}{5}$

= 20.000 mm

Then $\sigma_T$ = 0.0016 mm Since $T = \bar{x}$

$\sigma_{\bar{x}}$ = 0.0016 mm

LC = 0.001 mm Deviation from true or average value = 0.0016 - 0.001

= 0.0006 mm.