

First Question: (20 marks)

- (a) Prove analytically that the depth (P_2) of a flat form tool with positive rake angle is in the form:

$$P_2 = \{ \sqrt{r_2^2 - (r_1 \sin \gamma)^2} - r_1 \cos \gamma \} \cos(\gamma + \alpha) \quad (10 \text{ marks})$$

- b) For turning a workpiece with minimum diameter of 25 mm and maximum one of 30 mm by using a circular form tool having clearance angle " $\alpha = 10^\circ$ " and rake angle " $\gamma = 5^\circ$ ". When the difference center height " $H = 5.21 \text{ mm}$ ", calculate the major and minor diameters of the given form tool. (10 marks)

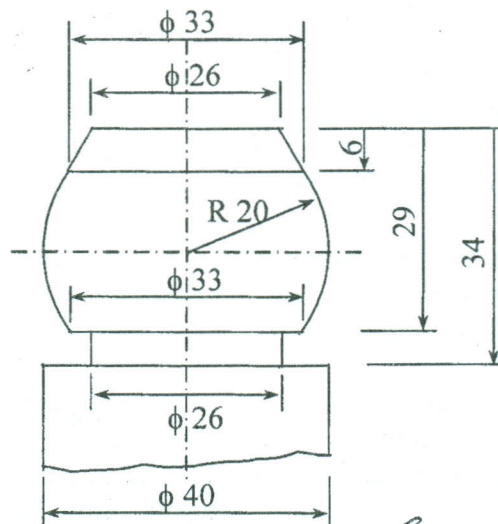
Second Question: (20 marks)

- (a) In a symmetrical face milling operation with 24 teeth face milling cutter, the full contact angle was found to be 112° . For a workpiece with 100 mm width, what is the used milling cutter diameter? (4 marks), and what is the maximum uncut chip thickness with feed rate of 36 mm/rev? (6 marks) (10 marks)
- (b) In planing operation using a Planer machine with 3 K.W. electric motor and 80% efficiency. Using the full cutting power, what is the required cross-sectional area of square H.S.S. tool?, which has 30 Kg/mm² bending strength and 70 mm tool overhang. Given are; the planer works at 35 full strokes/min, 325 mm length of ram stroke, and a speed ratio of 0.75. The available tools cross-sections are 15x15, 20x20, 25x25, 30x30, and 40x40 mm. (10 marks)

Third Question: (25 marks)

Graphically find the suitable profile of a form tool required to produce the product shown in figure. Given are:

- * For a circular form tool, the front clearance angle is 12° , $k = 5 \sim 10 \text{ mm}$, $m = 5 \text{ mm}$, and 12 mm mounting hole diameter.
- * For a flat form tool, the front clearance angle is 15° .
- * For both form tools, zero degree rake angle is used, and the drawing scale is 1:1.



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