Department of Mechanical Engineering
Indian Institute of Technology Kharagpur

Mid-Semester Examination February 2014
Machine Tools and Machining (ME30604)

Full Marks: 60   Duration: 2 hours

3rd Year BTech and Dual Degree Students of ME, MF, IEM and QEDM

All symbols have usual interpretations
Attempt all questions

1 (a) *Answers to Q.1(a) – (e) must accompany neat sketch of the cutting tool (relevant to question and numerical data) in top view to earn any credit*

The cutting plane and machine transverse plane of a single point turning tool coincide. The side rake (γ_x) of this turning tool is -7°. Find out the side cutting edge angle. [2]

(b) The auxiliary cutting plane and cutting plane of a single point cutting tool make an angle of 120°. The end cutting edge angle is 15°. Find out the principal cutting edge angle (φ). [2]

(c) The orthogonal plane and machine transverse plane of a single point cutting tool are at angle of 90°. Find out the back rake (γ_y) if the inclination angle of the main (principal) cutting edge is $+10^\circ$. [2]

(d) The tool geometry of a single point turning tool is specified as [2]
$0^\circ -10^\circ\ 8^\circ\ 10^\circ\ 15^\circ\ 90^\circ\ 0$ mm in ORS. Find out the angle between cutting plane and machine longitudinal plane.

(e) The tool geometry of a single point turning tool is specified as [2]
$0^\circ -10^\circ\ 8^\circ\ 10^\circ\ 15^\circ\ 90^\circ\ 0$ mm in ORS. Show the location of master line of the rake surface.

2 Draw the sketch to show the following machining operations and write the generatrix and directrix statements.

(a) parting off operation in a lathe [2]
(b) facing operation in a lathe [2]
(c) taper turning in a CNC lathe or a centre lathe [2]
(d) boring a hole in a lathe using boring tool [2]

(e) drilling in a column drilling machine [2]

3 (a) Draw the top view of a single point turning tool specified as [8]
$10^0 - 10^0\ 8^0\ 10^0\ 15^0\ 75^0\ 0.8$ mm in ORS and also show the relevant angles and features (in ORS) in top and sectional view.

(b) The longitudinal feed rate is 17 mm/min. The pinion responsible for longitudinal [2] feed in a lathe has 18 teeth and 1.5 module. The apron constant is 50. Determine the rotational speed of the feed rod in rpm.

4 (a) The cutting velocity while turning a bar of 200 mm diameter is 100 m/min when the [4] feed rod rotates at 16 rpm. The transimison ratio of the 'Norton Cone –Tumbler drive' and Meander drive are ½ and ½ respectively. Determine the transmission ratio of the change gear quadrant.

(b) Sketch a speed gear box with 18 speeds along with the prime mover and the spindle. [3]
(c) The feed gear box is not connected to speed gear box via the shaft carrying the chuck or [3] the spindle.
It is connected directly to the input shaft of the speed gear box. The spindle speed is 200 rpm and the longitudinal feed is 0.2 mm/rev. Now by changing the gears within the speed gear box the spindle is doubled (i.e made 400 rpm). What would be the new longitudinal feed in mm/rev and mm/min?

5 (a) The no of teeth in the gears of a driver and driven shaft pair are 20, 40, 60 and 80, 60, 40, 4 respectively, i.e., in each case the no of teeth in driver and driven gear is 100. Why is it necessary? Under what circumstances $Z1 + Z2$ for the same shaft pair can vary?

(b) The following is a tool designation. Point out the quantity which is in error. 2
$$\lambda_o - \gamma_o - \alpha_o - \gamma_o' - \varphi 1 - \varphi - r$$
(c) Name two pairs used for transforming a rotation to another rotation 2
(d) Name two pairs used for transforming a rotation to a translatory motion. 2

6 (a) Using a sketch show how a single gear tooth can be machined using a **lathe.** 2
(b) Name any four methods to produce a flat surface 2
(c) Sketch the feed gear drive (starting from the motor) of a lathe that is powered by an 2 independent motor (not the same motor used to power the speed gear box) using a block diagram.
(d) The feed gear drive of a lathe is equipped with change gear quadrant, Norton cone, 4 meander drive, lead screw and apron. The apron constant is 50. The pitch of the lead screw is 4 mm. Find the possible transmission ratios of the above gear box elements so that a thread with a pitch of 2 mm can be machined for a spindle speed of (i) 200 rpm and (ii) 400 rpm.