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B. E. (Fifth Semester) Examination, April-May/Nov.-Dec. 2020

(New Scheme)

(Mechanical Engg. Branch)

DYNAMICS of MACHINES

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *Part (a) is compulsory and any two parts from (b), (c) and (d) from each question.*

Unit-I

1. (a) Differentiate between governor and fly wheel. 2

(b) Define following terms :

(i) Hunting

(ii) Isochronism

(iii) Sensitiveness

(iv) Stability 7

(c) Each arm of a porter governor is 250 mm long and is pivoted on the axis of rotation. The mass of each ball is 5 kg and of the sleeve 25 kg. The radius of rotation of the ball is 150 mm when the sleeve is at lowest position and is 200 mm when the sleeve is at highest position. Determine the range of speech lift of the sleeve, governor effort and power. If friction at the sleeve is equivalent to 10 Newton. 7

(d) The mass of each ball of a Hartnell type governor is 1·4 kg. The length of ball arm of the bell crank liver is 100 mm whereas the length of arm towards sleeve is 50 mm. The distance of the fulcrum of bell crank lever from the axis of rotation is 80 mm. The extreme radii of rotation of the balls are 75 mm and 112·5 mm. The max equilibrium speed is 6% greater than the minimum equilibrium speed which is 300 r.p.m.

Determine :

(i) stiffness of the spring

(ii) equilibrium speed when radius of rotation of the ball is 90 mm.

Neglect the obliquity of arms. 7

Unit-II

2. (a) State condition for dynamic balance of several masses rotating in different planes. 2

(b) *A*, *B*, *C*, *D* are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and two mass of *B*, *C*, and *D* are 10 kg, 5 kg and 4 kg respectively. Find the required mass *A* and the relative angular sittings of the four masses so that the shaft shall be in complete balance. 7

(c) The reciprocating mass per cylinder is a 60° V-twin engine is 1·5 kg. The stroke and connecting rod length are 100 mm and 250 mm respectively. If the engine runs at 2500 r.p.m. Determine the maximum and minimum values of the primary force. Also find out the resultant secondary force. 7

(d) The crank and connecting rods of a 4-cylinder in-line engine running at 1800 rpm are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end. The cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1·5 kg.

Determine :

(i) unbalanced primary and secondary forces. If any

(ii) unbalanced primary and secondary couples with reference to central plane of the engine. 7

Unit-III

3. (a) Define a "gyroscope". 2

(b) What do you understand by gyroscopec couple? Derive a formula for its magnitude. 7

(c) The turbine rotor of a ship weight 5000 kg. has a radius of gyration of 50 cm and it supports on bearings 200 cm apart. It revolves at 750 rpm in

clockwise. Sense looking from the stern and propels the ship at 140 m/sec. along a curved path of radius 300 m towards. The starbound side.

Determine :

(i) The magnitude of gyroscopic reaction and its effect on sea vessel.

(ii) The reaction of the bearings. 7

(d) A racing car weight 20 kN. If has a wheel base of 2 m truck width 1 m and height of C. G. 300 mm above the ground level and lies midway between the front and rear axle. The engine flywheel rotates at 3000 r.p.m. clockwise when viewed from the front. The moment of Inertia of the flywheel is 4 kg-m^2 and moment of Inertia of each wheel is 3 kg-m^2. Find the reactions between the wheels and the ground when the car takes a curve of 15 m radius towards right at 30 km/h, taking into consideration the gyroscopic and the centrifugal effects. Each wheel radius is 400 mm. 7

Unit-IV

4. (a) Define critical speed of a shaft. 2

(b) In a single degree damped vibrating system, a suspended mass of 8 kg makes 30 oscillations in 18 seconds. The amplitude decreases to 0·25 of the initial value after 5 oscillations. Determine :

(i) The stiffness of the spring

(ii) The logarithmic decrement

(iii) The damping factor

(iv) The damping coefficient 7

(c) Describe Dunwerley's method to find the natural frequency of a shaft carrying sevels loads. 7

(d) A reciprocating IC Engine is coupled to a centrifugal pump through a pair of gears. The shaf from flywheel of Engine to the gear wheel has 48 mm diameter and 800 mm long. The shaft from pinion to pump has 32 mm diameter and in 280 mm long. The pump speed in 4 times to engine speed, moment of Inertia of flywheel, gear wheel, pinion and pump impeller are 1000 kg m^2, 14 kg m^2, 5 kg m^2 and 18 kg m^2. Find the natural frequency of torsional vibration of system $G = 80\ GN/m^2$. 7

Unit-V

5. (a) What is coefficient of fluctuation of speed of a fly wheels? 2

(b) The connecting rod of a gasoline engine is 300 mm long between its centres. It has a mass of 15 kg and mass moment of Inertia of 7000 kg-mm^2. If centre of gravity is at 200 mm from its small end centre, determine the dynamical equivalent two mass system of the connecting rod if one of the masses is located at the small end centre. 7

(c) Find a relation for the coefficient of fluctuation of speed in terms of Maximum fluctuation of energy and the kinetic energy of flywheel at mean speed. 7

(d) A punching press in driven by a constant torque electric motor. The press is provided with a flywheel. That rotates at maximum speed of 225 rpm. The radius of gyration of the flywheel is 0·5 m. The press punches 720 holes per hour ; each punching operation takes 2 sec. and requires 15 kN-m of energy. Find the power of the motor and the minimum mass of the flywheel it speed of the same is not to fall below 200 rpm. 7