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Total No. of Pages : 03

Total No. of Questions : 09

B.Tech.(ME) (2011 onwards) (Sem.-4)

**THEORY OF MACHINES-II**

Subject Code : BTME-402

Paper ID : [A1212]

Time : 3 Hrs.

Max. Marks : 60

**INSTRUCTION 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 has to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students has to attempt any TWO questions.

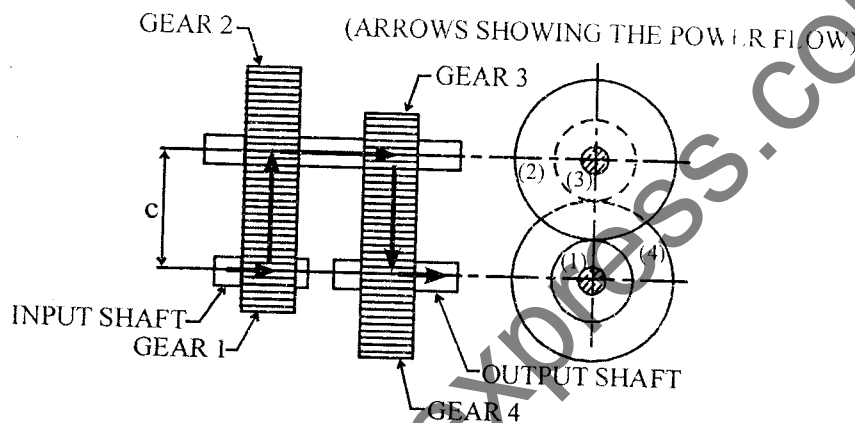
**SECTION-A**

**1. Write briefly :**

- a. What do you understand by applied forces and constrain forces? Explain with the help of suitable example.
- b. What is meant by dynamically equivalent system?
- c. What is meant by the term "crank effort"?
- d. Define the following terms as related to gears :  
Module, Pressure angle.
- e. What advantage double helical gears have over single helical gears?
- f. Why is balancing necessary for rotors of high speed engines?
- g. What is a gear train? What are its main types?
- h. Explain the terms as related to balancing of reciprocating masses –  
Primary balancing, Secondary balancing
- i. Explain the term as related to synthesis of mechanisms : Path generation.
- j. Explain the effect of gyroscopic couple on the motion of an aero plane negotiating a turn.

## SECTION-B

2. What are free body diagrams of a mechanism? Explain the implementation of this concept for a four link mechanism.
3. Figure 1 shows a reverted gear train comprising of gears 1, 2, 3 and 4. Center distance ( $c$ ) between two shafts is 180mm. Module of the gears 1 and 2 is 2.5 mm and gear 3 and 4 is 3mm. Given train is required to step down the input motion through a factor of 10:1. If the minimum number of teeth on any gear in the train is limited to 25, calculate the suitable number of teeth on all the gears.



4. Derive the expression for length of path of contact between two mating spur gears.
5. The number of teeth on each of the two equal spur gears in mesh are 40. The teeth have  $20^\circ$  involute profile and the module is 6 mm. If the arc of contact is 1.75 times the circular pitch, find the addendum.
6. What is pole of a coupler link of four link mechanism? List down its properties. What is relative pole?

## SECTION-C

7. A shaft has three eccentrics, each of length 20 mm and diameter 70mm. Axial distance between these eccentrics is 75mm. Distance of these eccentrics from the axis of the shaft are 15mm, 20 mm and 15mm respectively and their angular positions are  $120^\circ$  apart. Shaft material has a density of  $7200 \text{ kg/m}^3$ . If the shaft is running at 500 RPM, calculate the out of balance force and out of balance couple.

Further, if the shaft is to be balanced by adding two masses at radius of 50mm and these balancing masses are to be placed 110 mm from the central plane of the middle eccentric, calculate the masses required and their angular positions.

8. Length of connecting rod of a vertical double acting steam engine is 1.5 meter. Diameter of the cylinder is 400 mm and stroke of the engine is 600 mm. The crank is rotating at 200 rpm in clockwise direction. Crank has turned  $40^\circ$  from its top dead center and the piston is moving downwards. Steam pressure above the piston is  $0.6 \text{ N/mm}^2$  and below the piston is  $0.05 \text{ N/mm}^2$ . The mass of the reciprocating parts is 200 kg. Diameter of the piston rod is 50 mm. Find the thrust on the guide bars and crank shaft bearing and also the turning moment on the crank shaft.
9. A four wheel automobile has its engine mounted on its rear end. The engine axis is parallel to the rear axle and it rotates in the same direction as the wheels. It has to negotiate a curve of radius 100 m so that none of the wheels is lifted off the ground. Following details of the vehicle are given :

Track width = 1.4 m

Inertia of all the rotating parts of engine =  $1.5 \text{ kgm}^2$

Mass of the vehicle = 2400 kg

Wheel diameter = 600 mm

Inertia of each wheel =  $2.5 \text{ kgm}^2$

Gear ratio from engine to wheels = 1:4

Height of CG of vehicle from ground = 0.5 m.