B.E. Sixth Semester (Mechanical Engineering) (CGS)

10864 : Theory of Machines - II : 6 ME 04

P. Pages : 4 | AU - 2743

Time : Three Hours | Max. Marks : 80

Notes :
1. All question carry as indicated marks.
2. Answer **three** question from Section A and **three** question from Section B.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Diagrams should be given wherever necessary.
6. Retain the construction lines.
7. Illustrate your answer necessary with the help of neat sketches.
8. Use of slide rule logarithmic tables, Drawing instrument is permitted.
9. Discuss the mechanism wherever necessary.
10. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION – A

1. a) Explain with neat sketch:
   i) Hydrodynamic pressure distribution in the lubrication. **3**
   ii) Thick film and thin film lubrication. **3**

   b) Determine the input required torque on the crank of a slider-crank mechanism for the static equilibrium when the applied piston load F = 1500 N. The length of the crank is 40mm and connecting rod is 100 mm. The crank has turned through 45° from the inner-dead centre. (Piston position is on left side of IDC & F is towards right side) **8**

OR

2. a) State and Explain:
   i) Principle of virtual work. **3**
   ii) Static equilibrium of the mechanism. **3**

   b) For the static equilibrium of the four bar mechanism is shown in fig. 2 (b). Calculate the torque on link AB. The length of link AB = 200mm, BC = 370mm, CD = 350mm, CE = 100mm, AD = 215mm, angle BAD = 110°, angle CEF = 45° and value of force, F = 2000 N **8**

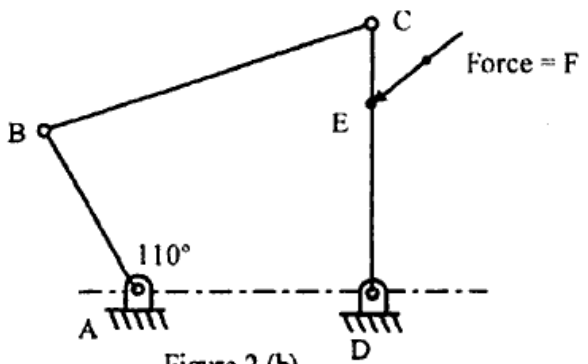


Figure 2 (b)

3. a) A flywheel with mass of 4 kN has a radius of gyration of 1.8m. Find the energy stored in the flywheel when its speed increases from 320rpm to 345rpm. **6**

b) The crank and connecting rod of a petrol engine, running at 1800 rpm are 50mm and 200mm respectively. The diameter of the piston is 80mm and the mass of the reciprocating parts is 1.2kg. At a point during the power stroke, the pressure on the piston is 0.8 N/mm^2, when it has moved 10mm from the inner dead centre. Determine: **7**

i) Net load on the gudgeon pin
ii) Thrust in the connecting rod
iii) Reaction between piston and cylinder

OR

4. a) Explain: **6**

i) D' Alembert's principle

ii) Dynamical equivalent system of connecting rod.

b) A machine is coupled to a two stroke engine which produces a torque of (800 + 180 sin3θ) N-m, where 'θ' is the crank angle. The mean engine speed is 400 rpm. The flywheel and the other rotating parts attached to the engine have a mass of 350 kg at a radius of gyration of 220mm Calculate: **7**

i) Power of the engine
ii) Total fluctuation of speed of the flywheel when the resisting torque is constant

5. a) Explain with neat sketch: **6**

i) What is gyroscopic couple? How it effects on toys and bi-cycle.
ii) Angle of heel for 2-wheeler vehicle.

b) A four wheeled trolley car of mass 3000 kg runs on rails, which are 1.5m apart and travels around a curve of 30m radius at 25km/hr. The rails are at the same level. Each wheel of the trolley is 0.75m in diameter and each of the two axles is driven by a motor running in a direction opposite to that of the wheels. The moment of inertia of each axle with gear and wheels is 18kg-m^2. Each motor with shaft and gear pinion has a moment of inertia of 12kg-m^2. The centre of gravity of the car is 0.9 m above the rail level. **7**

Determine the vertical force exerted by each wheel on the rails taking into consideration the centrifugal and gyroscopic effects. State the centrifugal and gyroscopic effects on the trolley.

