

Roll No.

Total No. of Pages : 02

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**B.Tech.(ME) (Sem.-3)**  
**THEORY OF MACHINES – I**  
**Subject Code : BTME-302-18**  
**M.Code : 76418**  
**Date of Examination: 11-12-2023**

Time : 3 Hrs.

Max. Marks : 60

**INSTRUCTIONS TO CANDIDATES :**

1. **SECTION-A** is **COMPULSORY** consisting of **TEN** questions carrying **TWO** marks each.
2. **SECTION-B** contains **FIVE** questions carrying **FIVE** marks each and students have to attempt any **FOUR** questions.
3. **SECTION-C** contains **THREE** questions carrying **TEN** marks each and students have to attempt any **TWO** questions.

**SECTION-A**

1. **Write briefly :**

- a) **Explain the terms :** i) Kinematic chain, and ii) Mechanism.
- b) Differentiate between 'Turning Pair' and 'Rolling Pair.' Also, categorise these pairs as lower pair or higher pair.
- c) What is the function of a 'Pantograph'?
- d) What are the various types of belts used for the transmission of power?
- e) Explain the phenomena of 'slip' in a belt drive.
- f) **Define the terms :** i) Pitch circle & ii) Stroke of the follower, as applied to cam with a neat sketch.
- g) Differentiate between 'Absorption dynamometer' and 'Transmission dynamometer'.
- h) Give the applications of friction clutches.
- i) Draw the turning moment diagram of a single cylinder double acting steam engine.
- j) Explain the term 'height of the governor'.

**SECTION-B**

2. Sketch and explain any two inversions of a slider crank chain.

3. Describe any one type of exact straight line motion mechanism with the help of a sketch.
4. Derive an expression to find the length of a belt in an open belt drive.
5. Determine the maximum, minimum and average pressure in plate clutch when the axial force is 4 kN. The inside radius of the contact surface is 50 mm and the outside radius is 100 mm. Assume uniform wear.
6. The turning moment diagram for a petrol engine is drawn to the following scales : 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 mm<sup>2</sup>. 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.

### SECTION-C

7. A cam is to be designed for a knife edge follower with the following data : a) Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion. b) Dwell for the next 30°. c) During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion. d) Dwell during the remaining 180°. Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft. The radius of the base circle of the cam is 40 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.
8. a) A band brake acts on the 3/4th of circumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 225 N-m. One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the operating force when the drum rotates in the i) anticlockwise direction, and ii) clockwise direction.  
 b) Describe the construction and operation of a Epicyclic-train dynamometer.
9. In a Hartnell governor, the lengths of ball and sleeve arms of a bell crank lever are 120 mm and 100 mm respectively. The distance of the fulcrum of the bell crank lever from the governor axis is 140 mm. Each governor ball has a mass of 4 kg. The governor runs at a mean speed of 300 r.p.m. with the ball arms vertical and sleeve arms horizontal. For an increase of speed of 4 per cent, the sleeve moves 10 mm upwards.  
 Neglecting friction, find : a) the minimum equilibrium speed if the total sleeve movement is limited to 20 mm, b) the spring stiffness, c) the sensitiveness of the governor, and d) the spring stiffness if the governor is to be isochronous at 300 r.p.m.

**NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.**