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**Question Paper Code : 30943**

M.E./M.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

First Semester

Manufacturing Engineering

MF 4103 — THEORY OF METAL CUTTING

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List any four reasons why metal machining is commercially and technologically important.
2. Differentiate between orthogonal and oblique cutting.
3. What are the two basic categories of cutting tools in machining? Give two examples of machining operations that use each of the tooling types.
4. Write the American Standard Association system (ASA) nomenclature of a single point cutting tool.
5. Mention any two measuring technique used to measure temperatures in machining.
6. Orthogonal cutting is performed on a metal whose mass specific heat = 1.0 J/g-C, density = 2.9 g/cm3, and thermal diffusivity = 0.8 cm2/s, The cutting speed is 4.5 m/s, uncut chip thickness is 0.25 mm, and width of cut is 2.2 mm. The cutting force is measured at 1170 N. Using Cooks equation, determine the cutting temperature if the ambient temperature = 22°C.
7. How does the performance of an HSS tool differ from that of a ceramic tool?
8. The life of a lathe tool is 4 hours when operating at a cutting speed=40 m/min. Given that $VT^n$=C, find the highest cutting speed that will give a tool life of 8 hours. Let n=0. 125.
9. The roughness of a machined surface depends on many factors that can be grouped into three categories. Name all the three categories.
10. Write the three possible modes by which a cutting tool can fail in machining.

PART B — (5 × 13 = 65 marks)

11. (a) Write short notes on the following: (i) Types of chips in machining (ii) Use of chip breaker in machining.

Or

(b) A carbon steel bar with 19.1 cm diameter has a tensile strength of 450 MPa and a shear strength of 310 MPa. The diameter is reduced using a turning operation at a cutting speed of 120 m/min. The feed is 0,027 cm/rev and the depth of cut is 0.3 cm. The rake angle on the tool in the direction of chip flow is 13°. The cutting conditions result in a chip ratio of 0.52. Using the orthogonal model as an approximation of turning, determine (i) the shear plane angle (ii) shear force (iii) cuffing force and feed force and (iv) coefficient of friction between the tool and chip.

12. (a) With the aid of a neat sketch, explain the nomenclature of a twist drill.

Or

(b) Sketch a plain milling cutter and show the following elements and angles (i) Face (ii) Land and bottom land (iii) Root diameter (iv) Outside diameter (v) Lib angles (vi) Clearance angle (vii) Radial rake angle.

13. (a) During a turning operation, a tool-chip thermocouple was used to measure cutting temperature. The following temperature data were clollected during the cuts at three different cutting speeds (feed and depth were held constant) : (i) v = 100 m/min, T = 505°C, (ii) v = 130 m/min, T = 552°C, (iii) v = 160 m/min, T = 592°C. Determine an equation for temperature as a functions of cutting speed that is in the form of the Trigger equation, $T = kv^m$.



Or

(b) Describe the desired properties types and functions of metal cutting fluids.

14. (a) List all the important properties of cutting tool materials and mention why each is important.

Or

(b) Define the term "machinability" and describe the material properties that affect machinability.

15. (a) Write short notes: mechanisms that cause wear at the tool—chip and tool—work interfaces in machining.

Or

(b) Describe the various steps that can be taken to reduce or eliminate vibrations in machining.

PART C — (1 × 15 = 15 marks)

16. (a) The XYZ Company is one of the world's leading manufacturers of portable, gasoline-powered chain saws. Some of the components are made wear-resistant hypereutectic silicon aluminum alloys. These alloys are extremely abrasive because of the presence of hard silicon crystallites in the material. When the cutting edge strikes the crystallite, the impact often chips the cutting edge despite the inherent toughness of the carbide tool used. The results are rapid dulling of the edge and a high tool-wear rate. Also, the carbide tool is unable to make a clean cut on the crystallites. Instead, the crystallites are broken and cracked and driven deep into the work material, This makes a subsequent honing operation necessary to obtain the desired final size, roundness and surface finish. What would your suggestion be to solve this tool-wear problem? Give the reasons for your choice of tool material or working condition.

Or

(b) Give examples of where the following cutting tool materials can be used with greatest advantage. Give reasons for your choice. (i) high carbon steel (ii) high speed steel (iii) tungsten carbide.