OR

6. a) Explain with neat sketch gyroscopic effect on naval ship during pitching & rolling. **6**

b) A truck weighing 60000N has a frontal area of 6m^2. The overall top gear ratio and second gear ratio are 6.2:1 and 15:1 respectively. The transmission efficiency at top gear is 88% and in second gear is 78%. The rolling resistance is 180N per 9900 N of truck weight and the wind resistance coefficient is 0.0029. If the truck is running on a level road at maximum speed of 86km.hr. Find: **7**

i) The engine B. P. required at the maximum truck speed; and
ii) Engine r.p.m. at maximum truck speed if driving wheels diameter of 800mm.

SECTION – B

7. a) Explain with neat sketch

   i) Vibration isolation. 2

   ii) Logarithmic decrement 2

   iii) What is degree of freedom in vibration. 2

   b) A 1.2m long shaft has a diameter of 45mm for half the length and 60mm for the remaining length. One end of the shaft is fixed and their other carries a rotor of 200kg mass with a radius of gyration of 45mm. Find the frequency of free torsional vibration neglecting the inertia of the shaft. Take $G = 80 \times 10^9 \text{ N/m}^2$. 8

OR

8. a) What is meant by torsionally equivalent length of a shaft as referred to a stepped shaft? Derive the expression for the equivalent length of a shaft which have several steps. 6

   b) What is the critically damped vibrations? Draw and explain 'displacement Verses time curve' and show on it critically damped, under damped and over damped vibrations. 8

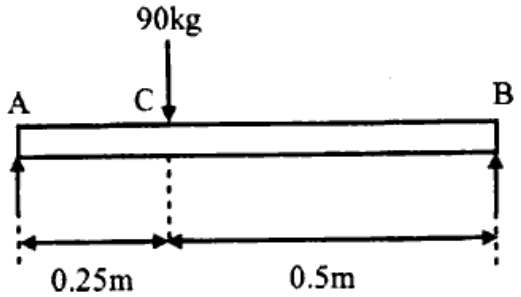
9. a) A shaft 80mm diameter and 3 meters long is simply supported at the ends and carriers three loads of 1400N, 1600N and 1000N at 1m, 2m and 2.5m from the left support. Find the frequency of transverse vibrations, If the young's modulus for shaft material is $200 \times 10^9 \text{ N/m}^2$. 7

   b) Derive an expression for natural frequency of transverse vibration by using Dunkerley's method for a several point loads. 6

OR

10. a) Explain the effect of inertia of the shaft in transverse vibrations. 6

    b) A shaft of length 0.75m supported freely at the ends is carrying a body of mass 90kg at 0.25m from one end. Find the natural frequency of transverse vibration. Assume $E = 200 \text{GN/m}^2$ and the shaft diameter = 50mm. (Refer figure 10 (b)). 7



(Figure 10-b)

11. a) A single cylinder reciprocating engine has speed 240 r.p.m., stroke 300 mm, mass of reciprocating parts 50kg' mass of revolving parts at 150 mm radius 37kg. If two-third of the reciprocating parts and all the revolving parts are to be balanced, find : 6
    i) The balance mass required at a radius of 400mm. and
    ii) The residual unbalanced force when the crank has rotated 60° from inner dead centre.

    b) A, B, C and D are four masses carried by a rotating shaft at radii 102, 127, 202 and 152 mm respectively. The planes in which the masses revolve are spaced 600mm apart and the mass of B, C and D are 12 kg, 7kg and 6kg respectively. 7

    Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance.

OR

12. a) What is meant by static and dynamic balancing? Explain with neat sketch condition of balancing and unbalancing of them mathematically and graphically. 6

    b) The following data refer to two cylinder locomotive with cranks at 90° : 7
    Reciprocating mass per cylinder = 300kg,
    Crank radius = 0.3m,
    Driving wheel diameter = 1.8m,
    Distance between cylinder centre lines = 0.65m,
    Distance between the driving wheel central planes = 1.55m.

    Determine:
    i) The fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46kN at 96.5 $^{km}/_{hr}$
    ii) The variation in tractive effect
    iii) The maximum swaying couple.

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