Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech /(PE)/SEM-1/PEM-103/2012-13

2012

THEORY OF MACHINING AND GRINDING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

Answer any *one* question

1. a) Explain why study of tool geometry is important for obtaining good machinability. 3

   b) A tool signature is given by :
   0° – (–) 7° – 6° – 6° – 15° – 90° – 0·4 mm.
   From this tool signature, evaluate the tool setting angles in ASA system for grinding rake face and principal flank surface. Derive the relationships used. 3 + 8

2. a) Define a normal plane. How is it different from an orthogonal plane ? State the advantage of using NRS of tool signature system. 1 + 2 + 2

   b) A HSS milling cutter has its flank surface with Archimedian spiral. After reaching its tool life, how this cutter can be made reusable ? Discuss the method briefly. 5

   c) "In a standard twist drill, rake and clearance angles vary along the cutting edge from its centre towards the periphery". Justify the statement. 4

GROUP – B

Answer any *two* of the following.

3. a) Discuss briefly the mechanism of chip formation in machining.

   b) Under what machining conditions a ductile material like Aluminium will give discontinuous chips ?

   c) Compare tungsten carbide and ceramic as cutting tool materials.

   d) Why diamond tool is not generally recommended for machining of ferrous materials ? What do you mean by high performance cutting tool ? 6 + 2 + 3 + 3

4. a) Derive Ernst and Merchant's solution. Explain the cause of necessary modifications in MCD.

   b) What is the purpose of using chip breakers ?

   c) Sketch a diagram to show the variation of rake angle and clearance angle along the cutting edge of a twist drill.

   d) During machining with a carbide tool, the wear land size l_w (mm) was found to be related to the cutting speed V (m/min) and tool life T (min) by the following relationship :

   $l_w = 56{\cdot}5 \times 10^{-8} V^{2{\cdot}4} T^{0{\cdot}6}$

   Assuming $l_w^* = 1 \cdot 5$ mm as the criterion for tool failure, obtain the tool life equation and evaluate the cutting speed for a tool life of 30 min. 6 + 2 + 3 + 3

5. a) Derive an expression to show the dependence of CRC on the frictional aspects at the chip tool interface and the orthogonal rake angle.

   b) Effectiveness of a cutting fluid is a function of the flow rate and direction of flow. Justify the statement.

   c) State the significance of restricted contact machining.

   d) During orthogonal machining with an HSS tool, the rake angle was 5°, the underformed chip thickness was 0·25 mm and the width of cut was 4 mm. Taking the shear strength of the work material to be 350 N/mm^2 and the co-efficient of friction between the chip and the tool to be 0·5, estimate the cutting force and thrust force components. 5 + 3 + 2 + 4

GROUP – C

Answer any *two* of the following.

6. a) Describe briefly the different methods of application of grinding fluid under different situations. 6

   b) How can surface finish and surface integrity of the product be improved in grinding ? 3

   c) The wheel is given an infeed of 25 μm in horizontal surface grinding. The stiffness factor is K = 0·3. After 10 spark-out passes without further in feed, what is the size error due to system deflection ? 2

   d) Describe different factors for selecting grinding wheel for any work. 3

7. a) What is meant by grindability and how can it be assessed and improved ? 4

   b) Why does grinding wheel need balancing, truing and dressing before use ? 2

   c) Derive the maximum uncut grit depth of cut (hm) assuming the abrasive to be square pyramid with apex angle of 120°. 8

8. a) Write short notes on the following :

      i) Creep feed grinding

      ii) High-efficiency deep grinding (HEDG) 4

   b) What are the possible causes and effects of vibration in grinding ? 3

   c) What is self-excited vibration ? Explain van der Pal's model of vibration for machining. 4

   d) What is high speed machining ? Explain its advantages and disadvantages. 3

9. a) Derive Gilbert's model for economic tool life. 7

   b) Derive the formula $lc = (a.\ ds)^{\frac{1}{2}}$ for surface grinding, where lc = arc length of contact, a = infeed and ds = grinding wheel diameter. 3

   c) Write short notes on the following :

      i) G-ratio

      ii) Grinding Temperature. 4