B.Tech Degree VI Semester (Supplementary) Examination in Mechanical Engineering, December 2002

ME 601 DYNAMICS OF MACHINERY

(1995 & 98 Admissions)

Time: 3 Hours Max. Marks: 100

I. (a) Analyze a four bar mechanism and obtain the restoring torque on the crank when the coupler is subjected to an external force F_3. Neglect friction at the pin joints. (6)

(b) Determine the required input torque on the crank of a slider crank mechanism for the static equilibrium when the piston load is 1500N. The lengths of the crank and the connecting rod are 40 mm and 100 mm respectively and the crank has turned through 45° from the inner-dead centre. (14)

OR

II. (a) Explain the variation of turning moment in multi cylinder engines. (6)

(b) The following data relate to a horizontal reciprocating engine.

Mass of reciprocating parts	=	120 kg.
Crank length	=	90 mm
Engine speed	=	600 rpm
Connecting rod :		
Mass	=	90 kg.
Length between centres	=	450 mm
Distance of centre of mass from big end centre	=	180 mm
Radius of gyration about an axis through centre of mass	=	150 mm

Find the magnitude and the direction of the inertia torque on the crank shaft when the crank has turned 30° from inner-dead centre. (14)

III. (a) Derive the expression for the total angular acceleration of a spinning rotor. (6)

(b) The turbine rotor of a ship has a mass of 2.2 tonnes and rotating at 1800 rpm clockwise when viewed from the aft. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and its effect when -

(i) the ship turns right at a radius of 250m with a speed of 25 km/h.
(ii) the ship pitches with the bow rising at an angular velocity of 0.8 rad/s.
(iii) the ship rolls at an angular velocity of 0.1 rad/sec. (14)

OR

IV. (a) Explain the effects of partial balancing of locomotives. (6)

(b) The cranks of a four cylinder marine oil engine are arranged at angular intervals of 90°. The engine speed is 70 rpm and the reciprocating mass per cylinder is 800 kg. The inner cranks are 1 m apart and are symmetrically arranged between the outer cranks which are 2.6 m apart. Each crank is 400 mm long. Determine the firing order of the cylinders for the best balance of reciprocating masses and also the magnitude of the unbalanced primary couple for that arrangement. (14)

V. (a) Using energy method obtain the expression for natural frequency of a spring mass system. (6)

(b) A mass 'm' is attached to one end of a spring of stiffness K having natural frequency of 6 Hz. When 1 kg mass is attached with 'm' the natural frequency of the system is lowered by 20%. Determine the value of mass 'm' and stiffness K. (14)

OR

VI. (a) Explain vibration isolation. (6)

(b) A vibrating body is supported by six isolators each having stiffness 32-KN/m and 6 dash pots having damping factor as 400 N-sec/m. The vibrating body is to be isolated by a rotating device having an amplitude of 0.06 mm at 600 rpm. Take m = 30 kg. Determine :

(i) the amplitude of vibration of the body
(ii) Dynamic load on each isolator due to vibration. (14)

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VII. (a) Explain the working of a seismometer. (6)

(b) A vibrometer indicates 2% error in measurement and its natural frequency is 5 Hz. If the lowest frequency that can be measured is 40 Hz, find the damping factor. (14)

OR

VIII. (a) Explain a torsionally equivalent shaft. (6)

(b) A reciprocating IC engine is coupled to a centrifugal pump through a pair of gears. The shaft from the flywheel of the engine to the gear wheel has a 48 mm diameter and is 800 mm long. The shaft from the pinion to the pump has a 32 mm diameter and is 280 mm long. Pump speed is four times the engine speed. Moments of inertia of fly wheel, gear wheel, pinion and pump impeller are 1000 kg-m^2, 14 kg-m^2, 5 kg-m^2, and 18 kg-m^2 respectively. Find the natural frequency of the torsional oscillation of the system. G = 80 GN/m^2. (14)

IX. (a) Explain :

(i) Static coupling

(ii) Dynamic coupling. (6)

(b) Determine the principal coordinates for the system shown in fig.1, if $m_1 = m_2 = m$ and $k_1 = k_2 = k$. (14)

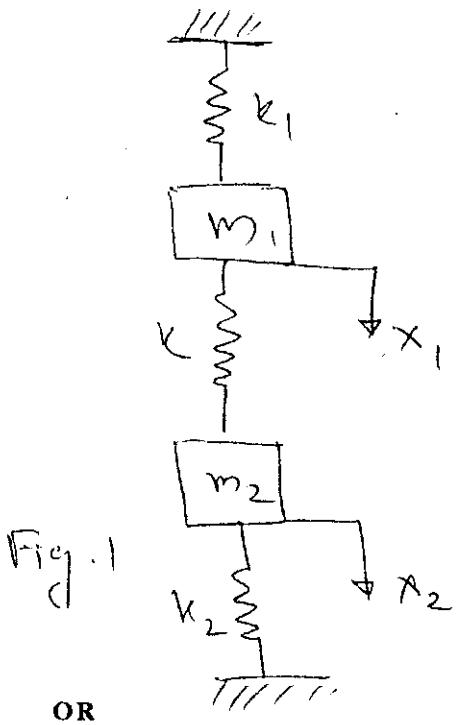

Fig. 1

OR

X. (a) What is meant by principal mode of vibration. (6)

(b) Find the natural frequency of the system shown in fig.2. (14)

E = 1.96 x 10^{11} N/m^2

I = 4 x 10^{-7} m^2

m_1 = 100 kg.

m_2 = 50 kg.

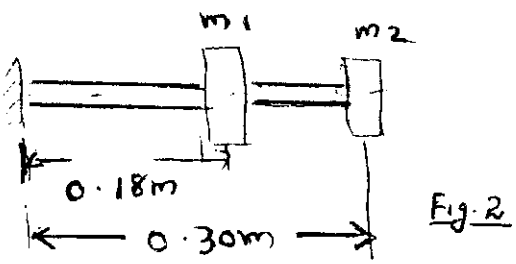

Fig. 2

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