Department of Mechanical Engineering
Indian Institute of Technology Kharagpur

Mid-Semester Examination of Machine Tools and Machining (ME30604)

Number of Students: 210 Full Marks: 60 Duration: 2 hours

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

All symbols have usual interpretations
Attempt all questions

1.	Master line of rake surface of a single point turning tool with no nose radius is parallel to the principal cutting edge and it is also perpendicular to the axis of the work piece. The auxiliary cutting edge angle is 15^0. The side rake is -10^0. (a) Draw the top view of the cutting tool showing the relevant angles. (b) Determine the inclination angle of the principal cutting edge and orthogonal rake. (c) Also determine the back rake. (d) It is stated that the master line for the principal flank of the above cutting tool would not be parallel to its principal cutting edge. Is the statement true or false? Comment with reason.	10
2.	Determine the expression for inclination angle of the auxiliary cutting edge (λ') in terms of relevant angles of (a) ASA and (b) ORS	10
3.	Refer to Fig.1. The main spindle is rotating at 312 rpm. The transmission ratio of the change gear quadrant is $1/3$. The transmission ratio of the feed gear box (i.e. the combined transmission ratio of the Norton Drive and Meander Drive) is $1/16$. The apron constant is 50. Calculate the rotational speed of the feed rod. If the pinion responsible for longitudinal feed is having 16 numbers of teeth and 2 module, calculate the longitudinal feed (in mm/rev) and feed rate (in mm/min). Now, the spindle speed is changed to 624 rpm. Calculate the new longitudinal feed (in mm/rev) and feed rate (in mm/min).	10
4.	Refer to Fig.1. The headstock has 4 shafts. The input shaft receives power from the main motor via the belt-pulley arrangement. This is followed by two intermediate shafts and they are followed by the main spindle. The possible transmission ratios between the input shaft and the 1st intermediate shaft are 1 and $3/4$. Similarly, the possible transmission ratios between the 1st intermediate shaft and the 2nd intermediate shaft are also 1 and $3/4$. The transmission ratio between the 2nd intermediate shaft and main spindle are 1, $3/4$ and $9/16$. If the motor is rotating at 1440 rpm and the diameters of the pulleys mounted on the motor and on the input shaft of the speed gear box are 200 mm and 300 mm respectively, determine the minimum and maximum main spindle speed. Also calculate the maximum cutting velocity that can be	10

	achieved if the diameter of the work piece is 30 mm.	
5.	Draw the schematic of the machining operation and write down the generatrix and directrix statements (a) facing in a centre lathe (b) end milling a groove in a plate (c) gear shaping (d) external thread cutting (e) enlarging a hole with a boring bar in a centre lathe	10
6.	Refer to Fig.1. The main spindle is rotating at 52 rpm. The transmission ratio of the change gear quadrant is $\frac{1}{4}$. The transmission ratio of the feed gear box (i.e. the combined transmission ratio of the Norton Drive and Meander Drive) is $\frac{1}{2}$. The feed rod and the lead screw rotate at the same rotational speed. The lead screw has a pitch of 16 mm. Determine the pitch of the single start thread being machined. What modifications (that can be implemented) do you suggest so that you machine a module thread with module as 1?	10

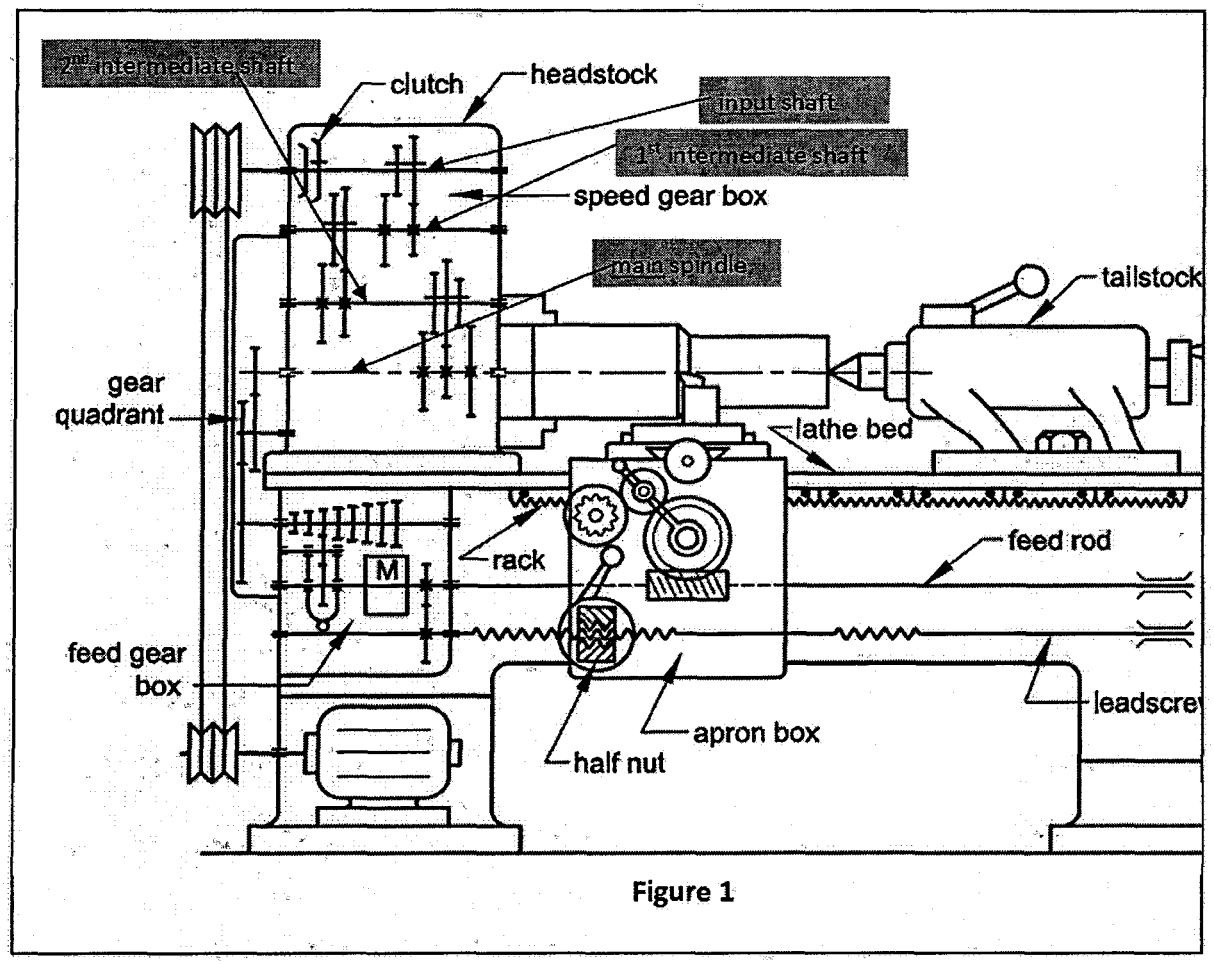

Figure 1