Reg. No. :

Question Paper Code : 40639

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Third/Fourth Semester
Automobile Engineering
AT 6302 – MECHANICS OF MACHINES
(Common to Aeronautical Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering)
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Define Kinematic Chain.
2. What are the important concepts in velocity analysis ?
3. What are the advantages and limitations of gear drive ? Write any two.
4. Where the epi-cyclic gear trains are used ?
5. Why self-locking screws have lesser efficiency ?
6. What is meant by initial tension in belts ?
7. Differentiate between static force analysis and dynamic force analysis.
8. State principle of superposition.
9. Differentiate between the unbalanced force caused due to rotating and reciprocating masses.
10. Define logarithmic decrement.

PART – B **(5×13=65 Marks)**

11. a) PQRS is a four bar chain with link PS fixed . The lengths of the links are PQ = 62.5 mm ; QR = 175 mm ; RS = 112.5 mm ; and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS.

(OR)

b) A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below :

1) To raise the valve through 50 mm during 120° rotation of the cam ;
2) To keep the valve fully raised through next 30° ;
3) To lower the valve during next 60° ; and
4) To keep the valve closed during rest of the revolution i.e. 150° ;

The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when the line of the stroke is offset 15 mm from the axis of the cam shaft. The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the valve rod when the cam shaft rotates. at 100 r.p.m.

12. a) A pair of involute spur gears with 16° pressure angle and pitch of module 6 mm is in mesh. The number of teeth on pinion is 16 and its rotational speed is 240 r.p.m. When the gear ratio is 1.75, find in order that the interference is just avoided ;
1) The addenda on-pinion and gear wheel ;
2) The length of path of contact ; and
3) The maximum velocity of sliding of teeth on either side of the pitch point.

(OR)

b) An epicyclic gear consists of three gears A, B and C as shown in Fig. 1. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 p.m. If the gear A is fixed, determine the speed of gears B and C.

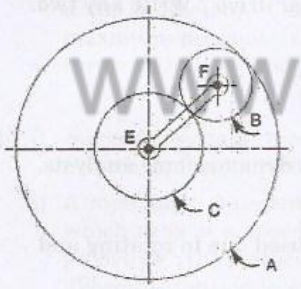

Figure 1

13. a) The pitch of 50 mm mean diameter threaded screw of a screw jack is 12.5 mm. The coefficient of friction between the screw and the nut is 0.13. Determine the torque required on the screw to raise a load of 25 kN, assuming the load to rotate with the screw. Determine the ratio of the torque required to raise the load to the torque required to lower the load and also the efficiency of the machine.

(OR)

b) Determine the width of a 9.75 mm thick leather belt required to transmit 15 kW from a motor running at 900 r.p.m. The diameter of the driving pulley of the motor is 300 mm. The driven pulley runs at 300 r.p.m. and the distance between the centre of two pulleys is 3 metres. The density of the leather is 1000 kg/m^3. The maximum allowable stress in the leather is 2.5 MPa. The coefficient of friction between the leather and pulley is 0.3. Assume open belt drive and neglect the sag and slip of the belt.

14. a) A four-link mechanism with the following dimensions is acted upon by a force 80 N at angle 150° on link DC [Fig. 2 : AD = 50 mm, AB = 40 mm, BC = 100 mm, DC = 75 mm, DE = 35 mm. Determine the input torque T on the link AB for the static equilibrium of the mechanism for the given configuration.

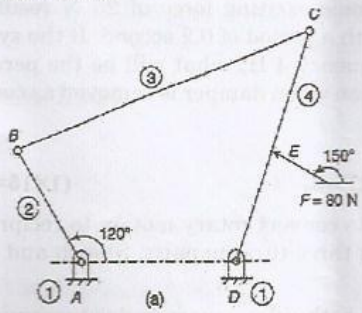

Figure 2

(OR)

b) For the static equilibrium of the quick return mechanism shown in Fig. 3 determine the input torque T_2 : to be applied on link AB Tor a force of 300 N on the slider D. The dimensions of the various links arc OA = 400 mm, AB = 200 mm, OC = 800 mm. CD = 300 mm.

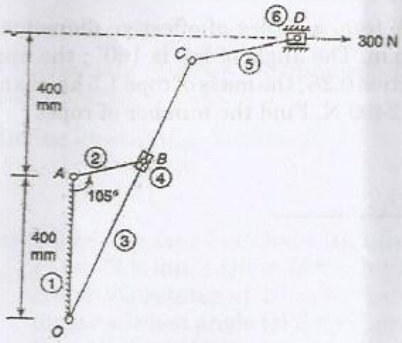

Figure 3

15. a) Four masses A, B, C and D as shown below are to be completely balanced.

	A	B	C	D
Mass (kg)	–	30	50	40
Radius (mm)	180	240	120	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°. B and C make angles of 210° and 120° respectively with D in the same sense. Find the magnitude and the angular position of mass A ; and the position of planes A and D.

(OR)

b) A machine part of mass 2 kg vibrates in a viscous medium. Determine the damping coefficient when a harmonic exciting force of 25 N results in a resonant amplitude of 12.5 mm with a period of 0.2 second. If the system is excited by a harmonic force of frequency 4 Hz what will be the percentage increase in the amplitude of vibration when damper is removed as compared with that with damping.

PART – C **(1×15=15 Marks)**

16. a) i) Suggest a suitable mechanism to convert rotary motion to reciprocating motion, comprising of minimum three turning pairs. Sketch and explain the same mechanism. **(8)**

ii) A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 r.p.m. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.255, the ratio of radii is 1.25 and the maximum pressure is not to exceed 0.1 N/mm². Also determine the axial thrust to be provided by springs. Assume the theory of uniform wear. **(7)**

(OR)

b) i) Suggest a suitable mechanism to connect two shafts whose axes are offset. Sketch and explain the same mechanism. **(8)**

ii) A rope drive transmits 600 kW from a pulley of effective diameter 4 m, which runs at a speed of 90 r.p.m. The angle of lap is 160° ; the angle of groove 45° ; the coefficient of friction 0.28 ; the mass of rope 1.5 kg/m and the allowable tension in each rope 2400 N. Find the number of ropes required. **(7)**

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