Department of Mechanical Engineering

Indian Institute of Technology Kharagpur

1st Class Test on Machine Tools and Machining, March 2017

Duration: 50 minutes

Full Marks: 40

Attempt all questions

Open Book Test

1 A low carbon steel bar of 200 mm diameter is being straight turned orthogonally at a cutting speed of 120 m/min and depth of cut of 4 mm. The feed rate in mm/min is 48 mm/min. The specific cutting energy (neglecting the contribution of feed force towards cutting energy) is 1.5 GJ/m^3. The angle between the friction force vector and main cutting force vector as measured on the Merchant's circle diagram is 96°. The chip thickness is 0.5 mm. Kronenberg's equation is not valid. The inclination angle and the back rake are same. Determine: (i) the shear force, (ii) the resultant thrust force (P_{xy}), and (iii) dynamic yield shear strength. 15

2 An engineering alloy is orthogonally straight turned at a cutting speed of 90 m/min, feed of 0.2 mm/rev and depth of cut of 2 mm. The measured forces are: main cutting force 1000 N, feed force i.e. axial thrust force 500 N and radial thrust force 134 N. The chip thickness is 0.35 mm. The ratio of friction force to normal force at the chip tool interface is 0.7. Further, the normal force vector at the chip tool interface is parallel to main cutting force vector. Kronenberg's equation is not valid. Determine: (i) the shear force, and (iii) dynamic yield shear strength. 10

3 Assume that shear force and normal force on the primary shear plane act at the mid-point of the shear plane. Similarly normal force and friction force act at the mid-point of the total contact length. The forces during chip formation are in equilibrium. 15

Prove that, $\left[\text{contact length} = \frac{\sin(\beta+\eta-\gamma_o)}{\cos\eta} \times \frac{a_1}{\sin\beta}\right]$