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Total No. of Questions: 09

Total No. of Pages: 02

**B.Tech. (ME) (Sem. 4)**  
**THEORY OF MACHINES - II**  
**Subject Code: BTME-402**  
**Paper ID: A1212**

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) Differentiate between the static and dynamic force.
- b) What are the various conditions for a body to be in equilibrium under the action of two forces with a torque?
- c) What are the difference between piston effort, crank effort and crank-pin effort?
- d) How the different masses rotating in different planes are balanced?
- e) Discuss the advantages and applications of cycloidal tooth profile.
- f) What do you understand by interference? How can we avoid this?
- g) Discuss the effect of gyroscopic couple of motion of an aero plane negotiating a turn.
- h) Explain the word synthesis in reference to mechanism.
- i) What do you understand by Grashof's law and inversion of Grashof's linkage?
- j) Describe the main advantages of double helical gear over single helical gear.

**SECTION B**

2. What are the free body diagrams of a mechanism? Explain the implementation of this concept for a four link mechanism.
3. What do you understand by balancing of reciprocating masses? Find out the primary and secondary unbalanced forces for slider crank mechanism.

4. Two spiral gear wheels of diameter ratio 1.5 are used on a machine tool. The angle between shafts is  $76^\circ$  and the approximate centre distance is 11.5 cm. Speed of A is 1.5 times the speed of B and normal pitch is 1 cm. Find the number of teeth on each wheel and spiral angle for each wheel.

5. For the four bar linkage, the following data are given:

$$\theta_2 = 60^\circ, \quad \theta_4 = 90^\circ, \quad \omega_2 = 3 \text{ rad/sec}, \quad \alpha_2 = -1 \text{ rad/sec}^2, \quad \omega_4 = 2 \text{ rad/sec}, \quad \alpha_4 = 0$$

Determine the link length ratios with the help of freudenstein's equation.

6. Write the classification of kinematic synthesis problem. Explain each of them in detail.

### SECTION C

7. A vertical single cylinder engine has a cylinder diameter of 250 mm and stroke length of 450 mm. The reciprocating parts have a mass of 180 kg. The connecting rod is four times the crank radius and the speed is 360 r.p.m. When the crank has turned through an angle of  $45^\circ$  from top dead centre, the net pressure on the piston is  $1.05 \text{ MN/m}^2$ . Calculate the effective turning moment on the crankshaft for this position.

8. In an epicyclic gear train, internal wheels A and B and the compound wheels C and D rotates independently about axis O. The wheels E and F rotates on pins fixed to the arm G. E gear with A and C and F gears with B and D. All wheels have the same module and the number of teeth are:

$$T_C = 28, \quad T_D = 26, \quad T_E = T_F = 18$$

- Find the number of teeth on A and B:
- If the arm G makes 100 r.p.m. clockwise and A is fixed, find the speed B:
- If the arm G makes 100 r.p.m. clockwise and wheel A makes 10 r.p.m. counter clockwise, find the speed of gear B.

9. What do you understand by gyroscope? Discuss the effect of the gyroscopic couple on a two wheeled vehicle when taking a turn with neat and clean diagram.