BTS(C) – VI – (S) – 09 – 045 – H

B. Tech Degree VI Semester (Supplementary) Examination October 2009

ME 601 DYNAMICS OF MACHINERY

(2002 Scheme)

Time : 3 Hours Maximum Marks : 100

I. (a) State and explain 'D' Alembert's Principle applied for the dynamic force analysis of links mechanism. (5)

(b) The mechanism as shown in the figure has the dimensions of various links as follows :

AB = DE = 150mm

BC = CD = 450 mm, EF = 375 mm.

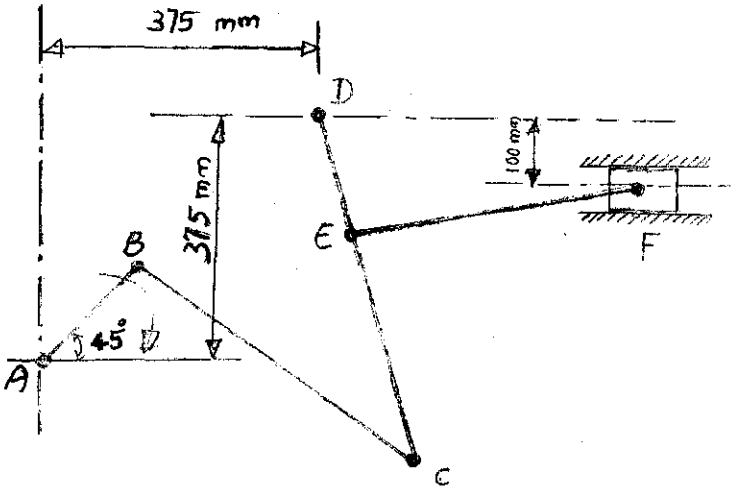
The crank AB makes an angle of 45^0 with the horizontal and rotates about A, in the clockwise direction at a uniform speed of 120 r.p.m. The lever DC oscillates about the fixed point D, which is connected to AB by the coupler BC. The block F moves in the horizontal guides being driven by the link EF.

Determine

(i) Velocity of the block F

(ii) Angular velocity of DC

(iii) Rubbing speed at the pin C which is 50 mm in diameter. (15)



OR

II. (a) What do you mean by dynamically equivalent system? Explain. (5)

(b) A horizontal gas engine running at 210 rpm has a bore of 220 mm and a stroke of 440 mm.The connecting rod is 924 mm long and the reciprocating part weigh 20 kg. When the crank is turned through an angle of 30^0 from the inner dead center, the gas pressure on the cover and the crank sides are 500 KN/m^2 and 60 KN/m^2 respectively. Diameter of the piston rod is 40 mm.

Determine

(i) Turning moment on the crank shaft.

(ii) Thrust on the bearings.

(iii) Acceleration of the flywheel which has a mass of 8 Kg and radius of gyration of 600 mm while the power of the engine is 22 KW. (15)

III. (a) Derive on expression for the energy stored in a fly wheel. (5)

(b) The intercepted areas between the output torque curve and the mean resistance line of a turning moment diagram for a multicylinder engine, taken in order from one end are as follows :

- 0.35 , + 4.10, - 2.85, + 3.25, - 3.35, + 2.6, -3.65, + 2.85, - 2.60 sq.cm.

The diagram has been drawn to a scale of 1 cm = 700 N-m and 1 cm = 45°. The engine speed is 900 r.p.m and the fluctuation in speed is not to exceed 2% of the mean speed. Find a suitable diameter and cross section of the fly wheel rim if the safe centrifugal stress is limited to 7 x 10^6 N/m^2 . The density of the material of the flywheel may be taken as 7200 Kg/m^3. The rim is rectangular with the width 2 times the thickness. Neglect effect of arms etc. (15)

OR

(Turn Over)

