BTS – (C) – VI – 05 – 022 (H)

B.Tech. Degree VI Semester Examination, June 2005

ME 601 DYNAMICS OF MACHINERY

(2002 Admissions)

Time: 3 Hours Maximum Marks: 100

(Engineering drawing instruments and drawing sheets permitted)

I a) Write the conditions of static equilibrium of two force member, three force member and member with two forces and a torque. (6)

b) For the static equilibrium of the quick-return mechanism shown in Fig. 1, find the required input torque T_2 for a force of 3500N on the slider D. Angle θ is 20^0. Coefficient of friction $\mu = 0.17$ for each sliding pair. The impending motion of slider is to the left AE=500mm, EB=200mm, AC=990mm,BC=400mm,CD=300mm. (14)

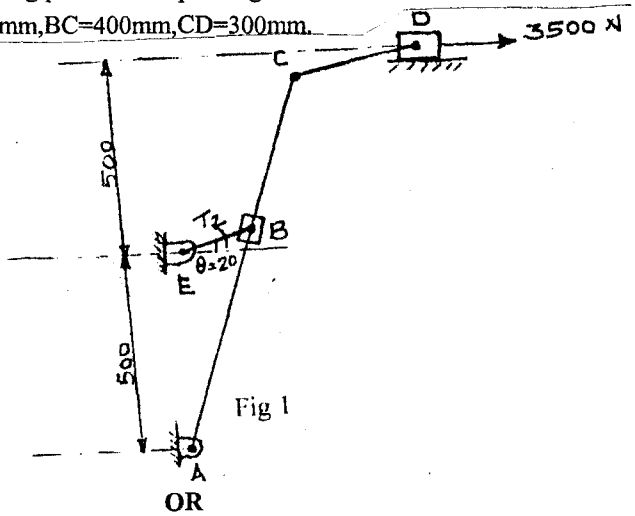

Fig 1

OR

II a) State and explain 'D' Alembert's Principle applied for the dynamic force analysis of links Mechanisms. (4)

b) The following data relate to a horizontal reciprocating engine. Mass of reciprocating parts = 120 Kg, Crank length= 90mm, Engine speed= 600 rpm. Connecting rod mass = 90 kg, length between centres = 450mm, Distance of centre of big and centre = 180 mm, radius of gyration about an axis through centre of mass=150mm. Find by graphical method the magnitude and direction of the inertia torque on the crankshaft when the crank has turned 30^0 from the Inner dead centre. (16)

III. a) Obtain the expression for a coefficient of fluctuation of speed in terms of maximum fluctuation of energy and kinetic energy of the fly wheel at mean speed. (5)

b) Turning moment curve for one revolution of a multi cylinder engine above line of mean are resisting torque are given by –0.32, +4.06, -2.71, +3.29,-3.16, +2.32, -3.74 and –2.45 sq.cm. The vertical and horizontal scales are 1cm=60,000kg-cm and 1 cm=24^0 respectively. The fluctuation of speed is limited to ± 1.5% of mean speed which is 250 r.p.m. The hoop stress in rim material is limited to 56kg./cm^2. Neglecting effect of boss and arms, determine suitable diameter and cross-section of flywheel rim. Density of rim materials is 0.0072kg./cm^2. Assume width of rim equal to four times its thickness. (15)

OR

IV. a) Obtain the expression for Gyroscopic Couple. (5)

b) A car is of total mass 3000Kg. It has wheel base equal to 2.5m and track width equal to 1.5m. The effective diameter of each wheel is 80cm. And moment of inertia of each wheel is 1.0 Kg.M2. The rear axle ratio is 4. The mass moment of inertia of engine rotating parts is 3 Kg. M2 and spin axis of engine parts is perpendicular to the spin axis of wheels. Determine the reaction at each wheel if car takes right turn of 100m radius at 108km/hr speed. Also determine critical speed. The height of C.G is 0.5m from ground and it is placed on the vertical line through geometric centre of wheels. (15)

