B. Tech Degree VI Semester Examination, April 2008

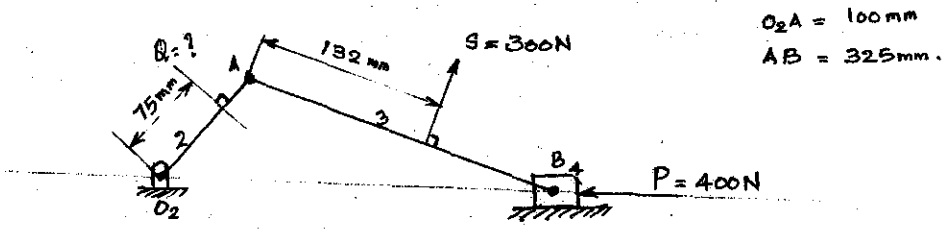
ME 601 DYNAMICS OF MACHINERY

(1999 Scheme)

Time : 3 Hours Maximum Marks : 100

I. (a) State and explain the principle of Virtual Work. (6)

(b) Known forces P and S are applied to links 4 and 3 respectively. What is the magnitude of force Q applied to link 2 for equilibrium? What are the pin forces? (Neglect sliding and pin function) (14)



OR

II. (a) With the help of an example, explain the need for carrying the static and dynamic force analysis after bringing out the difference between the two analysis. (6)

(b) The connecting rod of a vertical reciprocating engine is 2m long between centers and weighs 250 Kg. The mass centre is 800mm from big and bearing. When suspended as a pendulum from the gudgeon pin axis, it makes 8 complete oscillations in 22 seconds. Calculate the radius of gyration of the rod about an axis through its mass centre. The crank is 400mm long and rotates at 200rpm. Find the inertia torque exerted on the crank shaft when the crank has turned through 40^0 from TDC and the piston is moving downwards. (14)

III. (a) State and explain dynamically equivalent system. (6)

(b) A machine is coupled to a two stroke engine which produces a torque of $(800 + 180 \sin 3\theta)$ Nm. Where 'θ' is the crank angle. The mean engine speed is 400rpm. The flywheel and other rotating parts attached to the engine have a mass of 350Kg at a radius of gyration of 220 mm. Calculate

(i) power of the engine

(ii) fluctuation of speed of flywheel when resisting torque is $(800 + 80 \sin\theta)$ Nm. (14)

OR

IV. (a) Discuss the gyroscopic effects on sea vessels. (6)

(b) Each wheel of a motor cycle is of 600mm diameter and has a moment of inertia of $1.2 Kgm^2$. The total mass of the motor cycle and the rider is 180Kg and the combined centre of mass is 580mm above the ground level when the motor cycle is upright. The movement of inertia of the rotating parts of the engine is $0.2 Kgm^2$. The engine speed is 5 times the speed of the wheels and is in the same sense. Determine the angle of heel necessary when the motor cycle takes a turn of 35m radius at a speed of 54 Km/hr. (14)

V. (a) Discuss the effects of partial balancing in locomotives. (6)

(b) Four masses A,B,C and D are completely balanced. Masses C and D make angles of 90^0 and 195^0 respectively with that of mass B in the counter clockwise direction. The rotating masses have the following properties.

$$m_B = 25Kg,\ m_c = 40Kg, m_D = 35Kg,\ r_A = 150mm$$

$$r_B = 200mm\ r_c = 100mm,\ r_D = 180mm.$$

Planes B and C are 250mm apart. Determine

(i) the mass A and its angular position with B

(ii) the position of all the planes relative to plane of mass A. (14)

OR

(Turn Over)

VI. (a) Explain the terms ' Static Balancing' and 'Dynamic Balancing'. (6)

(b) The cylinders of a twin V-engine are set at 60^0 angle with both pistons connected to a single crank through their respective connecting rods. Each connecting rod is 600mm long and crank radius is 120mm. The total rotating mass is equivalent to 2Kg at the crank radius and the reciprocating mass is 1.2Kg/piston. A balance mass is also fitted opposite to the crank equivalent to 2.2Kg at a radius of 150mm. Determine the maximum and minimum values of the primary and secondary forces due to inertia of the reciprocating and rotating masses if the engine speed is 800 rpm. (14)

VII. (a) Discuss the effect of damping on vibratory systems. What is meant by Under damping, Over damping and Critical damping. (6)

(b) In a single degree damped vibrating system a suspended mass of 8Kg makes 30 oscillations in 18 seconds. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Determine.

(i) Stiffness of spring (ii) Logarithmic decrement

(iii) Damping factor (iv) Damping coefficient (14)

OR

VIII. (a) With the help of a neat sketch, explain an Accelerometer. (6)

(b) A machine part having a mass of 2.5Kg vibrates in a viscous medium. A harmonic exciting force of 30N acts on the part and causes a resonant amplitude of 14mm with a period of 0.22 seconds. Find the damping coefficient. If the frequency of the exciting force is changed to 4Hz, determine the increase in the amplitude of the forced vibrations upon the removal of the damper. (14)

IX. (a) Derive an expression for natural frequency of free longitudinal vibration by Rayleighs method. (6)

(b) A rotor has a mass of 12Kg and is mounted midway on a 24mm diameter horizontal shaft supported at the ends by two bearings. The bearings are 1m apart. The shaft rotates at 2400 rpm. If the centre of mass of the rotor is 0.11 mm away from the geometric centre of the rotor due of a certain manufacturing defect, find the amplitude of the steady-state vibration and the dynamic force transmitted to the bearing. $E = 200GN/m^2$. (14)

OR

X. (a) What is meant by whirling of shafts? Explain. (6)

(b) A shaft 1.2m long has diameter of 45mm for half the length and 60mm for the remaining length. One end of the shaft is fixed and the other carries a rotor of mass 200Kg with a radius of gyration of 600mm. Find the frequency of free torsional vibration neglecting the inertia of the shaft. Take $G = 84\ GN/m^2$. (14)

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