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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

I SEM M. Tech. (MANUFACTURING ENGINEERING) DEGREE END SEMESTER EXAMINATIONS, NOVEMBER 2018

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

Time: 3 Hours Max. Marks: 50

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

1. a) Discuss the Tool-point reference system of tool nomenclature and state its application in specifying the tool geometry of a single point cutting tool. **[05]**

   b) Discuss the mechanism of formation of chips while machining the brittle material and the reasons for its difference from that of ductile material. **[05]**

2. a) State the assumptions made by Merchant to obtain mathematical model for orthogonal machining and discuss its limitations. **[03]**

   b) In an orthogonal machining test the following conditions were noted:

   Rake angle = -5°, Cutting speed = 100 m/min, Width of cut = 2.5 mm, undeformed chip thickness = 0.25 mm, Chip thickness = 1 mm, Chip-tool contact length = 0.5 mm, Cutting force = 900 N, Thrust force = 600 N. Calculate: **[07]**

   i) Shear angle

   ii) Mean yield strength of work material

   iii) Energy required for shearing

   iv) Energy dissipated due to friction at the chip-tool interface

   v) Average normal stresses on shear plane and chip-tool interface

3. a) Obtain the mathematical model of 2D heat transfer in a moving material and discuss the distribution of temperature in chip, tool and work material during orthogonal machining of ductile materials. **[06]**

b) When machining steel with HSS tools, the following equation was found to fit the tool life data fairly well **[04]**

$$V T^{0.52} f^{0.6} d^{0.35} = 268.5$$

Calculate the tool life T at a cutting speed = 2.5m/s, feed = 0.00035 m/rev and depth of cut = 2.0 mm. Calculate the tool life, if the above parameters are increased by 25% individually.

4. a) Discuss the following mechanisms of cutting tool wear: **[06]**
   i) Diffusion
   ii) Abrasion

   b) Discuss the different forces exerted on a helical fluted drilling tool while drilling holes. **[04]**

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

   b) The following observations were made in an orthogonal machining experiment:

   Rake angle = 0°, Cutting force = 890 N, Thrust force = 667 N, Cutting speed = 2 m/s, Undeformed chip thickness = 0.25mm, Width of cut = 2.5mm, Chip thickness ratio = 0.3, Length of chip-tool interface = 0.75mm.

   Determine the maximum temperature on the tool face. Let density of work material = 7200 kg/m^3, Thermal conductivity = 43.6 W/mK and specific heat = 502 J/kgK. **[06]**