

B.E. MECHANICAL ENGINEERING THIRD YEAR FIRST SEMESTER - 2025**MACHINING TECHNOLOGY AND METROLOGY**

Time: 3 Hours

Full Marks: 100

Assume any relevant data, if necessary. Symbols in the Question Paper carry their usual meanings. Figures in the margin indicate full marks. All Parts of any one question must be answered together

Answer any one (1) question from Q1, and Q2**20×1=20**

- Q1.** a) State the properties a cutting tool material essentially possess and why? Discuss about HSS and Carbide as cutting tool material.
 b) Draw a single-point turning tool and visualize its different rake angles, clearance angles and cutting-edge angle in machine reference or ASA system. (CO1) (6+6) +8=20
- Q2.** a) State the differences among abrasion wear, adhesion wear and diffusion wear in respect of cutting tool wear.
 b) Under a given condition of turning, the tool life was found to decrease from 24 min to 16 min when only the cutting velocity V_c was raised from 200 m/min to 250 m/min. What will be the tool life if the cutting velocity is further increased to 300 m/min under the same machining condition? (CO1) (4+6) +10=20

Answer any two (2) questions from Q3, Q4, Q5, and Q6**20×2=40**

- Q3.** a) State why GP (geometric progression) is preferred to AP (arithmetic progression) for layout of spindle speeds in machine tools. With the help of a simple example and suitable diagrams, distinguish between (i) unilateral and bilateral systems, (ii) open and cross systems in respect of speed layout in machine tools.
 b) If in a 12 speed centre lathe the velocity ranges from 40 m/min to 200 m/min and job diameter ranges from 50 mm to 200 mm, then determine the values of those 12 standard spindle speeds following GP. (CO2) (6+4) +10=20
- Q4.** a) State the functions of feed rod and lead screw of a Lathe. Explain apron mechanism of Lathe with a schematic diagram.
 b) A metric thread of 0.8 mm pitch is to be cut on a lathe. Pitch of the lead screw is 1.5 mm. If the spindle rotates at 1500 rpm, calculate the speed of rotation of the lead screw (rpm)?
 c) A shaft 500 mm long has a taper of 100 mm/m for a distance of 200 mm from one end. The maximum diameter of the shaft is 150 mm. Determine the amount of set over required. (CO2) (4+6) +5+5=20
- Q5.** a) What is indexing? Name and briefly explain different indexing methods.
 b) Calculate the crank movement and change gear ratio for indexing 83 divisions.
 c) Determine the actual machining time that will be required for plain milling a rectangular surface of length 200 mm and width 50 mm by a helical fluted plain HSS milling cutter of diameter 70 mm, length 75 mm and 6 teeth. Assume $A=O=5$ mm, $V=44$ m/min and feed $s_0=0.2$ mm/tooth. (CO2) (1+6) +6+7=20
- Q6.** a) Write a short note on creep feed grinding.
 b) Explain the following grinding wheel specification:
 W A 46 K 5 V 17
 c) Find the time required for taking a complete cut on a plate 600 mm×900 mm, if the cutting speed is 9m/min. The return time to cutting time ratio is 1:4 and feed is 3 mm. the clearance at the end is 75 mm. (CO2) 5 +7+8=20

[Turn over

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Answer any one (1) question from Q7, and Q8

10×1=10

- Q7.** Explain the working principle of Electro Discharge Machining (EDM) with a neat sketch. Explain the function of dielectric fluid used in EDM. (CO3) 6+4=10
- Q8.** In an electrochemical machining (ECM) process with a pure iron workpiece, a removal rate of $5\text{cm}^3/\text{min}$ is desired. Determine the current required. Also deduce the formula required. The gram atomic weight, valency and density of iron are 56 gm, 2, and 78 gm/cm^3 respectively. (CO3) 5+5=10

Answer any one (1) question from Q9, and Q10

10×1=10

- Q9.** With the help of an illustration, explain the following terms: roughness, waviness, lay, and flaws. What are the primary reasons for surface irregularities? (CO4) 8+2=10
- Q10.** Explain RMS, R_a and R_z values of surface roughness. Explain in brief the principle and operation of Taylor–Hobson Talysurf roughness instrument. (CO4) 6+4=10

Answer any one (1) question from Q11, and Q12

20×1=20

- Q11.** a) Define (i) Interchangeability; (ii) Tolerance; (iii) Allowance
 b) What is meant by 'hole basis system' and 'shaft basis system'? Which one is preferred and why?
 c) Calculate the tolerances, fundamental deviations and limits of sizes for the hole shaft pair designated as 40 H8 / f7 and show the values in a diagram. For shaft f, fundamental deviation (upper deviation), $es = -5.5 (D)^{0.41}$. 40 mm lies in the diameter steps of 30 to 50 mm. The value of IT8 and IT7 are 25i and 16i respectively. i= standard tolerance unit in micron and D is the geometric mean diameter in mm. (CO5) 6+(4+2) +8=20
- Q12.** a) Explain two wire and three wire method for measuring pitch diameter of thread.
 b) What are the design considerations for a Comparator.
 c) Discuss the working principle of Eden-Rolt Millionth comparator. (CO5) (3+2) + 5+10=20
