

[03 - 2212]

II/IV B.E. DEGREE EXAMINATION.

Second Semester

Mechanical Engineering

THEORY OF MACHINES — I

(Common with Dual Degree Programme in  
Mechanical Engineering and Mechatronics Engineering)

(With effective from the admitted batch of 2006–2007)

Time : Three hours

Maximum : 70 marks

Question No. 1 is compulsory.

Answer any FOUR questions from the remaining.

All questions carry equal marks.

Answer to question No. 1 must be at one place.

Assume suitable data wherever necessary.

1. Answer ALL questions.

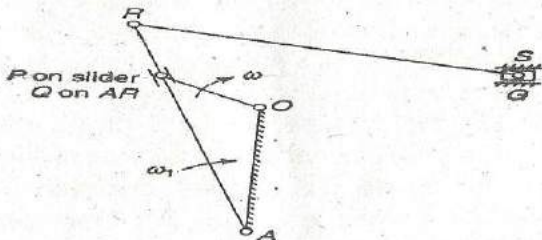
- (a) Distinguish between kinematics and dynamics.
- (b) What is a pantograph?
- (c) What is instantaneous centre of rotation?  
How do you know the number of instantaneous centers in a mechanism?

6. (a) Write short notes on anti friction bearing.  
(b) A multiple disc clutch has 6 active friction surfaces. The power transmitted is 20 kW at 400 rpm. Inner and outer radii of the friction surfaces are 90 and 120 mm respectively. Assuming uniform wear with a coefficient of friction 0.3. Find the maximum axial intensity of pressure between the discs.
7. A certain machine required a torque of  $(1500 + 200 \sin \theta)$  N.m to drive it, where  $\theta$  is the angle of rotation of the shaft. The machine is directly coupled to an engine which produces a torque of  $(1500 + 200 \sin 2\theta)$  N.m. The flywheel and the other rotating parts attached to the engine have a mass of 300 kg at a radius of gyration of 200 mm. If the mean speed is 200 rpm, find  
(a) The fluctuation of energy  
(b) The total percentage fluctuation of speed  
(c) The maximum and the minimum angular acceleration of the flywheel and the corresponding shaft positions.
8. (a) What is the function of a governor? How does it differ from that of a flywheel?  
(b) The controlling force in spring controlled governor is 1500 N when the radius of rotation of the balls is 200 mm and 887.5 N when it is 130 mm. The mass of each ball is 8 kg. If the controlling force curve is a straight line, determine the controlling force and the speed of rotation when the radius of rotation is 150 mm. Also find the increase in the initial tension so that the governor is isochronous. What will be the isochronous speed?
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- (d) What is a Scott-Russell Mechanism?
  - (e) Write a short note on anti-friction bearings.
  - (f) What is meant by effort and power of a governor?
  - (g) Why is balancing necessary for rotors of high speed engines?
2. (a) Explain the inversions of double slider crank chain. Give examples.
- (b) In a crank slotted lever quick return mechanism, the distance between the fixed centers is 15 cm and the driven crank is 10 cm long. Find the ratio of the time taken during the cutting and return stroke.
3. (a) State and explain angular velocity ratio theorem as applicable to mechanism.
- (b) In a four-link mechanism, the crank AB rotates at 36 rad/s. The lengths of the links are: AB = 200 mm, BC = 400 mm, CD = 450 mm and AD = 600 mm. AD is the fixed link. At the instant when AB is at right angle to AD, determine the velocity of
- (i) The mid-point of link BC,
  - (ii) A point on link CD, 100 mm from the pin-connecting the links CD and AD.

4. In a crank and slotted-liver quick-return mechanism, the distance between the fixed centers  $O$  and  $A$  is 250 mm. Other lengths are  $OP = 100$  mm,  $AR = 400$  mm,  $RS = 150$  mm and  $\angle AOP = 120^\circ$ . Uniform speed of the crank is 60 rpm clockwise.

Line of stroke of the ram is perpendicular to  $OA$  and is 450 mm from  $A$ . Calculate the velocity and the acceleration of the ram  $S$ .



5. (a) What do you mean by film friction? State its laws.
- (b) A screw jack is used to raise a load of 5 tonnes (1 tonne = 9,81 kN). The pitch of single start square threads used for the screw is 24 mm. The mean diameter is 72 mm. Determine the force to be applied at the end of 1.2 m long handle when the load is lifted with constant velocity and rotate with the spindle. Take  $\mu = 0.2$ . Also find the mechanical efficiency of the jack.