Duration: 3hrs **[Max Marks: 80]**

N.B. **(1)** All questions carry equal marks.
(2) Question No. 1 is Compulsory.
(3) Attempt any three questions from remaining five questions.
(4) Figures to the right indicate full marks.
(5) Assume Suitable data if necessary.

Que. 1 Attempt any **four** of the following: **(20)**

A. Prove that in metal cutting, chip flow velocity = cutting velocity × chip thickness ratio ($V_c = V \times r$).

B. Explain primary and secondary cutting edge finish.

C. Explain the various elements of a single point cutting tool, with the help of a neat sketch.

D. Explain the sources of heat generation in metal cutting with the help of sketches.

E. Sketch a twist drill and name all elements also write briefly on the following elements: Helix angle, chisel angle and point angle.

F Explain the crater wear and flank wear with the help of sketches.

Que. 2 A. Calculate and Design a round pull type broach for machining hole of diameter **35H7** and length **20** mm in a work piece of carbon steel. **(10)**
Specific cutting force = **4200** N/ mm^2, **IT7** = **0.025** mm, Tooth rise = **0.03** mm, Cutting speed in broaching = **8** m/min and Blunt broach factor = **1.25**. Draw the broach and indicate designed value.

B. What are the advantages of indexable inserts (tipped tool)? How can indexable inserts and their holders are specified (ISO coding)? **(10)**

Que. 3 A. The following data relate to an orthogonal turning process: **(10)**
Chip thickness = 0. 45 mm, Feed = 0.25 mm/ rev, Cutting speed = 2.5 m/sec, Rake angle = 10^0

(i) Calculate cutting ratio and chip reduction coefficient.
(ii) Calculate shear angle
(iii) Calculate shear velocity and chip velocity

B. Name and explain the various materials used for cutting tools. **(10)**

Que. 4 A. The following equation for tool life is given for a turning operation: **(10)**

$$V\,T^{0.13}\,f^{0.77}\,d^{0.37} = C$$

A 60 minute tool life was obtained while cutting at V = 30 m/min, f = 0.3 mm/rev, and d = 2.5mm. Where; V = cutting speed in m/min, T = Tool life in min, f = feed in mm/rev, and d = depth of cut in mm.

Determine the change in tool life if the cutting speed, feed and depth of cut are increased by 20% individually and also taken together.

B. Derive an expression for shear plane angle in terms of friction angle and rake angle for minimum rate of energy consumption. Also state your assumptions. **(10)**

Que. 5 A. For a turning operation, derive relationship for optimum cutting speed and optimum tool life for minimum cost criteria in metal cutting. **(10)**

B (I) Explain tool work thermocouple method with sketch for cutting temperature measurement. **(10)**

(II) How is the tool shank of a single point cutting tool designed?

Que. 6 A. (I) Explain working principle of Strain gauge type dynamometer.with the help of neat schematic sketch. **(10)**

(II) What are the functions and essential properties of a cutting fluid?

B. Sketch and name all elements of a **Solid Tap,** and discuss their design features. **(10)**