

College of Engineering, Pune
End Semester examination

S. Y. B. Tech (Mech)
ME 205- Theory of Machines I

Maximum Marks: 50
Duration – 3 hrs.

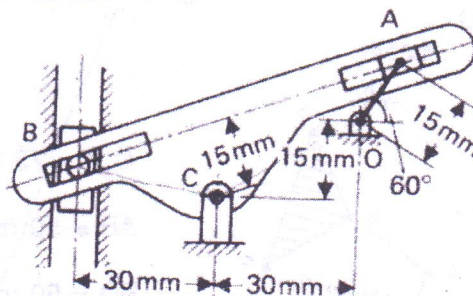
Instructions:

1. All questions are compulsory.
2. Questions are to be answered as per the internal options.
3. Neat sketches are to be drawn wherever necessary.
4. Mobiles and programmable calculators are not allowed.

Q. 1

- | | | Marks |
|----|--|-------|
| A. | Explain with neat sketch the inversions of single slider crank mechanism with applications. | 04 |
| B. | Two mating gear wheels have 18 and 36 teeth of 10mm module and 20° pressure angle. Determine the addendum height for each wheel if it is to be half the maximum possible for true involute action.
If the larger wheel rotates at 450rev/min, find the velocity at the point of contact of the surface of each tooth at the moment when the tip of the tooth on the smaller wheel makes contact, and hence find the velocity of sliding at that instant. | 04 |
| C. | A Hook joint is used to connect two shafts, the axes of which are inclined at 30° . The driving shafts are runs at a uniform speed of 250 rpm and the driven shaft carries a rotor of moment of inertia 1.25kg m^2 .
Find the torque on the driving shaft due the acceleration on the driven shaft at the instant when the acceleration is a maximum. | 02 |

- Q. 2 A. A crank OA, rotates clockwise about O at a constant angular velocity of 600 rev/min as shown in figure causing a slotted lever to rock about the pivot C and the sliding block B to oscillate in the vertical guide. Determine the linear velocity and acceleration of the block B. 07



- B. In an I.C engine mechanism the crank radius is 100mm and connecting rod is 400mm, crank is rotating at 45rad/s. When crank is normal to connecting rod and mass of piston is 2.3kg. find 03
- a) Inertia force on piston
 - b) The thrust in connecting rod
 - c) Torque to act at the crank shaft to overcome piston inertia.

Q.3 A. Show that the sliding velocity in the spiral gears is

$$V_s = \frac{C\omega_1 \sin\theta}{\cos\phi_2 + G\cos\phi_1}$$

where C is center distance and θ is angle between two shafts. Determine the pitch diameters of the wheels and the spiral angles if the distance apart of the shafts is fixed at 125mm, two shafts inclined at 60° to have a 2 to 1 velocity ratio, the shafts is fixed at 125mm, two shafts inclined at 60° to have a 2 to 1 velocity ratio, normal pitch of 12mm. Sliding of the teeth is to be a minimum as far as is practicable. If the pinion rotates at 240rev/min, what is the speed of sliding between the teeth?

B. The crank shaft of a vertical single cylinder engine, stroke 250mm, rotates at 400 rpm. The reciprocating parts including part of connecting rod have a mass of 120 kg. the connecting rod has a mass of 150kg, it is 450 mm long , the center of mass is 300mm from the gudgeon pin axis and the radius of gyration about the same axis is 363mm. when the crank is 40° from TDC position and moving downward find

- The side thrust on cylinder walls due to the inertia of reciprocating parts.
- Torque on the crank shaft.
- The total Kinetic energy of connecting rod

Q.4 A What is the correction couple? When and why it is applied while considering the inertia of the connecting rod of a reciprocating engine. 04

B With neat sketch, explain the working of Wilson-Hartnell governor. OR 04

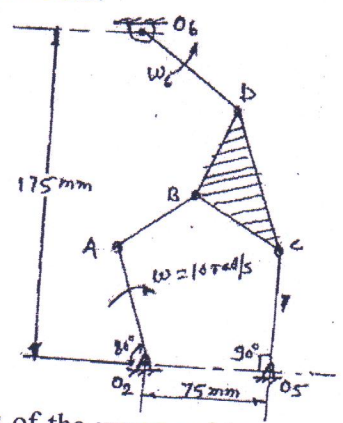
B Explain the following terms related to Governors, 04

- Sensitiveness.
- Hunting

Also discuss its implication on working of Governor.

C Show all force components of the resultant force acting on worm and worm gear in detail with neat diagram 02

Q5 A Determine the angular velocity and angular acceleration of link O_6D and also floating ternary link BCD. 06



- $O_2A = 75 \text{ mm}, O_5C = 65 \text{ mm}$
- $AB = 50 \text{ mm}, BC = 75 \text{ mm}$
- $BD = 50 \text{ mm}, CD = 100 \text{ mm}$
- $O_6D = 50 \text{ mm}.$

B The lengths of the upper and lower arms of a Porter governor are 250mm and 300mm respectively. Both the arms are pivoted at a distance of 25mm from the axis of rotation. The central load is 150 N, the weight of each ball is 20 N, and the friction of the sleeve together with the resistance of the operating gear is equivalent to a force of 30 N at the sleeve. If the limiting inclination of the upper arm to the vertical are 30° and 40° , determine the range of the speed of the governor. 04