

Subject Name: MECHANICS OF MACHINES

Pass Marks: 35

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in the respective section.

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. A combination of kinematic pairs, joined in such a way that the relative motion between the links is completely constrained, is called a _____.

a. Structure	b. Mechanism
c. Kinematic chain	d. Inversion

2. The mechanism forms a structure when the number of degrees of freedom (n) is equal to

a. 0	b. 1
c. 2	d. - 1

3. The Grubler's criterion for determining the degrees of freedom (n) of a mechanism having plane motion is

a. $n = (l - 1) - j$	b. $n = 2(l - 1) - 2j$
c. $n = 3(l - 1) - 2j$	d. $n = 4(l - 1) - 3j$

where l = Number of links, and j = Number of binary joints.

4. When the crank is at the inner dead centre, in a horizontal reciprocating steam engine, then the velocity of the piston will be

a. zero	b. minimum
c. maximum	d. average

5. The contact ratio is the ratio of arc of contact to the _____.

a. module	b. circular pitch
c. dedendum	d. addendum

6. In a radial cam, the follower moves

a. in a direction perpendicular to the cam axis
b. in a direction parallel to the cam axis
c. In any direction irrespective of the cam axis
d. along the cam axis

7. The law of gearing is satisfied if
- a. two surfaces slide smoothly
 - b. number of teeth = Pitch Circle Diameter / module
 - c. addendum is greater than dedendum
 - d. common normal at the point of contact passes through the pitch point on the line joining the centres of rotation
8. For dynamic balancing of a shaft,
- a. the net dynamic force acting on the shaft is equal to zero
 - b. the net couple due to dynamic forces acting on the shaft is equal to
 - c. both a) and b)
 - d. none of the above
9. The ratio of the maximum displacement of the forced vibration to the deflection due to the static force is known as _____.
- a. damping factor
 - b. damping coefficient
 - c. logarithmic decrement
 - d. magnification factor
10. In a simple harmonic oscillation, the acceleration against displacement for one complete oscillation will be
- a. an ellipse
 - b. a circle
 - c. a parabola
 - d. a straight line

Section B

Five Questions of 02 Marks each

- 11. Define kinematic link and kinematic chain
- 12. State the advantages of gear drives over belt drives.
- 13. What is a Cam? Mention the types of the followers.
- 14. Differentiate between static and dynamic balancing.
- 15. Define free, forced, and damped vibrations?

Section C

Seven Questions of 10 Marks each, of which any 05 questions are to be answered.

16. a) In an engine mechanism, the length of the crank and connecting rod are 150 mm and 600 mm, respectively. The crank position is 60° from top dead centre. The crankshaft speed is 450 r.p.m. (clockwise). Determine:
- i. Velocity and acceleration of the piston
 - ii. Angular velocity and angular acceleration of the connecting rod.

16. b) Apply Grubler's criterion to the mechanism shown in Fig.Qt-16b and find the degrees of freedom.

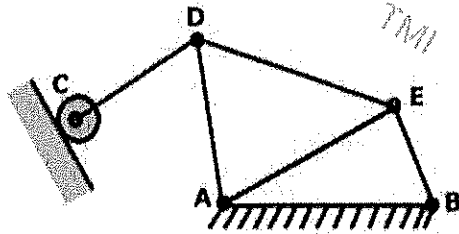
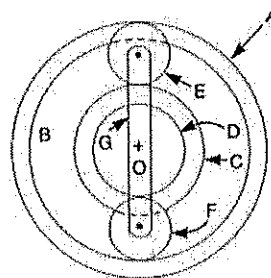


Fig.Qt-16b

[6+4 Marks]

17. State and prove law of gearing. Show that involute profile satisfies the conditions for correct gearing.
18. In an epicyclic gear train the internal wheels A & B are compound wheels C & D rotate independently about axis O. The wheel E & F rotate on pins fixed on the arm G. E gears with A & C. Wheel F gears with B & D. All the wheels have the same module and the number of teeth is $T_C=28$; $T_D = 26$; $T_E = T_F= 18$.
- 1) Sketch the arrangement
 - 2) Find the number of teeth on A & B.
 - 3) If the arm G makes 100 rpm clockwise and A is fixed, find the speed of B.
 - 4) If the arm G makes 100 rpm clockwise and wheel A make 10 rpm counter clockwise, find the speed of B.



19. A cam is to give the following motion to a knife-edged follower: Outstroke during 60° of cam rotation. Dwell for the next 30° of cam rotation. Return stroke during the next 60° of cam rotation, and Dwell for the remaining cam rotation. The stroke of the follower is 40 mm, and the minimum radius

of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Draw the profile of the cam when the axis of the follower is offset by 20 mm from the axis of the cam shaft.

20. A shaft carries four masses A, B, C, D of magnitude 200kg, 300kg, 400kg and 200kg respectively and revolving at radii 80mm, 70mm, 60mm and 80mm in planes measured from A at 300mm, 400mm, and 700mm. The angles between the cranks measured anticlockwise are A to B is 45° , B to C is 70° , C to D is 120° . The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100mm, between X and Y is 400mm and distance Y and D is 200mm. If the balancing masses revolve at a radius of 100mm, find their magnitudes and angular positions.
21. A 4-stroke five-cylinder in-line engine is required to be examined for static and dynamic balance. It has a firing order of 1-4-5-3-2-1. The distance between centre lines is 150 mm, and the reciprocating mass for each cylinder is 1.5 kg; the engine stroke length is 100 mm, and the connecting rod length is 175 mm. The engine runs at 600 rpm. Examine the engine for balance and determine primary and secondary unbalance couples. Determine the angle at which primary couple reaches its maximum value.
22. A shock absorber is to be designed for a motorcycle of mass 200 kg to sustain shocks during a road bump. During a road bump, the damped period of vibrations is to be limited to 2 seconds, and the amplitude of vibration should reduce to one-sixteenth in one cycle. Find i) stiffness and ii) the damping coefficient of the shock absorber so that the motorcycle can take shocks efficiently without failure.

Please read the Q No 8 as follows:

For dynamic balancing of a shaft,

- a. the net dynamic force acting on the shaft is equal to zero
- b. the net couple due to dynamic forces acting on the shaft is equal to **zero**
- c. both a) and b)
- d. none of the above

Please read the following part of Q No 18 as follows:

QUESTION NO 18 .

For - internal wheels A&B are compound wheels C&D rotate independently about axis O

Read - wheel A& B are internal gears and C&D are compound gears

