

63

Bihar Engineering University, Patna
B.Tech. 5th Semester Examination, 2023

Course: B.Tech.
Code: 102503

Subject: Kinematics of Machine

Time: 03 Hours
Full Marks: 70

Instructions:-

- (i) The marks are indicated in the right-hand margin.
- (ii) There are NINE questions in this paper.
- (iii) Attempt FIVE questions in all.
- (iv) Question No. 1 is compulsory.

Q.1 Choose the correct answer of the following (Any seven question only): **[2 x 7 = 14]**

- (a) In a slider crank mechanism, there are
 - (i) three links
 - (ii) four links
 - (iii) five links
 - (iv) None of these
- (b) The number of instantaneous centres of rotation for 10 link kinematic chain is
 - (i) 36
 - (ii) 90
 - (iii) 120
 - (iv) 45
- (c) In a slider crank mechanism, the maximum acceleration of slider is obtained when the crank is
 - (i) at the inner dead centre position
 - (ii) at the outer dead centre position
 - (iii) exactly midway position between the two dead centres
 - (iv) None of these
- (d) In the multi plate disc clutch if there are 6 disc on the driving shaft and 5 disc on the driven shaft, then the number of pairs of contact surfaces will be equal to
 - (i) 11
 - (ii) 12
 - (iii) 10
 - (iv) 22
- (e) The creep in a belt is due to the
 - (i) material of the pulleys
 - (ii) material of the belt
 - (iii) unequal size of the pulleys
 - (iv) unequal tension on tight and slack sides of the belt
- (f) The working surface above the pitch surface of the gear tooth is termed as
 - (i) addendum
 - (ii) dedendum
 - (iii) flank
 - (iv) face
- (g) The module is the reciprocal of
 - (i) circular pitch
 - (ii) diametral pitch
 - (iii) pitch circle diameter
 - (iv) None of these
- (h) In order to have complete balance of several revolving masses mounted in different planes and different angular position over a shaft
 - (i) The resultant force must be zero
 - (ii) The resultant couple must be zero
 - (iii) The resultant force as well as couple must be zero
 - (iv) None of these
- (i) For a governor running at constant speed, what is the value of the force acting on the sleeve?
 - (i) Zero
 - (ii) Variable depending upon the load
 - (iii) Maximum
 - (iv) Minimum
- (j) When the speed of the engine fluctuate continuously above and below the mean speed, then the governor is said to be
 - (i) Stable
 - (ii) Unstable
 - (iii) Isochronous
 - (iv) Hunting

Q.2 (a) Define the following terms with reference to kinematics of machine: **[8]**

- (i) Kinematic Pair
- (ii) Mechanism
- (iii) Ternary joint
- (iv) Degree of freedom

(b) Explain the working of crank and slotted lever quick return motion mechanism with a neat sketch. **[6]**

Q.3 (a) What is constrained motion and what are the different types of constrained motions? Give one example for each with suitable sketch. **[7]**

(b) In the mechanism shown in Fig.1 the dimensions are the following Crank OA= 200 mm; Connecting rod AB =600 mm; distance of centre of mass from crank end, AD =200 mm. At the instant, the crank has an angular velocity 50 rad/s clockwise and angular acceleration of 800 rad/s². Calculate the **[7]**

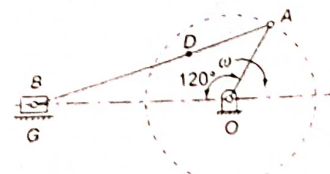


Fig.1

- (i) velocity of D and angular velocity of AB.
- (ii) acceleration of D and angular acceleration of AB.
- (iii) point on the connecting rod which has zero acceleration at this instant.

- Q.4** (a) Derive the relation $\frac{T_1}{T_2} = e^{\mu\theta}$ for a flat-belt drive with usual notations. [7]
- (b) A multi-plate disc clutch transmits 55 kW of power at 1800 rpm. Coefficient of friction for the friction surfaces is 0.1. Axial intensity of pressure is not to exceed 160 kN/m². The internal radius is 80 mm and 0.7 times the external radius. Find the number of plates needed to needed to transmit the required torque. [7]

- Q.5** The simple band brakes, as shown in Fig. 2 is applied to a shaft carrying a flywheel of mass 400 kg. The radius of gyration of the flywheel is 450 mm and runs at 300 rpm. If the coefficient of friction is 0.2 and the brake drum diameter is 240 mm find; [14]
- (i) The torque applied due to hand load of 100 N,
 (ii) The number of turns of the wheel before it is brought to rest, and
 (iii) The time required to bring it to rest, from the moment of the application of the brake.

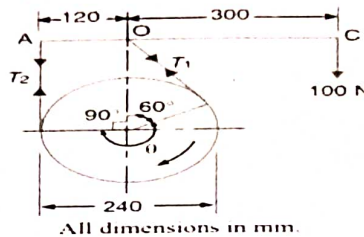


Fig. 2

- Q.6** (a) Derive an expression for minimum number of teeth necessary for gear to avoid interference. [7]
- (b) Two involute gear of 20° pressure angles are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module find: [7]
- (i) The angle turned through by pinion when one pair of teeth is in mesh; and
 (ii) The maximum velocity of sliding.

- Q.7** Two shafts A and B are coaxial. A gear C (50 teeth) is rigidly mounted on shaft A. A compound gear D-E gears with C and an internal gear G. D has 20 teeth and gears with C and E has 35 teeth and gears with an internal gear G. Gear G is fixed and is concentric with the shaft axis. The compound gear D-E is mounted on a pin which projects from an arm keyed to the shaft B. [14]
- (i) Sketch the arrangement.
 (ii) Find the number of teeth on internal gear G assuming that all gears have the same module.
 (iii) If shaft A rotates at 110 r.p.m., find the speed of shaft B.

- Q.8** A rotating shaft carries four unbalanced masses 18 kg, 14 kg, 16 kg and 12 kg at radii 5 cm, 6 cm, 7 cm, and 6 cm respectively. The 2nd, 3rd, and 4th, masses revolve in planes 8 cm, 16 cm and 28 cm respectively measured from the plane of the first mass and are angular located at 60°, 135° and 270° respectively measured anticlockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 5 cm radii and revolving in planes mid-way between those of 1st and 2nd masses and midway between those of 3rd and 4th masses. Determine the magnitudes of the masses and their respectively angular positions. [14]

- Q.9** A governor of the Proell type has each arm 250 mm long. The pivots of the upper and lower arms 25 mm from the axis. The central load acting on the sleeve has a mass of 25 kg and each rotating ball has a mass of 3.2 kg. When the governor sleeve is in mid-position, the extension link of the lower arm is vertical and radius of the path of rotation of the masses is 175 mm. The vertical height of the governor is 200 mm. If the governor speed is 160 r.p.m. when in mid position, find (i) length of the extension link; and (ii) tension in the upper arm. [14]

