

Enrollment No: _____

Exam Seat No: _____

C.U.SHAH UNIVERSITY

Summer Examination-2018

Subject Name: Theory of Machines

Subject Code: 4TE04TOM1

Branch: B.Tech (Mechanical)

Semester: 4

Date: 05/05/2018

Time: 10:30 To 01:30

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.

Q-1

Attempt the following questions:

(14)

- a) The capacity of a brake depends upon
 - (a) Unit pressure between braking surface
 - (b) Coefficient of friction between braking surface
 - (c) Ability to heat dissipation
 - (d) All of above
- b) The brake commonly used in motor cars is
 - (a) shoe brake
 - (b) band brake
 - (c) band and block brake
 - (d) internal expanding brake
- c) For measuring large powers particularly the power transmitted along the propeller shaft of a turbine or motor vessel _____ dynamometer is used.
 - (a) Thronycroft dynamometer
 - (b) rope brake dynamometer
 - (c) torsion dynamometer
 - (d) epicyclic-train dynamometer
- d) In a Hartnell governor, if a spring of greater stiffness is used, then the governor will be
 - (a) more sensitive
 - (b) less sensitive
 - (c) isochronous
 - (d) none of these
- e) When the sleeve of a Porter governor moves upwards, the governor speed
 - (a) increases
 - (b) decreases
 - (c) remains unaffected
 - (d) zero
- f) A hunting governor is
 - (a) more stable
 - (b) less sensitive
 - (c) more sensitive
 - (d) none of these
- 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) The axis, about which the axis of spin is to turn, is known as
 - (a) spin vector
 - (b) axis of active gyroscopic couple
 - (c) axis of precession
 - (d) axis of reactive gyroscopic couple
- i) The air screw of an aeroplane is rotating clockwise when looking from the front. If it makes a left turn, the gyroscopic effect will
 - (a) tend to depress the nose and raise the tail
 - (b) tend to raise the nose and depress the tail
 - (c) tilt the aeroplane



- (d) none of the above
- j) The maximum fluctuation of energy is the
 (a) sum of maximum and minimum energies
 (b) difference between the maximum and minimum energies
 (c) ratio of the maximum energy and minimum energy
 (d) ratio of the mean resisting torque to the work done per cycle
- k) 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
- l) 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
- m) In an engine, the work done by inertia forces in a cycle is
 (a) positive (b) zero (c) negative (d) none of these
- 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) Classify 'governors' and prove for Watt governor, height of the governor $h = 895/N^2$. Where N is speed of rotation of sleeve. **07**
- (b) A band and block brake, having 14 blocks each of which subtends an angle of 15° at the centre, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find: 1. maximum braking torque, 2. angular retardation of the drum, and 3. time taken by the system to come to rest from the rated speed of 360 r.p.m. The coefficient of friction between blocks and drum may be taken as 0.25. **07**

Q-3

Attempt all questions

- (a) List types of mechanical brakes and also derive condition of self locking for simple shoe or block brake. **07**
- (b) A gramophone is driven by a Pickering governor. The mass of each disc attached to the centre of a leaf spring is 20 g. The each spring is 5 mm wide and 0.125 mm thick. The effective length of each spring is 40 mm. The distance from the



spindle axis to the centre of gravity of the mass when the governor is at rest, is 10 mm. Find the speed of the turntable when the sleeve has risen 0.8 mm and the ratio of the governor speed to the turntable speed is 10.5. Take $E = 210 \text{ kN/mm}^2$.

- Q-4** **Attempt all questions** **07**
- (a) Discuss Effect of the Gyroscopic Couple on an Aeroplane. **07**
- (b) The turning moment diagram for a multicylinder engine has been drawn to a scale $1 \text{ mm} = 600 \text{ N-m}$ vertically and $1 \text{ mm} = 3^\circ$ horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: $+ 52, - 124, + 92, - 140, + 85, - 72$ and $+ 107 \text{ mm}^2$, when the engine is running at a speed of 600 r.p.m. If the total fluctuation of speed is not to exceed $\pm 1.5\%$ of the mean, find the necessary mass of the flywheel of radius 0.5 m. **07**
-
- Q-5** **Attempt all questions** **07**
- (a) Prove that the maximum fluctuation of energy, $\Delta E = 2.E.C_s$ Where, $E =$ Mean kinetic energy of flywheel, and $C_s =$ Coefficient of fluctuation of speed. **07**
- (b) A ship is propelled by a turbine rotor having a mass of 6000 kg and speed of 2400 r.p.m. The direction of rotation of rotor is anticlockwise when viewed from the bow end. The radius of gyration of rotor is 450 mm. Determine the gyroscopic effect when:
- (i) Ship is steering to the left in a curve of 60 m radius at a speed of 18 knots (1 knot = 1860 m/hr).
- (ii) Ship is pitching in S.H.M. with bow descending (falling) with maximum velocity. The time period of pitching is 18 seconds and the ship pitches 7.5° above and 7.5° below the normal position.
- (iii) Ship is rolling and at the instant, its angular velocity is 0.035 rad/s counter clockwise when viewed from stern. **07**
-
- Q-6** **Attempt all questions** **07**
- (a) Explain: Function generation, path generation & motion generation. **07**
- (b) In a slider crank mechanism, the length of the crank and connecting rod are 150 mm and 600 mm respectively. The crank position is 60° from inner dead centre. The crank shaft speed is 450 r.p.m. (clockwise). Using analytical method, determine: 1. Velocity and acceleration of the slider, and 2. Angular velocity and angular acceleration of the connecting rod. **07**
-
- Q-7** **Attempt all questions** **07**
- (a) Draw and explain Klien's construction for determining the Velocity and Acceleration of the Reciprocating Parts in Engines. **07**
- (b) Determine the chebyshev spacing for function $y = 2x^3 - x$ for the range $0 \leq x \leq 4$, where four precession points are required. For these precision points, determine $\theta_2, \theta_3, \theta_4$ and ϕ_2, ϕ_3, ϕ_4 if $\Delta\theta = 45^\circ$ and $\Delta\phi = 90^\circ$. **07**
-
- Q-8** **Attempt all questions** **07**
- (a) Define (i) Hunting (ii) Sensitiveness (iii) Sleeve lift and (iv) Isochronisms for governor. **07**
- (b) Derive an expression for angle of heel of a two wheeler taking turn. **07**

