2013

THEORY OF MACHINES

Time Allotted : 3 Hours   *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words

as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

i) The pressure angle of a cam is the angle at any point on

the pitch curve at an instant

a) made by line of motion of the follower with

horizontal axis

b) made by line of motion of the follower with vertical

axis

c) between normal to that point on the curve and the

line of the motion of follower

d) between tangent to the point on the curve and the

line of motion of the follower.

ii) Sensitiveness of a governor is the ratio of

a) mean speed to range of speed

b) range of speed to mean speed

c) maximum equilibrium speed to mean speed

d) minimum equilibrium speed to mean speed.

iii) Klein's construction is used when the crank has

a) uniform acceleration

b) uniform angular velocity

c) non-uniform acceleration

d) non-uniform angular velocity.

iv) The stroke of the follower is equal to

a) half of maximum travel of the follower from lowest

position to topmost position

b) maximum travel of the follower from lowest

position to topmost position

c) half of diameter of the base circle

d) half of diameter of the prime circle.

v) Friction, at the sleeve of he governor

a) increases the sensitiveness of the governor

b) decreases the sensitiveness of the governor

c) has no effect on the sensitiveness of governor

d) increases first and then decreases the

sensitiveness of the governor

vi) The tension caused by centrifugal force on the belt

a) increases power transmission

b) decreases power transmission

c) does not affect power transmission

d) affect power transmission temporarily.

vii) On which circle or curve does the size of the cam

depend ?

a) prime circle b) base circle

c) pitch circle d) pitch curve.

viii) When the speed of the governor decreases, the height of

governor

a) and radius of rotation both increase

b) and radius of rotation both decrease

c) decreases but radius of rotation increases

d) increases but radius of rotation decreases.

ix) The module of gear is the ratio of

a) number of teeth to pitch diameter

b) pitch diameter to number of teeth

c) circumference of pitch circle to number of teeth

d) none of these.

x) If the ratio of connecting rod length to crank radius be very large, then

a) primary forces are negligible

b) primary forces are maximum

c) secondary forces are negligible

d) secondary forces are maximum.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Explain all the inversions of single slider crank mechanism with neat sketches and specify their use.

3. Draw the displacement, velocity and acceleration diagrams for a follower when it moves with a simple harmonic motion. Also derive the expressions for maximum velocity and accelerations during outstroke.

4. Describe in detail's the procedure of reducing a geared rotor system to an equivalent single shaft two rotor system when the inertia of the gearing is neglected.

5. In connection with governors, explain the following terms :

(i) Sensitiveness

(ii) Stability

(iii) Isochronism

(iv) Hunting.

6. What do you mean by logarithmic decrement ? Find expression for logarithmic decrement in terms of the damping ratio.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) For a slider crank mechanism of a reciprocating engine, locate all the instantaneous centres. 5

b) Crank of a slider-crank mechanism is 150 mm and rotates clock-wise at a constant speed of 300 rpm. The connecting rod is 750 mm. Calculate the velocity and acceleration of the slider when the crank has turned 30° from inner dead centre. 10

8. a) For a given distance between the centres of the two pulleys and their diameters, show that the length of the cross-belt drive exceeds the length of the open-belt drive by the product of diameters of two pulleys divided by the distance between the centres of the two pulleys. 7

b) The included angle of V-groove is 30° in which the belt sinks 2 cm and the maximum width of the belt is also 2 cm. If the mass of the belt is 3·5 gm per cm length and the maximum allowable stress is 140 N/cm², determine the maximum power transmitted when angle of lap is 140° and the co-efficient of friction between belt and pulley is 0·15. 8

9. a) Two parallel shafts are connected with the help of a pinion and a gear on each shaft respectively. The number of teeth on pinion is 40 and its shaft speed is 500 rpm. If the speed ratio is 2·5 and the circular pitches of the pinion and the gear are 24 mm, then find (i) number of teeth on the gear with shaft speed and (ii) centre distance between the two shafts. 6

b) An epicyclic gear train as shown in the following figure is composed of a fixed annular wheel A having 150 teeth. Meshing with A is a wheel B which drives wheel D through an idle wheel C. D is concentric with A. Wheels B and C are carried on an arm which revolves clockwise

at 100 rpm about the axis of *A* or *D*. If the wheels *B* and *D* are having 25 teeth and 40 teeth respectively, find the number of teeth on *C*, the speed of C and the sense of its rotation. 9
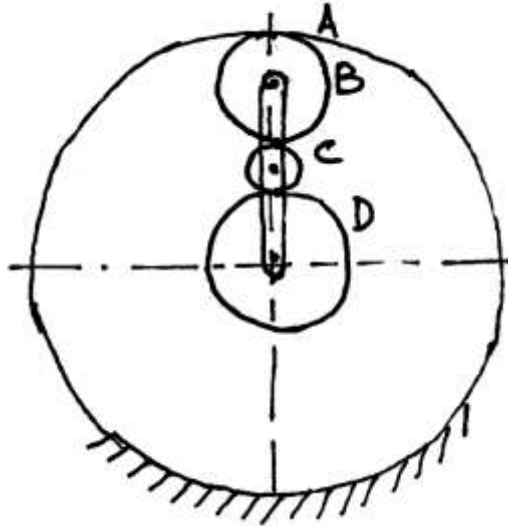
10. a) Explain the procedure of balancing primary and secondary forces in a symmetrical two cylinder V-engine having a common crank. 7

b) A 4-cylinder vertical engine is in complete primary balance. The length of all cranks is 150 mm. The planes of rotation of the first, second and fourth cranks are 400 mm, 200 mm and 200 mm respectively from the third crank and their reciprocating masses are 50 kg, 60 kg and 50 kg respectively.

Find :

(i) the mass of the reciprocating parts of the third cylinder

(ii) the relative angular positions of the cranks. 8

11. a) What do you understand by isolation of machine vibrations ? Derive an expression for transmissibility when a viscous damper is used to reduce the effect of

resonance. 7

b) A shaft is simply supported at the ends and is 20 mm in diameter and of 600 mm span. The shaft carries a load of 9·81 N at the mid-span. The weight of shaft per metre length is 124·1 N. Find the critical speed of the shaft. Take Young's modulus of the shaft material as 200 GN/m². 8

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