(Turn Over)

V a) Explain the affects of partial balancing in locomotives. (6)

b) Four masses 200kg, 300kg, 240kg and 260kg are attached to a shaft. These masses are revolving at radii 270mm, 210mm, 300mm and 360mm respectively in planes measured from A_1 at 270mm, 420mm and 720mm respectively. The angles measured anticlockwise are m_1 to m_2 45°, m_2 to m_3 75°, m_3 to m_4 135° and the distance between the planes L and M in which the balance masses are to be placed is 500mm. The distance between planes A_1 and L is 120mm and M and A_4 is 100mm. If the balancing masses revolve at a radius of 72mm, find their magnitude and angular positions. (14)

OR

VI A four cylinder vertical engine has cranks 300mm long. The planes of rotation of the first, third and fourth cranks are 750mm 1050mm and 1650mm respectively from that of the second crank and the air reciprocating masses are 150kg, 400kg and 250 kg respectively. Find the mass of the reciprocating parts of the second cylinder and relative angular positions of the cranks in order that the engine may be in complete primary balance. Also if each connecting rod of all four cylinders is 1.35m long and the speed is 300 rpm, find I) maximum unbalanced secondary force and couple and ii) crank positions at which maximum unbalanced secondary force and couple occur. (20)

VII a) Obtain the expression for displacement of mass from mean position at time t for various damping conditions is free damped vibrations. Explain the characteristics of motion in all conditions. (5)

b) A body having a mass of 15 kg is suspended from a spring which deflects 12mm under weight of the mass. Determine the frequency of the free vibrations. What is the viscous damping force needed to make the motion aperiodic at a speed of 1mm/s?
If, when damped to this extent, a disturbing force having a maximum value of 100N and Vibrating at 6 Hz is made to act on the body, determine the amplitude of the ultimate motion. (15)

OR

VIII a) Explain seismometer and accelerometer. (6)

b) The rotor of a turbo super charger weighing 9 kg is keyed to the centre of a 25mm dia steel shaft 40cm between bearings. Determine i) The critical speed of a shaft ii) the amplitude of vibration of the rotor at a speed of 3200 rpm, if eccentricity is 0.015mm and iii) the vibratory force transmitted to the bearing at this speed. Assume the shaft to be simply supported and that the shaft material has a density of $8gm/cm^3$.E $=2.1x10^6$ kg/cm^2. (14)

IX a) Explain i. Multi degree of freedom vibrating system ii) Matrix formulation for solution of multi degree freedom vibrating system. iii) Semi definite systems. (6)

b) Two equal masses of weight 400kg each and radius of gyration 40 cm are keyed to the opposite ends of a shaft ends of a shaft 60 cm long. The shaft is 7.5 diameter for the first 25cm of its length, 12.5 cm diameter for the next 10 cm and 8.5 cm diameter for the remaining of its length. Find the frequency of free torsional vibrations of the system and position of node. Assume G=$0.84x10^6$$kg/cm^2$. (14)

OR

X Consider two pendulums of length L as shown in Fig.2. Determine the natural frequency of each pendulum. If K=100N/m,m_1=2kg,m_2=5kg,L=20m,a=10m. (20)

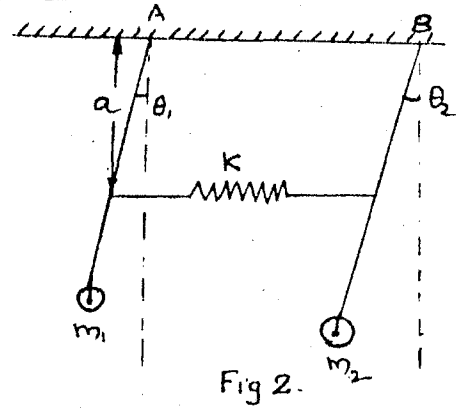

Fig 2.