

C.U.SHAH UNIVERSITY

Summer Examination-2019

Subject Name: Theory of Machines

Subject Code: 4TE04TOM1

Branch: B.Tech (Mechanical)

Semester: 4

Date: 26/04/2019

Time: 02:30 To 05:30

Marks: 70

Instructions:

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
 - (2) Instructions written on main answer book are strictly to be obeyed.
 - (3) Draw neat diagrams and figures (if necessary) at right places.
 - (4) Assume suitable data if needed.
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- Q-1** **Attempt the following questions:** **(14)**
- a) The brake commonly used in motor cars is
 - (a) shoe brake
 - (b) band brake
 - (c) band and block brake
 - (d) internal expanding brake
 - b) Which of the following is an absorption type dynamometer?
 - (a) Thronycroft dynamometer
 - (b) rope brake dynamometer
 - (c) epicyclic-train dynamometer
 - (d) torsion dynamometer
 - c) A Hartnell governor is a
 - (a) pendulum type governor
 - (b) spring loaded governor
 - (c) dead weight governor
 - (d) inertia governor
 - d) A governor is said to be hunting, if the speed of the engine
 - (a) remains constant at the mean speed
 - (b) is above the mean speed
 - (c) is below the mean speed
 - (d) Fluctuates continuously above and below the mean speed.
 - e) Isochronism in a governor is desirable when
 - (a) the engine operates at low speeds
 - (b) the engine operates at high speeds
 - (c) the engine operates at variable speeds
 - (d) one speed is desired under one load
 - f) When the pitching of a ship is upward, the effect of gyroscopic couple acting on it will be
 - (a) to move the ship towards port side
 - (b) to move the ship towards star-board
 - (c) to raise the bow and lower the stern
 - (d) to raise the stern and lower the bow
 - g) In an automobile, if the vehicle makes a left turn, the gyroscopic torque
 - (a) increases the forces on the outer wheels
 - (b) decreases the forces on the outer wheels
 - (c) does not affect the forces on the outer wheels
 - (d) none of the above
 - h) In a turning moment diagram, the variations of energy above and below the mean



resisting torque line is called

- (a) fluctuation of energy
 - (b) maximum fluctuation of energy
 - (c) coefficient of fluctuation of energy
 - (d) none of the above
- i) The ratio of the maximum fluctuation of speed to the mean speed is called
- (a) fluctuation of speed
 - (b) maximum fluctuation of speed
 - (c) coefficient of fluctuation of speed
 - (d) none of these
- j) In an engine, the work done by inertia forces in a cycle is
- (a) positive
 - (b) zero
 - (c) negative
 - (d) none of these
- k) A rigid body, under the action of external forces, can be replaced by two masses placed at a fixed distance apart. The two masses form an equivalent dynamical system, if
- (a) the sum of two masses is equal to the total mass of the body
 - (b) the centre of gravity of the two masses coincides with that of the body
 - (c) the sum of mass moment of inertia of the masses about their centre of gravity is equal to the mass moment of inertia of the body
 - (d) all of the above
- l) When the crank is at the inner dead centre, in a horizontal reciprocating steam engine, then the velocity of the piston will be
- (a) zero
 - (b) minimum
 - (c) maximum
 - (d) none of these
- m) The analysis of mechanism deals with
- (a) the determination of input and output angles of a mechanism
 - (b) the determination of dimensions of the links in a mechanism
 - (c) the determination of displacement, velocity and acceleration of the links in a mechanism
 - (d) none of the above
- n) The synthesis of mechanism deals with
- (a) the determination of input and output angles of a mechanism
 - (b) the determination of dimensions of the links in a mechanism
 - (c) the determination of displacement, velocity and acceleration of the links in a mechanism
 - (d) none of the above

Attempt any four questions from Q-2 to Q-8.

Q-2

Attempt all questions

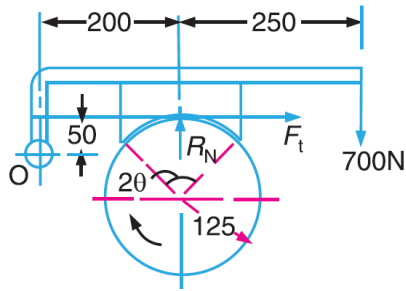
- (a) Describe with the help of a neat sketch the principles of operation of an internal expanding shoe. Derive the expression for the braking torque. (07)
- (b) A Porter governor has all four arms 250 mm long. The upper arms are attached on the axis of rotation and the lower arms are attached to the sleeve at a distance of 30 mm from the axis. The mass of each ball is 5 kg and the sleeve has a mass of 50 kg. The extreme radii of rotation are 150 mm and 200 mm. Determine the range of speed of the governor. (07)

Q-3

Attempt all questions

- (a) Describe the construction and operation of a rope brake absorption dynamometer. (07)
- (b) A single block brake is shown in Fig. The diameter of the drum is 250 mm and the angle of contact is 90° . If the operating force of 700 N is applied at the end of a lever and the coefficient of friction between the drum and the lining is 0.35, determine the torque that may be transmitted by the block brake. (07)





All dimensions in mm.

Q-4

Attempt all questions

- (a) Discuss effect of the Gyroscopic Couple on an aeroplane. (07)
- (b) The turning moment diagram for a petrol engine is drawn to the following scales: (07)
Turning moment, 1 mm = 5 N-m ; crank angle, 1 mm = 1°. The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line taken in order are 295, 685, 40, 340, 960, 270 mm². The rotating parts are equivalent to a mass of 36 kg at a radius of gyration of 150 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1800 r.p.m.

Q-5

Attempt all questions

- (a) Explain the turning moment diagram of a four stroke cycle internal combustion engine. (07)
- (b) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: (07)
- When the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h.
 - When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.

Q-6

Attempt all questions

- (a) State and explain D-Alembert's principle (07)
- (b) A four bar mechanism is to be synthesized by using three precision points, to generate the function $y = x^{1.5}$, for the range $1 < x < 4$. Input link is to start from 30° and is to have a range of 90°. The output link is to start at 0° and is to have a range of 90°. Find out values of x, y, input angles and output angles corresponding to three precision points. (07)

Q-7

Attempt all questions

- (a) Explain: function generation, path generation & motion generation. (07)
- (b) A connecting rod is suspended from a point 25 mm above the centre of small end, and 650 mm above its centre of gravity, its mass being 37.5 kg. When permitted to oscillate, the time period is found to be 1.87 seconds. Find the dynamical equivalent system constituted of two masses, one of which is located at the small end centre. (07)

Q-8

Attempt all questions



- (a) Define (i) Hunting (ii) Sensitiveness (iii) Sleeve lift and (iv) Isochronisms for governor. (07)
- (b) Draw and explain Klien's construction for determining the velocity and acceleration of the piston in a slider crank mechanism. (07)

