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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Mechanical Engineering

Semester End Examination; May / June - 2019

Kinematics of Machines

Time: 3 hrs

Max. Marks: 100

Note: Answer **FIVE** full questions, selecting **ONE** full question from each unit.

UNIT - I

- 1 a. Define the following :
 - i) Lower pair
 - ii) Mechanism
 - iii) Inversion
 - iv) Structure
- b. Determine the mobility of Four bar and single slider crank mechanisms.
- c. Explain the following :
 - i) Watts indicator mechanism
 - ii) Elliptical trammel
2. Explain with the help of neat sketches :
 - a) Whitworth quick return motion mechanism
 - b) Peasucelliar's straight line mechanism
 - c) Davis steering gear mechanism

UNIT - II

- 3 a. Locate all the instantaneous centres for the slider crank mechanism.
- b. State and prove Kennedys theorem of instantaneous centre.
- c. In a four bar chain ABCD, AD is fixed and 150 mm long. The crank AB is 40 mm long and rotates at 120 rpm clockwise while the link CD = 80 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 60°.
4. In a four bar chain PQRS, PS is fixed and 600 mm long. The crank PQ is 300 mm long has an angular velocity of 10 rad/s and an angular acceleration of 30 rad/s², both clockwise while the link QR = 360 mm and RS = 360 mm determine the angular velocities and angular accelerations of RS, and QR and the velocity and acceleration of the joint R when angle QPS = 60°.

UNIT - III

- 5 a. Classify the gears.
- b. Derive an expression for minimum number of teeth required on the pinion in order to avoid interference in involute gear teeth.
- c. The number of teeth on each of the two equal spur gears in mesh are 40. The teeth have 20° involute profile and the module is 6 mm. If the arc of contact is 1.75 times the circular pitch, find the addendum.

- 6 a. Derive an expression for the length of the path of contact in a pair of meshed spur gear. 8
- b. A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact arc of contact and the contact ratio. 12

UNIT - IV

- 7 a. Sketch and explain; i) Compound gear train ii) Epicyclic gear train. 6
- b. An internal Wheel B with 80 teeth is keyed to a shaft F. A fixed internal wheel C with 82 teeth is concentric with B. A compound wheel D-E gears with the two internal wheels, D has 28 teeth and gears with C while E gears with B. The compound wheels revolve freely on a pin which projects from a disc keyed to a shaft A co-axial with F. If the wheels have the same pitch and the shaft A makes 800 rpm, what is the speed of shaft F? Sketch the arrangement. 14
- 8 a. Explain the following terms in a belt drive : 4
- i) Creep ii) Initial tension
- b. Derive an expression for ratio of tension in flat belt drive. 8
- c. Power is transmitted using a V-belt drive. The included angle of V-groove is 30° . The belt is 20 mm deep and maximum width is 20 mm. If the mass of the belt is 0.35 kg per metre length and maximum allowable stress is 1.4 MPa, determine the maximum power transmitted when the angle of lap is a 140° , $\mu = 0.15$. 8

UNIT - V

- 9 a. Classify the type of follower with the neat schematics according to motion and path of motion. 8
- b. A cam with 30 mm minimum radius drives a knife edge reciprocating follower; during first 120° rotation of the cam follower moves outwards through a distance of 30 mm with SHM. The follower dwells during next 60° cam rotation. During next 90° cam rotation, the follower moves inwards with UV. Follower dwell for the remaining period of cam rotation, draw the profile of the cam. 12
10. Draw the profile of a cam operating a roller reciprocating follower and with the following data: 20
- Minimum base radius of cam = 30 mm, lift = 30 mm, roller diameter = 16 mm. Axis of the follower is offset to the right of the cam axis by 18 mm. Ascent of the follower takes place with UARM is 120° followed by a period of rest 60° . Then the follower descent with SHM during 120° and the cam rotates at a uniform speed of 240 rpm (CW direction). Calculate the maximum velocity and acceleration of the follower during the ascent and decent period.