IV. (a) Discuss the effect of Gyroscopic couple on aeroplane. (5)

(b) A racing car of mass 2500 Kg has a wheel base of 2m and track width of 105 cm. The center of gravity lies mid-way between the front and the rear axles and is 0.4m above the ground. The engine rotating parts are equivalent of a flywheel of M.I. of 50 Kg-m^2 rotating at 6000 r.p.m in clock-wise direction when viewed from front. If the car speeding at 50 Km/hr. rounds a curve of 15 metre radius, determine the reaction between the wheels and the ground. Consider the gyroscopic effects of the flywheel, the dead weight of the car and the centrifugal effects. Neglect the effect due to rotating wheels. (15)

V. (a) Explain the balancing of reciprocating mass. (5)

(b) A rotating shaft carries four unbalanced masses 18 Kg, 14 Kg, 16 Kg and 12 Kg at radii 5 cm, 6cm, 7 cm and 6cm respectively. The 2^{nd}, 3^{rd} and 4^{th} masses revolve in planes 8cm, 16 cm and 28 cm respectively measured from the plane of the first mass and are angularly located at 60°, 135° and 270° respectively measured anticlockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 5cm radii and revolving in planes mid way between those of Ist and 2^{nd} masses and midway between those of 3^{rd} and 4^{th} masses. Determine graphically or otherwise, the magnitude of the masses and their respective angular positions. (15)

OR

VI. (a) Explain Hammer Blow. (5)

(b) In a 4 – cylinder in line reciprocating engine, the masses of the reciprocating parts per cylinder are 1 kg. The stroke is 12cm. The length of the connecting rod is 22 cm. The cylinders are spaced at 12 cm pitch. If the cylinders are numbered from 1 to 4 from one end then in the end view, the cranks appear to successive intervals of 90 in the order 1,4,2,3. Find with reference to the central plane of the engine, the maximum value of any primary and secondary out of balance effects when the engine is running at 2000 r.p.m. (15)

VII. (a) Briefly explain the methods of Vibration Analysis. (5)

(b) A mass of 200 Kg is suspended on a spring having a scale of 30000N/m and is acted upon by a harmonic force of 80 N at the undamped natural frequency. The damping may be considered to be viscous with a coefficient of 200 N.Sec/m.
Calculate

(i) the undamped natural frequency
(ii) the amplitude of vibration of the mass
(iii) the phase difference between the force and the displacement. (15)

OR

VIII. (a) Explain the working of an accelerometer. (5)

(b) The flywheel of a engine dynamo weights 150 N and has a radius of gyration of 25 cm. The shaft at the flywheel end has an effective length of 22cm and is 4.5cm in diameter. The armature weights 90 N and has a radius of gyration of 20 cm. The dynamo shaft has a diameter of 4cm and an effective length of 18 cm. Neglecting the inertia of the shaft and the coupling calculate the frequency of torsional vibrations and position of the node. (15)

IX. A steel shaft ABCD, 1.5m long has fly wheel at its ends A and D. The mass of the fly wheel A is 600 Kg and has a radius of gyration of 0.6m. The mass of the fly wheel D is 800 Kg and has a radius of gyration of 0.9 m. The connecting shaft has a diameter of 50 mm for the portion AB which is 0.4m long; and has a diameter of 60 mm for the portion BC which is 0.5 m long and has a diameter d mm for the portion CD which is 0.6m long.
Determine :

(i) The diameter 'd' of the portion CD, so that the mode of the torsional vibration of the system will be at the center of the length BC
(ii) The natural frequency of the torsional vibrations

The modulus of rigidity for the shaft material is 80 GN/m^2 (20)

OR

X. (a) Derive an expression for the natural frequency of the free longitudinal vibration by Rayleigh's method. (5)

(b) A shaft 40 mm diameter and 2.5m long has a mass of 15 Kg per meter length. It is simply supported at the ends and carries 3 masses 90 Kg, 140 Kg and 60 Kg at 0.8 m, 1.5m and 2 m respectively from the left support. Taking E = 200 GN/m^2, find the frequency of the transverse vibrations. (15)

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