B.Tech. Degree VI Semester (Supplementary) Examination, September 2008

ME 601 DYNAMICS OF MACHINERY

(1999 Scheme)

Time: 3 Hours Maximum Marks: 100

I a) Explain D'Alembert's principle. (6)

b) A four bar mechanism has the following dimensions.

DA = 30 cm

CB = AB = 36 cm

DC = 60 cm

The link DC is fixed and the angle ADC is 60°

The driving link DA rotates uniformly at a speed of 100 r.p.m. clockwise and the constant driving torque has the magnitude of 5 Kg.m. Determine the velocity of the point B and angular velocity of the driven link CB. Also find the actual mechanical advantage and the resisting torque if the efficiency of the mechanism is 70 percent. (14)

OR

II a) Explain the terms 'coefficient of fluctuation of speed' and 'coefficient of fluctuation of energy'. (6)

b) Turning moment curve for one revolution of a multicylinder engine above and below line of mean resisting torque are given by –0.32, +4.06, –2.71, +3.29, –3.16, +2.32, –3.74, +2.71 and –2.45 Sq.cm. The vertical and horizontal scales are 1cm = 60,000 Kg –cm and 1cm = 24° respectively. The fluctuation of speed is limited to ±1.5 percent 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 fly wheel rim. Density of rim material is 0.0072 Kg. per cubic cm. Assume width of rim equal to four times its thickness. (14)

III a) Explain axes and planes of spin, precision and gyroscopic couple. (6)

b) The moment of inertia of an aeroplane air screw is 6.75 Kg.-m^2 and rotates at 1200 r.p.m. The air craft makes a complete half circle turn in 10 seconds. Calculate the gyroscopic couple on the air craft and state its effect on the air craft. The air screw rotates clockwise when viewed from the rear. (14)

OR

IV a) Explain the terms:

i) Static balancing ii) Dynamic balancing (6)

b) A shaft carries four rotating masses A,B,C and D in this order along its axis. The mass A may be assumed to be concentrated at a radius of 18 cm, B at 24 cm, C at 12 cm, and D at 15 cm. The weights of B, C and D are 30 Kg, 50 Kg and 40 Kg respectively. The planes containing B and C are 30 cm apart. The angular spacing of the planes containing C and D are 90° and 210° respectively relative to B measured in the same sense. If the shaft and masses are to be in complete dynamic balance, find:

i) the weight and angular position of mass A

ii) the position of the planes A and D (14)

V a) Explain the concept of Partial Balancing in locomotives. (6)

b) A vibrating system is defined by the following parameters:

m = 3 Kg, k = 100N/m

C = 3N – Sec/m

Determine :

i) The damping factor

ii) The natural frequency of damped vibration

iii) Logarithmic decrement

iv) The ratio of two consecutive amplitudes

v) The number of cycles after which the original amplitude is reduced to 20 percent (14)

OR

VI a) Prove that the whirling speed for a rotating shaft is the same as the frequency of natural transverse vibration. (6)

b) A shaft 18 cm diameter is supported on two bearings 250cm apart. It carries three discs of weight 250 Kg, 500 Kg and 200 Kg at 60 cm, 150 cm and 200 cm from the left hand. Assuming the shaft to weigh 1.9 Kg/cm length determine the critical speed of the shaft. Young's modulus for the material of the shaft is 2.11×10^6 Kg/cm^2. (14)

VII a) Explain Seismometer and accelerometer. (6)

b) An accelerometer is used to measure the motion of a structure which vibrate at 15 cpm. The static deflection of the seismic mass of the accelerometer is 1.30 cm. Determine the amplitude of the structure if the reading of the instrument is 0.6cm. (14)

OR

VIII a) Derive an expression for finding the length of torsionally equivalent shaft. (6)

b) An electric motor rotating at 1500 r.p.m. drives a centrifugal pump at 500 r.p.m through a single stage reduction gearing. The moments of inertia of the pump impeller and the electric motor are 1400 Kg.m^{2}and 400 Kg.m^2 respectively. The pump shaft and the motor shaft are 45 cm and 18 cm long respectively, and their respective diameters are 9 cm and 4.5 cm. Determine the frequency of torsional oscillations of the system.
Neglect inertia of the gears.
$C = 0.84 \times 10^6$ Kg/cm^2. (14)

IX a) Explain vibration absorber. (6)

b) A body weighing 10 Kg is suspended from a spring having a stiffness of 2Kg/cm. The motion of the body is controlled by a dash pot such that the amplitude of vibration decreases to $1/10^{th}$ of its original value after two complete vibrations. Determine:

i) the frequency of vibration

ii) the value of damping force (14)

OR

X a) Explain the Dunkerly method of determination of frequency of vibration. (6)

b) Figure below shows a vibrating system having two degrees of freedom. Determine the two natural frequencies of vibration and the ratio of amplitudes of the motion of m_1 and m_2 for the two modes of vibration. Take m_1 = 10 Kg. m_2 = 15 Kg. K = 320 N/m. Surface friction can be neglected. (14)