Roll No. Total No. of Pages : 02

Total No. of Questions : 09

B.Tech. (ANE)/(Aerospace Engg.) (2012 Onwards)/(ANE) (Sem.–4)

# THEORY OF MACHINES – I

Subject Code : ME-203

Paper ID : [A1033]

Time : 3 Hrs. Max. Marks : 60

**INSTRUCTIONS TO CANDIDATES :**

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

## SECTION–A

**Q1. Answer briefly :**

a) What is the material used for belts and ropes?

b) Explain crowning of pulleys.

c) What is a roller follower?

d) Which energy is absorbed by the brakes of an elevator during braking process?

e) What is hunting of a governor?

f) Difference between a clutch and a coupling.

g) What is fluctuation of speed and coefficient of steadiness in flywheel?

h) How many links are required to form a constrained kinematic chain?

i) What is sticking-failure of a governor?

j) What is meant by kinematic pair and kinematic chain?

## SECTION-B

Q2. The power is transmitted from a pulley 1 m diameter running at 200 *r.p.m.* to a pulley 2.25 m diameter by means of a belt. Find the speed lost by the driven pulley as a result of creep, if the stress on the tight and slack side of the belt is 1.4 MPa and 0.5 MPa, respectively. The Young's modulus for the material of the belt is 100 MPa.

Q3. Derive expressions for displacement, velocity and acceleration for a tangent cam operating on a radial-translating roller follower when the contact is on straight flank.

Q4. A vehicle moving on a rough plane inclined at 10° with the horizontal at a speed of 36 km/h has a wheel base 1.8 metres. The centre of gravity of the vehicle is 0.8 metre from the rear wheels and 0.9 metre above the inclined plane. Find the distance travelled by the vehicle before coming to rest and the time taken to do so when :

a) The vehicle moves up the plane, and

b) The vehicle moves down the plane.

The brakes are applied to all the four wheels and the coefficient of friction is 0.5.

Q5. Sketch a pantograph, explain its working and show that it can be used to reproduce to an enlarged scale a given figure.

Q6. Sketch and explain any two inversions of a double slider crank chain.



## SECTION-C

Q7. A multi-cylinder engine is to run at a speed of 600 *r.p.m.* On drawing the turning moment diagram to a scale of 1 mm = 250 N-m and 1 mm = 3°, the areas above and below the mean torque line in $mm^2$ are : + 160, –172, + 168, – 191, + 197, – 162. The speed is to be kept within ± 1% of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. Determine the suitable dimensions of a rectangular flywheel rim if the breadth is twice its thickness. The density of the cast iron is 7250 $kg/m^3$ and its hoop stress is 6 MPa. Assume that the rim contributes 92% of the flywheel effect.

Q8. The arms of a Porter governor are 300 mm long. The upper arms are pivoted on the axis of rotation. The lower arms are attached to a sleeve at a distance of 40 mm from the axis of rotation. The mass of the load on the sleeve is 70 kg and the mass of each ball is 10 kg. Determine the equilibrium speed when the radius of rotation of the balls is 200 mm. If the friction is equivalent to a load of 20 N at the sleeve, what will be the range of speed for this position?

Q9. Write notes on :

a) Sensitivity of governor.

b) Aronhold Kennedy's theorem.

c) Grubler's criterion for plane mechanisms.