CBCS SCHEME

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18MR42

Fourth Semester B.E. Degree Examination, July/August 2022
Theory of Machines

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define mechanism with an example. Sketch and explain any one inversion of single slider crank chain. **(10 Marks)**

b. Explain the following terms with examples:
(i) Element (ii) Kinematic pair (iii) Degrees of freedom
(iv) Kinematic chain (v) Inversion **(10 Marks)**

OR

2 a. Define mobility of mechanisms and write the Grubler's mobility equation for planar mechanism. **(04 Marks)**

b. What is a pantograph and what are its uses? Give a neat sketch of pantograph and explain its working principle. **(10 Marks)**

c. What is an intermittent motion mechanism? With a neat sketch, explain Ratchet Mechanism. **(06 Marks)**

Module-2

3 a. State and explain the different laws and types of friction. **(08 Marks)**

b. A leather belt 125 mm wide and 6 mm thick, transmits power from a pulley 750 mm diameter which runs at 500 rpm. The angle of lap is 150° and the coefficient of friction between the belt and the pulley is 0.3. If the belt density is 1000 kg/m^3, and the stress in the belt is not to exceed 2.75 N/mm^2, find the maximum power that can be transmitted. Also find the initial tension in the belt. **(12 Marks)**

OR

4 a. Derive an expression for the ratio of tensions for a flat belt passing over a pulley. **(08 Marks)**

b. The diameter of a pulley on the driving shaft rotating at 200 rpm is 1 meter. A counter shaft is to be driven at 400 rpm by an open belt drive. The coefficient of friction is 0.25 m and the distance between the centre lines of the shaft is 3 meters. Find the necessary width of the belt to transmit 7.5 KW, if the safe pull in the belt is not exceed 20 N/mm width of the belt. **(12 Marks)**

Module-3

5 a. Explain balancing of several masses rotating in the same plane. **(06 Marks)**

b. A shaft carries four rotating masses A, B, C and D in this order along the axis. The mass A may be assumed to be concentrated at 160 mm radius, B at 180 mm, C at 200 mm and D at 120 mm radius. The masses B, C and D are 40, 30 and 50 kg respectively. The planes containing B and C are 300 mm apart. The angular spacings of C and D are 90° and 210° respectively with respect to B measured in the same direction. If the shaft and masses are to be in complete dynamic balance, determine:
(i) Mass and angular position of A
(ii) Position of planes A and D **(14 Marks)**

OR

6 a. State the conditions of balance in a multi-cylinder 'In-line engine'. **(06 Marks)**

b. The firing order in a 6 cylinder vertical 4 stroke in line engine is 1-4-2-6-3-5, the piston is 100 mm, length of each C.R = 200 mm. The pitch distance between cylinder centerlines are 100 mm, 100 mm, 150 mm, 100 mm and 100 mm. Determine the out of balance primary and secondary forces and couples on this engine taking a plane midway between cylinders 3 and 4 as reference plane. The reciprocating mass per cylinder is 2 kg and the engine runs at 1500 rpm. **(14 Marks)**

Module-4

7 a. Explain sensitiveness, isochronisms, effort and power of a governor. **(08 Marks)**

b. The arms of a porter governor are 300 mm long. The upper arms are pivoted on the axis of rotation and the lower arms are attached to the sleeve at a distance of 35 mm from the axis of rotation. The mass of the sleeve is 54 kg and the mass of each ball is 7 kg. Determine the equilibrium speed when the radius of rotation of the ball is 225 mm. What will be the range of speed for this position if the frictional resistance to the motion of sleeve is equivalent to a force of 30 N at the sleeve? **(12 Marks)**

OR

8 a. Define Gyroscopic effect. Explain the gyroscopic effect of steering, pitching and rolling of a ship moving in a heavy sea. **(10 Marks)**

b. Each road wheel of a motor cycle has a moment of inertia of 2 kgm^2. The rotating parts of the engine of the motor cycle has a moment of inertia of 0.2 kgm^2. The speed of the engine is 5 times the speed of the wheel and is in the same sense. The mass of motor cycle with rider is 200 kg and its CG is 500 mm above ground level. The diameter of the wheel is 500 mm. The motor cycle is travelling at 15 m/sec on a curve of 30 m radius. Determine: (i) Gyrocouple, centrifugal couple, overturning couple and balancing couple interms of angle of heel ; (ii) Angle of heel. **(10 Marks)**

Module-5

9 a. With neat sketches, explain different types of CAMS. **(06 Marks)**

b. A cam with 25 mm as a minimum radius is rotating counter clockwise at a uniform speed of 100 rpm, and has to give the motion to the knife-edge follower as below:

(i) Follower to move outwards through 25 mm during 120° of cam rotation.
(ii) Follower to dwell for the next 60° of cam rotation.
(iii) Follower to return to its starting position during next 90° of cam rotation.
(iv) Follower to dwell for the rest of the cam rotation.

The displacement of the follower takes place with UARM on both outward and return stroke. Draw the cam profile when follower axis is offset to left by 10 mm from the axis of the cam. Determine the maximum velocity and acceleration during outstroke and return stroke. **(14 Marks)**

OR

10 A cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower through a roller of 10 mm diameter. The follower motion is defined below:

- Follower to move outwards during 120° of the cam rotation with equal UARM.
- Follower to dwell in the lifted position for next 30° of cam rotation.
- Follower to return to its starting position during 120° of cam rotation with SHM.
- Follower to dwell for the rest of the cam rotation.

The stroke of the follower is 30 mm. The minimum radius of the cam is 20 mm. Draw the profile of the cam when :

(i) Line of stroke of the follower passes through the center of the cam shaft
(ii) Line of the stroke of the follower is offset 10 mm from the axis of the cam shaft.

Find the maximum velocity and acceleration of the follower during its outward stroke. **(20 Marks)**