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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

B. Tech III Year I Semester Examinations, November/December-2013

DYNAMICS OF MACHINERY  
(Common to AME, ME, MCT, MIM)

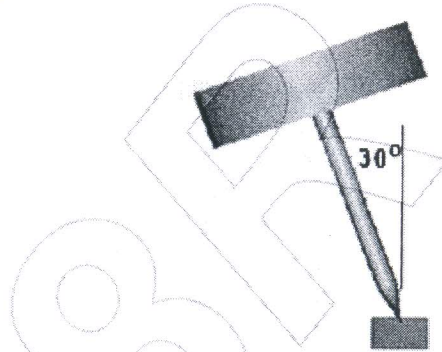
Time: 3 hours

Max. Marks: 75

Answer any five questions  
All questions carry equal marks

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- 1.a) How do the effects of gyroscopic couple and of centrifugal force make the rider of a two wheeler tilt on one side? Derive a relation for the limiting speed of the vehicle.
- b) A top consists of a spinning disc of radius 40 mm and mass 0.5 kg mounted at the end of a light rod as shown in figure. The distance from the tip to the centre of gravity is 100 mm. calculate the velocity of the precession when it spins at 30 rev/min. [7+8]



2. The dimensions of a four-link mechanism are:  $AB = 400$  mm,  $BC = 600$  mm,  $CD = 500$  mm,  $AD = 900$  mm, and  $\angle DAB = 60^\circ$ .  $AD$  is the fixed link.  $E$  is a point on the link  $BC$  such that  $BE = 400$  mm and  $CE = 300$  mm ( $BEC$  clockwise). A force of  $150 \angle 45^\circ$  N acts on  $DC$  at a distance of 250 mm from  $D$ . Another force of magnitude  $100 \angle 180^\circ$  N acts at point  $E$ . Find the required input torque on the link  $AB$  for static equilibrium of the mechanism. [15]
- 3.a) Derive Freudenstein's equation for a four-bar linkage. How this equation can be used to design a four bar mechanism?
- b) What are the limitations of the three position synthesis? [7+8]
- 4.a) Explain Self-locking and self-energizing brakes.
- b) A conical clutch has an inclined angle of  $120$ . The outer and inner diameters are 80 mm and 20 mm respectively. Calculate the force required to press the two halves together if it is to transmit 200 W at 600 rev/min. The coefficient of friction is 0.3. Use both the uniform wear theory and the uniform pressure theory. [5+10]

- 5.a) A single cylinder 4-stroke engine shall require larger flywheel as compared to the multi-cylinder engine.
- b) A single cylinder four-stroke petrol engine develops 18.4 kW power at a mean speed of 300 rpm. The work done during suction and exhaust strokes can be neglected. The work done by the gases during explosion strokes is three times the work done on the gases during the compression strokes and they can be represented by the triangles. Determine the mass of the flywheel to prevent a fluctuation of speed greater than 2 per cent from the mean speed. The flywheel diameter may be taken as 1.5 m. [3+12]
- 6.a) For Hartung governor, derive the expression for the isochronous speed and the condition for isochronous.
- b) A simple Watt governor in which the arms intersect on the axis is running at 100 rpm. Find the percentage variation of its height if the speed changes  $\pm 5\%$ . [7+8]
7. A shaft carries three pulleys A, B and C at distance apart of 600 mm and 1200 mm. The pulleys are out of balance to the extent of 25, 20 and 30 N at a radius of 25 mm. The angular position of out of balance masses in pulleys B and C with respect to that in pulley A are  $90^\circ$  and  $210^\circ$  respectively. It is required that the pulleys be completely balanced by providing balancing masses revolving about axis of the shaft at radius of 125 mm. The two masses are to be placed in two transverse planes midway between the pulleys. [15]
- 8.a) A steel wire 2 mm diameter is held between chucks 1 m apart. The wire weighs 0.24 N/m. The flexural stiffness is  $0.157 \text{ Nm}^2$ . Calculate the first two critical speeds.
- b) A vibrating system is analysed and it is found that two successive oscillations have amplitudes of 3 mm and 0.5 mm respectively. Calculate the amplitude reduction factor and the damping ratio. [7+8]

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