

Theory of Machines-II
(ME-204/206, Dec-2007)

Note: Section A is compulsory. Attempt any four questions from Section-B and any two from Section-C.

Section-A

- a. a) Define 'Inertia Force'.
- b. b) What do you mean by 'Dynamically Equivalent System'?
- c. What is 'Secondary Unbalanced Force'?
- d. Define the term 'Swaying Couple'.
- e. Explain the term 'Pressure Angle' w.r.t. Gears.
- f. Define 'Axial pitch' relating to helical gears.
- g. What is difference between 'Path of contact' and 'Arc of contact'?
- h. What is the special advantage of Epicyclic Gear train?
- i. What is D'Alembert's principle?
- j. Explain the meaning of term 'Gyroscopic Torque'.

Section-B

- 1) Find the inertia force for the following data of an IC engine. Bore: 175 mm, Stroke: 200mm, Engine speed: 500 rpm, length of connecting rod: 400mm, crank angle: 60° from TDC, and mass of reciprocating parts: 180kg.
- 2) Derive an expression for "Swaying Couple".
- 3) A pair of spiral gears is required to connect two shafts 165 mm apart, the shaft angle being 75° . The velocity ratio to be 1.5 to 1, the faster wheel having 80 teeth and the pitch circle diameter of 95 mm. Find the spiral angles for each wheel.
- 4) In a reverted epicyclic train: the arm A carries two wheels B and C and a compound wheel D-E. The wheel B gears with wheel E and the wheel C gears with wheel D. The number of teeth on wheels B, C and D are 80, 35 and 95 respectively. Find the speed and direction of wheel C when wheel B is fixed and the arm A makes 120 rpm clockwise.
- 5) What will be the effect of the gyroscopic couple on a disc fixed at a certain angle to a rotating shaft?

Section-C

- 6) Derive expressions for the velocity and acceleration of the piston of a slider crank mechanism in terms of crank radius r , connecting rod length l , crank angle θ from inner dead centre position and the constant angular velocity w of the crank.
- 7) An air compressor has four vertical cylinders 1, 2, 3 and 4 in line and the driving cranks at 90° intervals reach their uppermost positions in this order. The cranks are of 150 mm radius, the connecting rods 500 mm long and the cylinder centre line 400 mm apart. the reciprocating parts for each cylinder weigh 22.5 kg and the speed of rotation is 400 rpm. Show that there are no out of balance primary or secondary forces and determine the corresponding couples, indicating the position of No. 1 cranks for maximum values, the central plane of the machine may be taken as reference plane.
- 8) (a) A pair of involute spur gears with 16° pressure angle and pitch in module 6 mm is in mesh, the number of teeth on pinion is 16 and its speed is 260 rpm. When the gear ratio is 1.8, find in order that the interference is just avoided, (i) The addenda on pinion and the gear wheel, (ii) The length of path of contact (iii) The maximum velocity of sliding of teeth on either side of the pitch point.
(b) State the conditions of correct gearing.