7. The reciprocating masses of the three cylinder engine are 4.1, 6.2 and 7.4 tons respectively. The centre lines of the three cylinders are 5.2m, 3.2m and 1.2 m from the fourth cylinder. If the cranks for all the cylinders are equal, determine the reciprocating mass of the fourth cylinder and the angular position of the cranks such that the system is completely balanced for the primary force and couple .If the cranks are 0.8 m long, the connecting rods 3 m and the speed of engine 75 rpm, find the maximum unbalanced secondary force and the crank angle at which it occurs. [15]

8. (a) What is meant by equivalent spring stiffness? How is it determined?
(b) The flywheel of an engine driving a dynamo has a mass of 180 kg and a radius of gyration of 30 mm. The shaft at the flywheel end has an effective length of 2 mm and 50 mm diameter. The armature mass is 120 kg and its radius of gyration 22 mm. The dynamo shaft is 43 mm diameter and 200 mm effective length. Calculate the position of the node and the frequency of torsional oscillation. G = 83 kN/mm^2. [5+10]

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Code No: R31033 **R10** **Set No: 3**

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

DYNAMICS OF MACHINERY

(Common to Mechanical Engineering and Automobile Engineering)

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 track of 100m mean radius. Each of the four road wheels have a moment of inertia 2 kg-m² and effective diameter of 60 cm. Engine rotating parts have a moment of inertia 1 kg-m². The engine axis is parallel to the rear axle and the crank shaft rotates in the same sense as the road wheels. The gear ratio engine to back axle is 3:1. The vehicle weighs 15000 N and has centre of gravity 50 cm above the road level. The width of the track of the vehicle is 1.5m. Determine the limiting speed of vehicle around the curve for all four wheels to maintain contact with the road surface if this is not cambered. [15]

2. (a). Derive the expression for the friction torque in conical pivot bearing considering uniform pressure.
   (b). A conical pivot bearing supports a vertical shaft of 200mm diameter. It is subjected to a load of 30kN. The angle of the cone is 120^0 and the coefficient of friction is 0.025. Find the power lost in friction when the speed is 120 rpm, assuming uniform pressure and uniform wear conditions. [7+8]

3. (a). Derive the expression for the torque transmitting capacity of a single plate clutch by considering uniform wear
   (b). A cone clutch with a cone semi –angle 14°is to transmit 12 kW at 750 rpm. The width of the face is $1/4^{th}$ of the mean diameter and the normal pressure between the contact faces is not to exceed 0.85 bar. Taking coefficient of friction between contact surfaces as 0.2, determine the mean dimensions of the clutch and the axial force. [5+10]

4. (a). Write a short notes on piston effort. [5+10]
   (b). The turning moment diagram for a petrol engine is drawn to vertical scale of 1mm to 6N-m and a horizontal scale of 1mm to 1^0. The turning moment repeats itself after every half revolution of the engine. The areas above and below the mean torque line are 305, 710, 50, 350, 980 and 275 mm^2. The rotating parts amount to a mass of 40kg at a radius of gyration of 140mm. Calculate the coefficient of fluctuation of speed of engine is 1500 rpm.

5. In a porter governor, the links and arms are each 30 cm long. Each ball weighs 2.5 kg and the central load is 25 kg. For the lowest and highest of the sleeve the arms are inclined 30° and 40° respectively to the vertical. The friction at the governor and the mechanism connecting it to the value is equivalent to a force of 2.5 kg at the sleeve. Assuming the links and arms intersect on the axis, Find,
   (i) The travel of the sleeve (ii) The minimum ascending speed
   (iii) The maximum descending speed (iv) Range of speed of the governor. [15]

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6. A shaft carries four masses A, B, C and D of 12,20,30 and 16 kg respectively spaced 18cms apart .Measuring angle anti-clockwise from A,B is 240°, C is 135° and D is 270°.The radii are 15 cm , 12 cm, 6cm and 18 cm and the speed of the shaft is 120 rpm. Find the magnitude and direction relative to A of the resultant at a plane midway between A and B. [15]

7. A two cylinder uncoupled locomotive has inside cylinders 0.6 m apart. The radius of each crank is 300mm and are at right angles .The revolving mass per cylinder is 250 kg and the reciprocating mass per cylinder is 300 kg .The whole of the revolving and two – third of the reciprocating masses are to be balanced and the balanced masses are placed in the planes of rotation of the driving wheels, at a radius of 0.8 m. The driving wheels are 2 m in diameter and 1.5 m apart. If speed of the engine is 80 kmph; find hammer blow, maximum variation in tractive effort and maximum swaying couple. [15]

