Roll No. ☐☐☐☐☐☐☐☐☐☐☐☐☐                          Total No. of Pages : 03

Total No. of Questions : 09

**B.Tech.(Marine Engineering) (2013 Onwards)**
**B.Tech.(Mechanical Engg.) (2011 Onwards)**
**(Sem.–3)**
**THEORY OF MACHINES – I**
**Subject Code : BTME-302**
**Paper ID : [A1139]**

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. What is the difference between lower and higher pairs? Give examples of each.

   b. What do you mean by instantaneous center? What are the properties of instantaneous center?

   c. Explain the phenomenon of slip and creep in belt drives.

   d. What do you mean by pitch circle and prime circle in the cam profile?

   e. Explain the principle on which band brake works.

   f. How the function of governor is different from that of flywheel? Explain.

   g. What do you mean by engine indicator? Explain with the help of a diagram.

   h. What do you mean by crowning of pulleys?

   i. What is meant by inversion of a mechanism?

   j. Explain the term sensitiveness and isochronism in governors.

## SECTION-B

2. Explain two inversions of slider crank mechanism, which are used in quick return mechanism.

3. Describe the various factors which govern the choice of cam profile. Explain with the help of velocity and acceleration diagram, why a cycloidal profile is preferred over SHM profile for cams used in high speed application?

4. A flat belt of $200 \times 12$ mm$^2$ cross-section runs between two pulleys. The allowable strength of belt material is 2.5 N/mm$^2$. Determine the maximum power that can be transmitted by it, if the ratio of tension is 2 and the density of material of the belt is 1000 kg/m$^3$.

5. Write down the condition of correct steering. What are different kinds of steering gears? Explain with the help of neat sketches with the relative advantages of each.

6. A punching machine has a capacity of producing 30 holes of 20 mm diameter per minute in a steel plate of 16 mm thickness. The material of the plate has ultimate shear strength of 360 N/mm$^2$. The actual punching operation lasts for a period of 36° rotation of the crankshaft. This crankshaft is powered by a flywheel through a reduction gear having a ratio of 1:8.

   Mechanical efficiency = 80%, speed fluctuation = 10%, mean diameter of flywheel = 0.75 m.

   Determine the following :

   a) power required

   b) fluctuation of energy

   c) cross-section of rim if the width of the thickness ratio is 1.5.

## SECTION-C

7. A cam with 30 mm minimum radius is rotating clockwise at 1200 rpm to give the follower motion to a roller follower of 20 mm diameter,

   a) lift = 25 mm,

   b) follower rises during 120° cam rotation with simple harmonic motion,

   c) follower to dwell for 60° cam rotation,

   d) follower to return during 90° cam rotation with uniform acceleration and deceleration,

   e) follower to dwell for the remaining period.

   Draw the profile of the cam and determine the maximum velocity and acceleration during rise and return stroke.

8. a) Explain the working of Wilson-Hartnell governor with the help of a neat sketch.

   b) In a Wilson-Hartnell governor, the two springs are attached to the balls. Each has a stiffness of 0.75 N/mm and free length of 120 mm. The mass of each ball is 4 kg, the length of the ball arm of each bell crank lever is 80 mm and that of the sleeve arm is 70 mm; the auxiliary spring lever is pivoted at its mid-point. When the radius of rotation of the ball is 100 mm, the equilibrium speed is 300 rpm. If the sleeve is to lift by 8 mm for 5% increase of speed, determine the required stiffness of the auxiliary spring.

9. Write a short notes on the following :

   a) Friction devices and clutches.

   b) Absorption and transmission dynamometers.