

**Department of Mechanical Engineering  
Indian Institute of Technology Kharagpur**

**Mid-Semester Examination February 2013  
Machine Tools and Machining (ME30604)**

Number of Students: 233

Full Marks: 60

Duration: 2 hours

3<sup>rd</sup> Year BTech and Dual Degree Students of ME, MF and IEM

**All symbols have usual interpretations**

**Attempt any six questions**

1. The principal cutting edge of a single point turning tool is  $90^\circ$ . The inclination angle of the cutting edge is zero degree. The side rake is  $-10^\circ$ . The angle between the cutting planes is  $75^\circ$ . Show the top view of the tool and plot the location of the master line. 3  
Determine the expression for inclination angle of the auxiliary cutting edge ( $\lambda'$ ) of a single point turning tool (not the above one) in terms of relevant angles of (a) ASA and (b) ORS 7
2. The maximum rake of a metric threading tool is zero degree. The side clearance angle is  $5^\circ$ . The tool is utilised to machine a 6 mm pitch thread on a 50 mm diameter job with a cutting velocity of 60 m/min. Calculate the inclination angle of the principal cutting edge, feed velocity, modified side rake and modified side clearance. 10
3. A single motor is utilised to provide both longitudinal and transverse motion in a kinematic chain. Show an arrangement such that both motions cannot be engaged simultaneously. 6  
What is the purpose of a pulley placed between the motor and a gear box? 2  
In a cluster gear arrangement involving three pairs of gears, the no of teeth of the driver gears are 60, 40 and 80. If the number of teeth in the 1<sup>st</sup> driven gear is 40, then those for the other two will be 60 and 20. – explain. Assume all the gears have the same module. 2
4. Draw the kinematic diagram (line diagram) of an 18-speed 'speed gear box' of a centre lathe driven by a belt pulley mechanism. The speed gear box would have 4 shafts and it would employ sliding cluster gears. The maximum transmission ratio between any two shafts of the speed gear box is 1. The motor rotates at 1440 rpm with a rated power of 22 kW. The diameters of the pulleys on the motor and on the input shaft of the speed gear box are 300 mm and 200 mm respectively. Find the maximum spindle speed. 10
5. The apron constant is 100. The pinion in mesh with the rack has 12 number of teeth with a module of 1.5 mm. The spindle speed is 500 rpm. The transmission ratios of the change gear quadrant, Norton cone, Meander drive are 0.25, 0.75 and 2 respectively. The output of the Meander is 4

directly attached to the feed rod. Calculate the longitudinal feed in mm/rev, the feedrate in mm/min and rotational speed of the feed rod in rpm.

Also calculate the feed (mm/rev) and feedrate for a spindle speed of 1000 rpm. 3

Under similar circumstances (the spindle speed being raised to 1000 from 500) will there be a change in feed or feedrate if the feed gearbox is run by a separate motor connected to the change gears through a pulley? 3

6. Draw the schematic of the machining operation and write down the generatrix and directrix statements 10

(a) Cylindrical grinding using a tool-post grinder

(b) end milling of a T slot

(c) taper turning by swivelling the compound slide

(d) Taper turning using a form tool

(e) Facing using centre lathe

7. A right handed single point turning tool without nose radius has the same back rake and inclination angle. The auxiliary cutting edge angle is  $15^\circ$ . The side rake and the maximum rake angles are same and equal to  $-10^\circ$ . The orthogonal clearance angle is  $10^\circ$ . Draw the following (a) top view of the tool (b) orientation and location of the master line of the rake surface and (c) orientation and location of the master line of the principal flank surface. Determine the following (i) orthogonal rake and (ii) minimum principal clearance or relief angle. 10