8. (a) Discuss the expression for a natural frequency of free transverse vibrations for a simply supported shaft carrying a uniformly distributed mass of m kg per unit length.
(b) A mass hanging from a spring is observed to make one complete oscillation in 0.8 sec and the amplitude of the fifth oscillation is half that of first. If the top of the spring be compelled to make vertical oscillation of period 4 sec and amplitude 29 mm, find the amplitude of the motion of the mass. Damping is assumed proportional to the velocity. [5+10]

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Code No: R31033 **R10** **Set No: 4**

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

DYNAMICS OF MACHINERY

(Common to Mechanical Engineering and Automobile Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. A four wheel trolley car of total mass 2000 kg running on rails of 1 m guage, rounds a curve of 25 m radius at 40 km/hr. The track is banked at 10°. The wheels have an external diameter of 0.6 m. and each pair of an axle has a mass of 200kg. The radius of gyration for each pair is 250 mm. the height C.G of the car above the wheel base 0.95 m. allowing for centrifugal force and gyroscopic couple action; determine the pressure in each rail. [15]

2. (a). Explain the difference between the coefficient of friction and angle of friction
   (b). A Shaft has a number of collars integral with it. The external diameter of the collars is 400mm and the shaft diameter is 250mm. If the intensity of pressure is 0.35N/mm^2 (uniform) and the coefficient of friction is 0.05, estimate,
   (i). Power absorbed when the shaft runs at 105 rpm carrying a load of 150kN
   (ii). Number of collars required. [7+8]

3. (a). With the help of neat sketch, explain the working of a block or shoe brake
   (b). In a single block brake, the drum diameter is 300mm, the angle of contact is 90^0, and the coefficient of friction between the lining and the drum is 0.30. If the operating force is 400N, applied at the end of a lever 400mm long, determine the torque transmitted by the brake. The distance of the fulcrum from the center of the brake drum is 200mm and assumes that the force of friction passes through the fulcrum. [7+8]

4. A high speed has connecting rod length 5 times the crank which is 6cm. It weighs 30 N has a center of gravity 10 cm from the big end bearing .When suspended in bearing it makes 50 complete oscillations in 52 seconds. The reciprocating parts weigh 15N.Determine the torque exerted on the crank shaft due to the inertia of the moving parts when the crank makes an angle of 135 degrees with the top dead center when the speed of rotation is 1200 r.p.m. [15]

5. In a porter governor, the links and arms are each 30 cm long. Each ball weighs 2.5 kg and the central load is 25 kg. For the lowest and highest of the sleeve the arms are inclined 30° and 40° respectively to the vertical. The friction at the governor and the mechanism connecting it to the value is equivalent to a force of 2.5 kg at the sleeve. Assuming the links and arms intersect on the axis, Find,
   (i) The travel of the sleeve (ii) The minimum ascending speed
   (iii) The maximum descending speed (iv) Range of speed of the governor. [15]

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6. A shaft 3 m span between the bearings carries two masses of 5 kg and 10 kg acting at the extremities of the arms 0.45m and 0.6m long respectively. the planes in which the masses rotate are 1.2 m and 2.4 m respectively from the left hand bearing and the angle between the arms is 60°.If the speed of rotation is 100r.p.m. Find the displacing force on the two bearings of the machine .If the masses are balanced by two additional rotation masses acting at a radius 0.3 and placed 0.3 from each bearing, estimate the magnitude of the two balanced masses and the angles at which they may be set with respect to the two arms. [15]

7. Two locomotives are built with similar sets of reciprocating parts. One is an inside cylinder engine with two cylinders with central lines at 0.5 m apart. The distance between the driving wheel centres is 1.5 m in both the cases. The inside cylinder locomotive runs at 0.75 times the speed of the outside cylinder locomotive and the hammer blow of the inside cylinder locomotive is 1.3 times hammer blow of outside cylinder locomotive. If the diameter of the driving wheel of the outside cylinder locomotive is 2m, calculate the diameter of the driving wheel of the inside cylinder locomotive compare also the variation of the swaying couples of the two engines assuming that the same fraction of the reciprocating masses are balanced in both the cases and that the cylinders are at the same distance from wheels in the outer cylinder locomotive. [15]

8. A cast iron flywheel used for a four stroke I.O engine is developing 180 kW at 240 r.p.m. The hoop stress developed in the flywheel is 5 MPa. The total fluctuation of speed is to be limited to 3% of the mean speed. If the work done during the power stroke is 1/3 times more than the average work done during the whole cycle. Find, (i) The mean diameter of the flywheel (ii) Mass of the flywheel and (iii) Cross-sectional dimensions of the rim when the width is twice the thickness. The density of cast iron may be taken as 7300 kg /m^3. [15]

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