Code No: 155BA

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, February - 2022
DYNAMICS OF MACHINERY
(Common to ME, MCT)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
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1. A rear engine automobile is travelling along a curved of 120 m radius. Each of the four wheels has a moment of inertia of 2.2 kg/m ^{2} and an effective diameter of 600 mm. The rotating parts of the engine have a moment of inertia of 1.25 kg.m ^{2}. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The mass of the vehicle is 2050 kg and the centre of mass is 520 mm above the road level. The width of the track is 1.6 m. what will be the limiting speed of the vehicle if all the four wheels maintain contact with the road surface? [15]

2. The dimensions of a four link mechanism are AB= 500 mm, BC= 660 mm, CD= 560 mm and AD= 1000 mm. the link AB has a angular velocity of 10.5 rad/s counter clockwise and an angular retardation of 26 rad/s ^{2} at the instant when it makes an angle of 60 ^{0} with AD, the fixed link. the mass of the links BC and CD is 4.2 kg/m length. The link AB has a mass 3.54 kg, the centre of which lies at 200 mm from A and a moment of inertial of 88500 kg.mm^2. Neglecting gravity and friction effects, determine the instantaneous value of the drive torque required to be applied on A to overcome the inertial force. [15]

3. A three cylinder single acting engine has its cranks set equally at 120 ^{0} and it runs at 600 r. p. m. The torque-crank angle diagram for each cycle is a triangle for the power stroke with a maximum torque of 90 N-m at 60^0 from dead center of corresponding crank. The torque on the return stroke is sensibly zero. Determine
a) Power developed
b) Coefficient of fluctuation of speed, if the mass of the flywheel is 12 kg and has a radius of gyration of 80 mm,
c) Coefficient of fluctuation of energy, and
d) Maximum angular acceleration of the flywheel. [15]

4. A punching press pierces 35 holes per minute in a plate using 10 kN-m of energy per hole during each revolution. Each piercing takes 40 percent of the time needed to make one revolution. A cast iron flywheel used with the punching machine is driven by a constant torque electric motor. The flywheel rotates at a mean speed of 210 rpm. And the fluctuation of speed is not to exceed ± 1% of the mean speed. Find:
a) Power of the electric motor,
b) Mass of the flywheel, and
c) Cross-sectional dimensions of the rim when the width is twice its thickness.
Take hoop stress for cast iron = 4 MPa and density of cast iron = 7200 kg/m^3. [15]

5. Explain the working principle of cone clutch with the help of neat sketch. [15]

6. Differential band brake acting on the 3/4 th of the circumference of a drum of 450 mm diameter, is to provide a braking torque of 225 N-m. One end of the band is attached to a pin 100 mm from the fulcrum of the lever and the other end to another pin 25 mm from the fulcrum on the other side of it where the operating force is also acting. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the two values of the operating force corresponding to two directions of rotation of the drum. [15]

7. A Proell governor has all four arms of length 305 mm. The upper arms are pivoted on the axis of rotation and the lower arms are attached to a sleeve at a distance of 38 mm from the axis. The mass of each ball is 4.8 kg and are attached to the extension of the lower arms which are 102 mm long. The mass on the sleeve is 45 kg. The minimum and maximum radii of governor are 165 mm and 216 mm. Assuming that the extensions of the lower arms are parallel to the governor axis at the minimum radius, find the corresponding equilibrium speeds. [15]

8.a) Derive the expression for frequency of torsional vibration of a general system.

b) Calculate the whirling speed of a shaft 20 mm diameter and 0.6 m long carrying a mass of 1 kg at its mid-point. The density of the shaft material is 40 Mg/m^3 and Young's modulus is 200 GN/m^2. Assume the shaft to be freely supported. [7+8]

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