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BME-020

00887

BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

Term-End Examination

June, 2010

BME-020 : KINEMATICS & DYNAMICS OF MECHANISMS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt **six** questions in all. Question number **1** is **compulsory** and **any five** questions from the rest. Make suitable assumptions wherever necessary if any.*

1. Attempt ***any five*** parts of the following : **3x5=15**

(a) Explain higher pairs with the help of suitable sketches and practical examples.

(b) A four bar linkage has lengths of four links as 8, 10, 12 and 15 cms. Determine whether it satisfies Grashoff's criteria or not.

(c) A sphere having radius equal to 'r' is executing pure rolling motion. Find absolute velocities of top point and points on the periphery of horizontal diameter if velocity of centre of the sphere is V.

(d) Explain whirling of shafts.

(e) Explain primary and secondary imbalance of an reciprocating locomotive engine.

(f) Explain where do we use single plane balancing and where do we use two plane balancing ?

2. (a) Classify and write merits and demerits of each cam. **4+7=11**

(b) A quick return motion mechanism is shown in Figure 1. The angular velocity of the crank is 20 r/s. Determine angular acceleration of the slotted link.

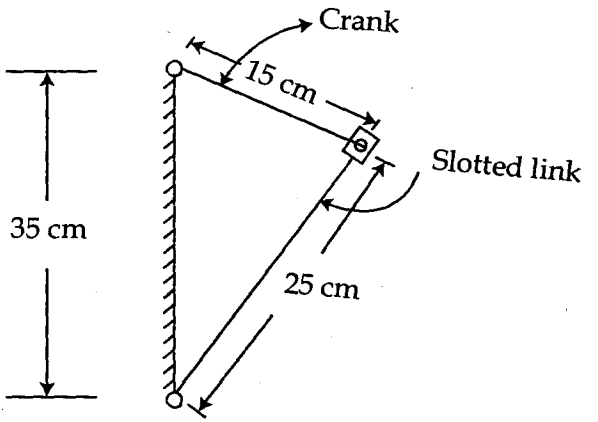

Figure - 1

3. (a) Explain Chebyshev's spacing of accuracy points. **3+8=11**

(b) Design a slider crank mechanism so that the displacement of slider is proportional to the cube of crank rotation in the interval of $30° \leq \theta \leq 100°$. Assume initial distance of slider equal to 15 cm and final distance to be 10 cm.

4. (a) Find the minimum number of teeth on the pinion to avoid interference when it meshes with a gear with gear ratios 1 : 3 and rack, for the 20° pressure angle. **4+7=11**

(b) In a Hartnell and rotating governor the radius of rotation is 7 cm at 500 rpm. At this speed ball arm is normal and sleeve is in mid position. The sleeve lift is 2 cm with ±5% change in speed. The mass of the sleeve is 6 kg and the friction is equivalent to 25 N at the sleeve. Ball mass is 2 kg. Determine the following :

(i) spring rate and

(ii) initial compression in spring

5. (a) Explain the effects of imbalance in a rotating system. **3+8=11**

(b) A 60° V-twin engine carries reciprocating mass of 1.5 kg in each cylinder and stroke length is 100 mm. Find maximum and minimum values of primary forces and the corresponding crank positions if engine speed is 1500 rpm.

6. (a) A disc of mass 4 kg is mounted on a shaft of 10 mm diameter at the centre between the two short bearings. The span length is 500 mm. The eccentricity of mass is 2 mm from the geometric centre of the disc. The equivalent viscous damping at the point of disc mounting is 50 N sec/m. The angular speed of the shaft is 250 rpm. Determine : **11**

(i) the maximum stress in the shaft, and

(ii) the power required to drive the shaft. Assume $E = 2 \times 10^{11}$ Pa.

7. (a) Explain inversions of double slider crank chain. **3+3+3+2=11**

(b) Explain vehicle differential with the help of a neat sketch.

(c) Explain force analysis in case of worm gears.

(d) Derive ratio of tensions in a flat belt drive.

8. (a) Find the magnitude and the sense of inertia torque on the crank when it has turned 30° from inner dead centre for the following data : **7+4=11**

Reciprocating mass which moves horizontally	= 120 kg
Crank length	= 90 mm
Engine speed	= 600 rpm
Length of connecting rod	= 450 mm
Mass of connecting rod	= 90 kg
The radius of gyration	= 150 mm
Distance of C. G. from small end centre	= 180 mm

(b) A mechanical system is shown in Figure 2. Prove that the natural frequency of the system is :

$$\left(\frac{1}{2\pi} \sqrt{\frac{k}{m + \frac{I}{r^2}}} \right) \text{Hz.}$$

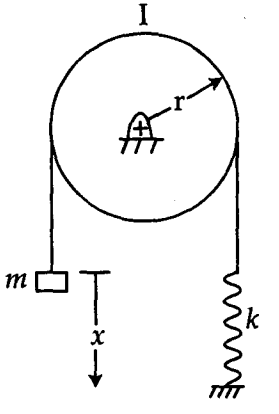

Figure - 2