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Question Paper Code : 52582

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth Semester

Mechanical and Automation Engineering

AN 6402 — KINEMATICS AND DYNAMICS OF MACHINERY

(Common to Robotics and Automation Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

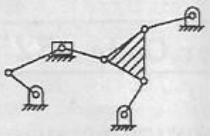
Answer ALL questions.

PART A — (10 × 2 = 20 marks)

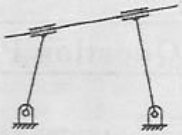
1. What do you mean by kinematic inversions?
2. Define face and flank with respect to cams.
3. Why involute tooth profile is preferred for gears in Industries?
4. What is crowning in gears?
5. Define tractive resistance.
6. Why do we use square threads in screw jacks?
7. What are free-body diagrams?
8. State the main difference between the static and dynamic force analysis.
9. Why balancing of rotating parts is more important in high speed machines?
10. What is the purpose of modal analysis in vibration?

PART B — (5 × 13 = 65 marks)

11. (a) Determine the degree of freedom of the mechanisms shown in Fig.



(i)



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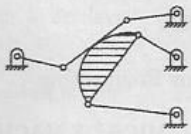


(iii)

Or

(b) Figure 11(b) shows a mechanism in which OA = 300 mm, AB = 600 mm, AC = BD = 1.2 m. OD is horizontal for the given configuration. If OA rotates at 200 rpm in the clockwise direction, find

(i) Linear velocities of C and D

(ii) angular velocities of links AC and BD

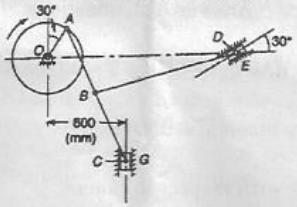
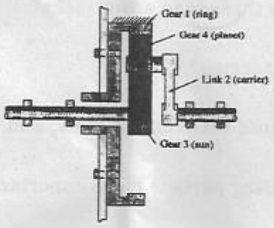


Figure Q. 11 (b)

12. (a) A planetary gear train is illustrated in Figure. The carrier (link 2) serves as the input to the train. The ring gear (gear 1) is the fixed gear and has 120 teeth. The planet gear (gear 4) has 40 teeth. The sun gear (gear 3) serves as the output from the train and has 30 teeth. Determine the rotational velocity of all members of this gear train when the input shaft rotates at 1200 rpm clockwise.



Planetary train

Or

(b) The number of teeth on each of the two equal spur gears in mesh are 40. The teeth have 20° involute profile and the module is 6 mm. If the arc of contact is 1.75 times the circular pitch, find the addendum.

13. (a) An electric motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 300 mm/min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at the screw threads is 0.1. Estimate power of the motor.

Or

(b) A single dry plate clutch transmits 7.5 kW at 900 r.p.m. The axial pressure is limited to 0.07 N/mm². If the coefficient of friction is 0.25, find 1. Mean radius and face width of the friction lining assuming the ratio of the mean radius to the face width as 4, and 2. Outer and inner radii of the clutch plate.

14. (a) Write a short note on static force analysis of a. slider crank mechanism and derive the expressions for (i) piston side thrust, (ii) force along the connecting rod (iii) Tangential force at the crank pin.

Or

(b) The dimensions of a four link mechanism are, AB = 500 mm, BC = 660 mm, CD = 560 mm and AD = 1000 mm. The link AB has an angular velocity of 10.5 rad/s counter clockwise and an angular retardation of 26 rad/s² at the instant when it makes an angle of 60° with AD, the fixed link. The mass of the links BC and CD is 4.2 kg/m length. The link AB has a mass of 3.54 kg, the centre of which lies at 200 mm from A and a moment of inertia of 88500 kg-mm². Neglecting gravity and friction effects, determine the instantaneous value of the drive torque required to be applied on AB to overcome inertia forces.

15. (a) A body vibrating with viscous damping makes 10 complete oscillations per second and in 100 cycles its amplitude diminishes 10%. Calculate the logarithmic decrement, and determine the damping constant n and the damping ratio n/ω. In what proportion would the period of vibration be decreased if damping were removed?

Or

(b) A flywheel is mounted on a vertical shaft as shown in Fig.15 (b). The both ends of the shaft are fixed and its diameter is 50 mm. The flywheel has a mass of 500 kg. Find the natural frequencies of longitudinal and transverse vibrations. Take E = 200 GN/m².

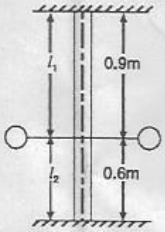


Figure Q. 15 (b)

PART C — (1 × 15 = 15 marks)

16. (a) Three pulleys A, B and C are mounted on a shaft. Axial distance between A and B is 1200 mm and that between B and C is 900 mm. The pulleys A, B and C have a mass of 15 kg, 20 kg and 16 kg and have their centers of gravity at a distance of 25 mm, 10 mm and 20 mm respectively from the axis of rotation. Bearings supporting the shaft are located 2.65 m apart and are equidistant from pulleys A and C. Find the angular position of the centers of gravity of the various pulleys graphically, so that the static balance is achieved. It is desired to place weights at a radial distance of 400 mm, so that the dynamic balance is achieved. If the weights are to be placed in pulleys A and C, find the magnitude and angular positions of the desired masses graphically.

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:

(i) To raise the valve through 50 mm during 120° rotation of the cam; (ii) To keep the valve fully raised through next 30°; (iii) To lower the valve during next 60°; and (iv) To keep the valve closed during rest of the revolution i.e. 150°; The diameter of the roller is 20mm 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. Draw the displacement, the velocity and the acceleration diagrams for one complete revolution of the cam.

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