[3 Hours]   **[Maximum Marks: 80]**

- **Question No.1 is compulsory and Answer 3 Questions remaining 5 Questions.**
- **Assume suitable data wherever necessary**
- **Diagram and sketches explanations are right to reserve full marks**

Q1 (i) **Attempt any four of the following**   **10**

    (ii)   a) Difference Between orthogonal and oblique metal cutting   **10**

         b) Draw Merchant's Circle diagram with usual notations and show all forces

         c) Explain Cutting fluids functions and classification

         d) Draw single point cutting tool three views and ASA Tool signature

         e) Milling cutter types with diagram and selection criteria for milling cutters in metal cutting process

Q2 (i) Derive an equatrion of merchant's modified theory with usual **10** notations, merchat circle diagram and assumptions

    (ii) Explain the various steps involved in the design of circular broach and **10** draw the neat diagram

Q3 (i) Design a circular form tool graphically and to cut a semicircular groove **10** in the cylindrical work piece whose details are given below Minimum radius = 50mm; and Maximum radius = 75mm Assume Design a circular form tool graphically and to cut a semicircular rake and relief 12^0 and 7^0 respectively. The form tool is HSS

    (ii) A pipe 30mm in diameter is being turned on a lathe with a tool having **10** rake angle of 10^0 and a feed of 0.2mm/rev. The length of chip over one revolution of workpiece is 72mm. The cutting speed is 60m/mim . the tangential force is 1KN and the feed force is 0.65KN. chip thickness 0.6mm Calculate (a) Resultant force; (b) Shear angle; (c) Shear force; (d)Normal compressive force (e) Frictional force; (f) Normal force; (g) Cutting Power

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Q4 (i) Calculate the length of broach for roughing and finishing operation for machining a slot of 10 mm in depth and 20 mm in width for 400 mm long steel piece having specific cutting energy of 2000 N/mm^2. Cutting speed is 5m/min and chip space number 8. Taking roughing feed as 0.08 mm/tooth and finishing feed as 0.02mm/tooth. **10**

(ii) Derive an expression for optimum cutting speed at minimum cost criteria by using usual notations **10**

Q5 (i) Derive an expression for shear angle in orthogonal cutting in terms of rake angle and chip thickness ratio **8**

(ii) A 200 mm long and 30 mm in diameter metal bar is being turned on lathe with a feed of 0.25 mm / rev. The operating cost is Rs.5 / min while tool cost is Rs.10 per cutting edge. Tool changing time is 1 min for each cutting edge. Compare the machining cost per component while operating under most economical conditions for following materials: **12**

Material	Tool life equation
X	$VT^{0.1} = 67$
Y	$VT^{0.1} = 90$

Q6 **Attempt any four of the following:** **4 x 5 =20**

(i) Explain tool life parameters with tool life equation

(ii) Explain machinability with example and Macinability Index

(iii) Classify cutting tool Materials and explain any one of the material

(iv) Design Procedure of single point cutting tool

(v) Different types of chips in metal cutting process