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BME-020

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) / BTMEVI

00692 **Term-End Examination**

December, 2017

BME-020 : KINEMATICS & DYNAMICS OF MECHANISMS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. All questions carry equal marks. Use of non-programmable calculator is allowed. Make suitable assumptions wherever necessary. Standard symbols and notations have usual meaning.*

1. (a) A bullet is fired from a gun aiming at a falling ball from the ground position simultaneously as the ball falls vertically down. Show that the bullet will hit the ball regardless of initial velocity and the distance. *8*

(b) Describe inversions of 3R-1P kinematic chain with neat sketches. *6*

2. (a) In a slider crank chain, crank OA = 10 cm and connecting rod AB = 40 cm. Determine velocity and acceleration of the slider B, if the crank rotates at 600 rpm at $\theta = 0°$, 90° and 180° by using Klein's constructions. *6*

(b) Draw a profile of a cam operating a knife edge follower for the following data :

Maximum lift of the follower = 2·5 cm

Angle for rise of the follower = 120°

Dwell angle after rise = 60°

Angle for return of the follower = 100°

Least radius of the cam = 3 cm

Both the strokes are with SHM and the cam rotates at a uniform velocity of 300 rpm. Determine the maximum velocity and acceleration of the follower during rise and return. *8*

3. (a) Derive the expression for ratio of tensions for a V-belt pulley drive. *4*

(b) Find the minimum number of teeth on the pinion to avoid interference when it meshes with gear ratio 1, 2 and the rack for having 20° pressure angle. Derive the formulae used. *10*

4. (a) Explain the turning moment diagram. How can it be used for the design of the flywheel ? Discuss. *4*

(b) In a Hartnell governor, the speed is 500 rpm at 7 cm radius with the ball arm vertical and the sleeve at mid position. The total sleeve movement is 2·5 cm with ± 4% change in speed. The mass of the sleeve is 6 kg and friction is equivalent to 25 N at the sleeve. The mass of the ball is 2 kg and ball arm is equal to sleeve arm.

Determine

(i) Spring rate and initial compression of the spring,

(ii) Governor effort and power for 1% change in speed if there is no friction. *10*

5. (a) Explain dynamically equivalent system. *6*

(b) The rotor of a turbo generator weighing 9 kg is keyed to the centre of a 24 mm shaft. The span length is 50 cm. Determine the critical speed and the amplitude of vibration of the rotor at a speed of 200 rpm. The mass eccentricity is 0·015 mm. Assume $E = 2 \times 10^5$ MPa. *8*

6. (a) A pinion of 9 cm p.c.d. drives a gear of 24 cm p.c.d. The pressure angle of the pair is 20°. Make force analysis of the pair if the input torque is 6000 N cm. Assume both the pinion and gear are mounted mid-way on the simply supported shafts. *7*

(b) A single cylinder engine has 38 cm bore diameter and 40 cm stroke. The connecting rod length is 112 cm. The mass of reciprocating parts is 120 kg. At the expansion stroke with crank at 30° from TDC, the gas pressure is 0·85 MPa. If the engine runs at 250 rpm, determine

(i) Net force on the piston,

(ii) Resultant force on gudgeon pin, and

(iii) Thrust on cylinder walls. *7*

7. (a) What do you mean by Static and Dynamic balancing ? Describe in brief. *4*

(b) A trailer weighs 1·2 tonnes when fully loaded and 250 kg when empty. The total stiffness of the suspension springs is 355 kN/m. The damping factor is 0·5 when fully loaded. Find the ratio of amplitudes when it is fully loaded to that when it is empty. The speed of the trailer is 100 kmph over a road having sinusoidal irregularity of 4 m wavelength. *10*

8. (a) Describe in brief, how in-line engines are balanced. *4*

(b) In an uncoupled locomotive, the cylinders are placed at a distance of 675 mm. The cranks are 435 cm long each and are at right angle to each other. The masses of revolving and reciprocating parts are 270 kg and 320 kg respectively. The whole of revolving and $\frac{2}{3}$ of reciprocating masses are to be balanced by providing balancing masses at a radius of 800 mm on the driving wheels. The diameter of each driving wheel is 2 m and they are 1·5 m apart. Find

(i) the magnitude and position of the balancing masses,

(ii) maximum unbalanced forces, and

(iii) couples acting on the locomotive at the speed of 95 kmph. *10*