

(3 Hours)



(80 Marks)

NB : (1)Q.No. 1 is compulsory.

- (2) Attempt any three of remaining five questions.
- (3) Illustrate answers with sketches wherever required.
- (4) Assume suitable data if required and state it very clearly.
- (5) Figures to the right indicate full marks.

Q. No..1) Attempt any four questions.

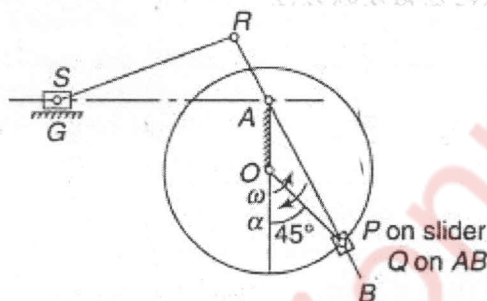
(20 marks)

- 1) Derive the expression to determine gyroscopic couple.
- 2) With a neat sketch explain any one type of dynamometer.
- 3) Define degree of freedom and explain Gruebler's criterion.
- 4) Distinguish between longitudinal, transverse and torsional vibration.
- 5) State and explain Kennedy's theorem.
- 6) Explain law of Gearing.

Q.No.2) Attempt the following.

(14 marks)

a) A Whitworth quick-return mechanism has been shown in the figure. The dimensions of the links are $OP=240\text{mm}$, $OA=150\text{mm}$, $AR=165\text{mm}$, $RS=430\text{mm}$. The crank OP has an angular velocity of 2.5rad/s and angular deceleration of 20rad/s^2 at the instant. Determine the 1) acceleration of slider S . 2) angular acceleration of links AR and RS .



b) Give the classification of kinematic pairs.

(06 marks)

Q.No.3) Attempt the following.

- a) Draw a cam profile to drive an oscillating roller follower to the specifications given below,
 - a) Follower to move outwards through an angular displacement of 20° during the first 120° rotation of the cam.
 - b) Follower to return to its initial position during next 120° rotation of the cam.
 - c) Follower to dwell during the next 120° of cam rotation.

The distance between pivot center and roller center = 120mm ; distance between pivot center and cam axis = 130mm ; minimum radius of cam = 40mm ; radius of roller = 10mm ; inward and outward strokes take place with Simple harmonic motion. (14 marks)

b) State and explain the inversions of double slider crank mechanism.

(06 marks)

Q.No.4) Attempt the following.

a) Two mating gears have 20 and 40 involute teeth of module 10mm and 20° pressure angle. The addendum on each wheel is to be made of such a length that the line of contact on each side of the pitch point has half the maximum possible length. Determine the addendum height for each gear wheel, length of path of contact, arc of contact and contact ratio.

(10 marks)

b) A multiple disc clutch has five plates having four pairs of active friction surfaces. If the intensity of pressure is not to exceed 0.127N/mm^2 , find the power transmitted at 500rpm. The outer and inner radii of friction surfaces are 125mm and 75 mm respectively. Assume uniform wear and take coefficient of friction as 0.3.

(10 marks)

Q.No.5) Attempt the following.

a) Derive an expression for minimum number of teeth on pinion to avoid interference.

(8 marks)

b) A band and block brake, having 14 blocks each of which subtends an angle of 15° at the center, is applied to a drum of 1m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000kg and a combined radius of gyration of 500mm. The two ends of the band are attached to pins on opposite sides of the brake lever at a distance of 30mm and 120mm from the fulcrum. If a force of 200N is applied at a distance of 750mm from the fulcrum, find

1) maximum braking torque 2) angular retardation of the drum 3) time taken by the system to come to rest from the rated speed of 360rpm. take $\mu=0.25$.

(12 marks)

Q.No.6) Attempt the following.

a) Calculate the whirling speed of a shaft 20mm diameter and 0.6m long carrying a mass of 1kg at its midpoint. The density of the shaft material is 40Mg/m^3 and its young's modulus is 200GN/m^2 . Assume the shaft to be freely supported.

(8 marks)

b) Four masses A, B, C and D carried by rotating shaft at radii 100mm, 125mm, 200mm and 150mm respectively are completely balanced. Masses B, C and D are 12Kg, 5Kg and 4kg respectively. Determine the mass A and the relative angular positions of the four masses if the planes are spaced 500mm apart.

(12 marks)

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