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MANIPAL INSTITUTE OF TECHNOLOGY
A Constituent Institute of Manipal University, Manipal

I SEM M. Tech. (MANUFACTURING ENGG & TECHNOLOGY) DEGREE END SEMESTER EXAMINATIONS NOVEMBER/DECEMBER 2016

SUBJECT: THEORY OF METAL CUTTING (MME 5123)
REVISED CREDIT SYSTEM

Time: 3 Hours Max. Marks: 50

Instructions to Candidates:
- Answer **ALL** questions.
- Missing data, if any, may be assumed appropriately.

1. a) Show the Tool-in-hand nomenclature of a turning tool and discuss the influence of each of the geometry parameters on machining. **[05]**

   b) Discuss the construction and working of a 2-component strain gauge based dynamometer. **[05]**

2. a) Obtain Merchant's shear angle solution for orthogonal machining. **[04]**

   b) An alloy steel rod is machined by a tool with rake angle 10° at 100 m/min, the uncut chip thickness is 1 mm and the width of cut is 5 mm. The yield strength of the alloy in shear is 240 MPa, the coefficient of friction at the chip-tool interface is 0.3 and the length of this interface is 1.2 mm. Evaluate the following: **[06]**
      i) Shear angle using Lee Shaffer's model
      ii) Cutting and thrust forces on the tool
      iii) Average normal and shear stresses at the chip-tool interface
      iv) Shear and Chip velocities.

3. a) Discuss the distribution of normal and shear stresses at the chip-tool interface of a single point tool and obtain the equations for normal and tangential forces on the rake. **[06]**

   b) Discuss the influence of the following on cutting tool life: **[04]**
      i) Tool material
      ii) Work material

4. a) Discuss the following tool wear mechanisms in machining: **[04]**
      i) Adhesion

ii) Fatigue

b) In orthogonal machining of a brass tube the tool rake angle is 5°. Determine the temperature rise at the shear plane and secondary deformation zone, if the depth of cut, t = 1.5 mm, yield stress of brass, τ_y = 200 MPa, friction angle, β = 30°, specific heat of work material, C = 380 J/kgK, cutting speed, V = 100 m/min, chip thickness ratio, r_c = 0.4, width of cut, b = 3 mm, thermal conductivity, K = 109 W/mK and Density ρ = 8400 kg/m^3, fraction of the heat transferred to work material is 0.1. **[06]**

5. a) Discuss the deformation mechanisms involved in chip formation, while machining the following: **[04]**

   i) Ductile material

   ii) Brittle material

   b) Discuss the mechanics of machining based on the models proposed by Okushima and Piispanen. **[06]**