B.Tech Degree VI Semester Examination May 2003

ME 601 DYNAMICS OF MACHINERY

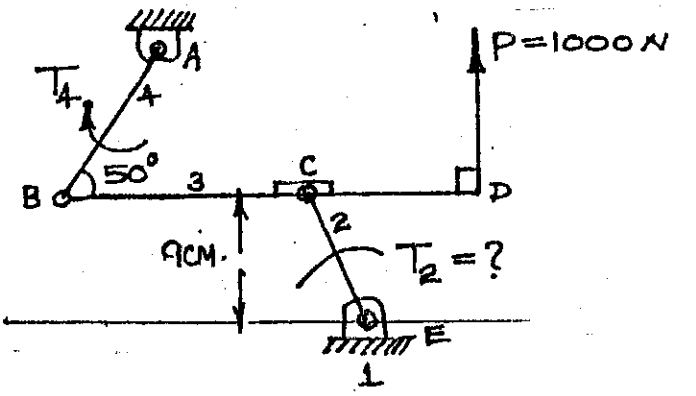
(1999 Admissions onwards)

Time: 3 Hours Maximum Marks: 100

(All questions carry equal marks)

I. (a) Explain the effect of sliding friction in the static force analysis of Slider Crank Mechanism.

(b) In the figure the value of T_4 is given as $T_4 = 5600$ N-CM . P = 1000 N. Determine the value of T_2. Various dimensions of links area given. CE = 11 CM. BD = 30 CM. BC = 17 CM. BA = 14 CM. Neglect pin friction.



OR

II. (a) State and explain D' Alembert's principle.

(b) A single-Cylinder diesel engine has a 7.5 CM Crank radius and a connecting rod length of 28 CM. If the Crank Speed is 2000 RPM counter clockwise and is constant, determine the Inertia force magnitude and location for each link when the crank makes an angle of 60° from the inner dead centre. Distance of C.G. of crank from main bearing is 5 CM and distance of C.G. of connecting rod from crank pin is 12 CM. The mass of each link is given as follows: Crank is 2.5 kg, connecting rod is 4 kg and piston is 3 kg.

III. (a) Define and explain the terms "piston effort" and "crank-pin effort".

(b) The turning Moment diagram for a multicylinder engine has been drawn to a vertical scale of 1 mm = 650 N-M and a horizontal scale of 1 mm = 4.5° . The areas above and below the mean torque line are -28, + 380, -260, +310, -300, +242, -380, +265, and -229 mm^2 The fluctuation of speed is limited to ±1.8% of the mean speed which is 400 RPM. Density of the rim material is 7000 kg/m^3 and width of the rim is 4.5 times its thickness. The centrifugal stress (hoop stress) in the rim material is limited to 6 n/mm^2. Neglecting the effect of the boss and arms,determine the diameter and cross-section of the flywheel rim.

OR

IV. (a) Explain the terms "Spin axis", "torque axis" and "precession axis" with the help of a neat sketch.

(b) A four-wheeled trolley car has a total mass of 3000 kg. Each axle with its two wheels and gears has a total moment of Inertia of 32 $kg\text{-}m^2$. Each wheel is of 450 mm radius. The centre distance between two wheels on an axle is 1.4m. Each axle is driven by a motor with a speed ratio of 1:3. Each motor along with its gear has a moment of Inertia of 16 $kg\text{-}m^2$ and rotates in the opposite direction to that of the axle. The centre of mass of the car is 1m above the rails. Calculate the limiting speed of the car when it has to travel around a curve of 250m radius without the wheels leaving the rails.

VII. (a) What is meant by "static balancing" and "dynamic-balancing" ? What are the necessary conditions to achieve them ?

(b) A two cylinder Uncoupled locomotive has its cylinders 60 CM apart and balanced masses are 60° apart, the planes being symmetrically placed about the centre line. For each cylinder the revolving masses are 300 kg at crank pin radius of 32 cm and reciprocating part 285 kg. All the revolving and 2/3 rd of the reciprocating masses are balanced. The driving wheels are 1.8m diameter. When the engine runs at 60 KM per hour. Find :

(i) The hammer blow.
(ii) The variation in foractive effort.
(iii) The swaying couple.

OR

VI. (a) Explain briefly the method balancing V-engines.

(b) A shaft carries four rotating masses A, B, C and D at equal radii. The distance of the planes B, C and D from A are 40 cm, 50 cm, and 120 cm respectively. The masses at A, B and C are 60 kg, 45 kg and 70 kg respectively. If the system is in complete balance, determine the mass at D and the position of masses B, C and D with respect to A.

VII. (a) Distinguish between longitudinal, Transverse and torsional force vibrations.

(b) A body of 5 kg is supported on a spring of stiffness 200 N/m and has a dashpot connected to it which produces a resistance of 0.002 N at a velocity of 1 cm/sec. In what ratio will the amplitude of vibration be reduced after 5 cycles?

OR

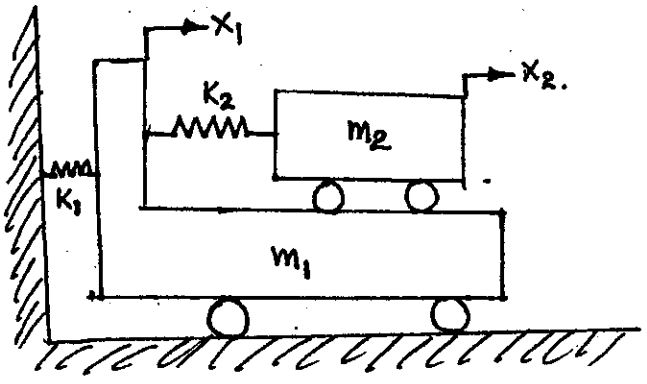
VIII. (a) Explain the terms "Vibration isolation" and "Transmissibility".

(b) A machine part of a mass 2 kg vibrates in a viscous medium. Determine the damping co-efficient when a harmonic exciting force of 25N results in a resonant amplitude of 1.25 cm with a period of 0.20 second. If the system is excited by a harmonic force of frequency 4 cycles/sec, what will be the percentage increase in the amplitude of forced vibration when damper is removed.

IX. (a) Briefly explain the working of a "SEISMO METER".

(b) Derive the equation of motion of the vibratory system shown in figure :-
Determine the natural frequencies for given data

$K_1 = 98000$ N/m $\quad m_1 = 196$ kg
$K_2 = 19600$ N/m $\quad m_2 = 49$ kg



OR

X. (a) What is meant by "Normal mode Vibration"?

(b) A shaft of length 1.25m is 75 mm in diameter for the first 275 mm of its length, 125 mm in diameter for the next 500 mm length, 87.5 mm diameter for the next 375 mm length and 175 mm in diameter for the remaining 100 mm of its length. The shaft carries two rotors at two ends. The mass moment of Inertia of the first rotor is 75 kg-m^2 whereas of the second rotor is 50 kg-m^2. Find the frequency of natural torsional vibrations of the system. The modulus of the rigidity of shaft material may be taken as 80 GN/m^2.

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