

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

**Mid-Semester (Spring) Examination, February 2016
Machine Tools and Machining (ME30604)**

Time: 2 hours

Full Marks: 60 minutes

Attempt all questions

Different parts of the same question need to be answered at the same place (i.e. contiguously)
The numbers noted near the right margin indicate marks

- 1 (a) The module and number of teeth on the pinion that is engaged with the rack [3]
(underneath the lathe-bed) are 1.5 and 12. The main spindle speed is 144 rpm.
The transmission ratio between the main spindle and the above mentioned
pinion is $\left(\frac{1}{200}\right)$. Determine the feed in mm/rev.
- 1 (b) The 3ϕ induction motor, with 11 kW power rating attached to a centre lathe, [2]
rotates at 2880 rpm. The transmission ratio between the motor and input of the
speed gear box is $\left(\frac{2}{3}\right)$. The transmission ratio of the speed gear box is $\left(\frac{1}{8}\right)$.
Determine the main spindle speed in rpm.
- 1 (c) An input shaft is directly connected to an output shaft. The input shaft has a [3]
cluster gear (2 gears) with 24 and 36 number of teeth. The output shaft has 2
fixed gears with 40 and z number of teeth. The gear with 40 teeth (on output
shaft) meshes with gear with 24 teeth (on the input shaft). The input shaft is
rotating at 350 rpm. Determine the maximum rotational speed of the output
shaft in rpm.
- 1 (d) A single point right handed turning tool is specified in orthogonal rake system [2]
(ORS) as $0^\circ 7^\circ 10^\circ 10^\circ 15^\circ 90^\circ 0.8$ mm. The feed is 0.24 mm/rev. (i) Calculate the
theoretical peak-to-valley surface roughness in μm **OR**(ii) Calculate the back
rake angle.
- 2 A single point right handed turning tool is specified in ASA system as [10]
 $0^\circ 7^\circ 10^\circ 10^\circ 15^\circ 15^\circ 0$ mm. It is used to machine a taper in CNC turning centre.
The half apex angle of the taper is 15° . The cutting speed and diameter of the
workpiece are 120 m/min and 100 mm. The feed is 0.4 mm/rev along the
direction of taper. Determine the modified side and back rake angle
 $(\gamma_{X,WRS}$ and $\gamma_{Y,WRS})$ due to the effect of feed (i.e. in Work Reference System –
WRS).
- 3 (a) The master line of a single point right handed turning tool is parallel to the [4]
machine transverse plane (π_Y) and cutting plane. The side rake angle (γ_X) is 7° .
Determine maximum rake angle.

- 3 (b) A single point right handed turning tool is specified in orthogonal rake system (ORS) as $0^\circ-7^\circ$ 10° 15° 75° 0.8 mm. Draw the view of the cutting tool on reference plane showing the master line of rake surface. [3]
- 3 (c) For a single point right handed turning tool, can the cutting plane and machine transverse plane (π_y) coincide? If they do, then which condition is to be satisfied? Is it necessary that the inclination angle of the auxiliary cutting edge (λ') would have to be zero (0°) if the above condition is satisfied? [3]
- 4 Identify the generatrix and directrix, and write the generatrix and directrix statements for the following operations: (i): thread cutting in a CNC lathe, (ii) machining of a keyway in a slotting machine, (iii) machining of a spur gear in gear shaper, (iv) making a slot by end milling.
- 5 (a) Derive the correlation between the inclination angle of the auxiliary cutting edge and relevant angles in ORS [5]
- (b) Sketch an 18 speed gearbox employing cluster gears for a centre lathe.
- 6 A job of 100 mm diameter is being turned using a WC insert with a cutting velocity of 50π m/min. The following are the relevant transmission ratios: Change gear quadrant connecting the speed and the feed gear box $\frac{1}{4}$, Norton cone $\frac{1}{2}$, meander drive $\frac{1}{2}$, apron constant 50. The output of the Meander drive is directly connected to the feed rod. The pinion responsible for longitudinal feed has 20 teeth and the rack under the lathe bed has a module of 1.5. Determine the longitudinal feed in mm/rev. Also determine the feed in mm/min and mm/rev if the spindle speed is doubled. [10]