

II B. Tech II Semester Supplementary Examinations, April - 2021
KINEMATICS OF MACHINERY
 (Com to ME, AME, MIN)

Time: 3 hours

Max. Marks: 70

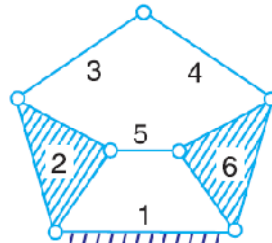
- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
 2. Answer **ALL** the question in **Part-A**
 3. Answer any **FOUR** Questions from **Part-B**

PART -A

1. a) Write down Kutzbach criterion to find the mobility of a planar mechanism. (3M)
- b) Explain about pantograph (2M)
- c) Define the following terms for a cam mechanism: pressure angle, base circle, angle of ascent and offset. (2M)
- d) What are the various types of motions of follower (3M)
- e) What is a differential gear? Where is it used? (2M)
- f) Explain the phenomena of 'slip' and 'creep' in a belt drive. (2M)

PART -B

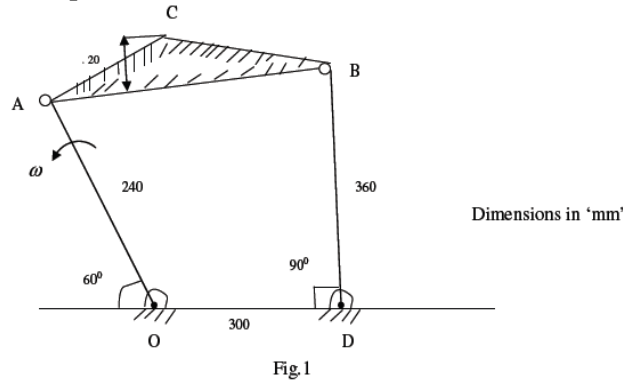
2. Describe the following mechanisms with neat sketches and state on which kinematic chain each one is based: (i) Beam engine (ii) Whitworth quick return mechanism (iii) Scott Russel mechanism (iv) oldham coupling (14M)
3. a) Determine the mobility (degrees of freedom) of the mechanism shown in Fig. using Kutzbach mobility criterion. (7M)



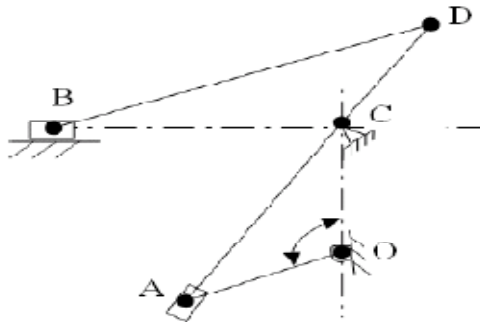
- b) Crank of a slider crank mechanism rotates clockwise at a constant speed of 300rpm, crank and connecting rod are of lengths 150mm and 600 mm respectively. Determine the following; at a crank angle of 45° from inner dead centre position (i) Linear velocity and acceleration of the midpoint of connecting rod (ii) Angular Velocity and angular acceleration of the connecting rod. (7M)



4. A mechanism consists of a four bar chain as shown in figure 1. The connecting rod 'ACB' making an isosceles triangle is a rigid body. Find the velocity of point C, the acceleration of B, when the crank OA rotates, in the counter clock wise direction at 30 rad/sec at constant speed (14M)



5. A shaper mechanism is shown in figure. The crank OA rotates at uniform speed of 20 rpm clockwise. The guide block A slides along the slotted lever AD that has its fulcrum at 'C'. The connecting rod BD connects the tool head B to AD. The tool head is constrained to move along BC perpendicular to OC. Find the velocity and acceleration of 'B'. OA= 200 mm; OC=400 mm; CD=200 mm; BD=500mm and angle AOC= 120°. (14M)



6. a) A pair of gears, having 40 and 20 teeth respectively, are rotating in mesh, the speed of the smaller being 2000 r.p.m. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point, and at the point of disengagement if the smaller gear is the driver. Assume that the gear teeth are 20° involute form, addendum length is 5 mm and the module is 5 mm. Also find the angle through which the pinion turns while any pairs of teeth are in contact (7M)
- b) Define arc of contact and deduce the expression to determine its magnitude. (7M)
7. a) Carry out the motion analysis for a sun and planet gear when the sun wheel is fixed using tabular method. (7M)
- b) A flat belt transmits 15 kW power from a pulley of 80 cm diameter which runs at 300 r.p.m. The angle of embrace of belt and pulley is 150 degrees and coefficient of friction between belt and pulley is 0.25. The thickness of the belt is 8 mm and has a density of 1 g/cm³. Determine the minimum width of the belt for a maximum stress of 180 N/cm². (7M)



II B. Tech II Semester Regular/Supplementary Examinations, November - 2020
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PART -A

1. a) What is the difference between a mechanism and a structure? (2M)
- b) What are the limitations of a single Hooke's joint? (2M)
- c) State and prove Kennedy's theorem of instantaneous centers of rotation of three bodies. (3M)
- d) Enumerate the various types of follower motions used in cam mechanisms. (3M)
- e) State the advantages of involute profile as a gear tooth profile. (2M)
- f) With a suitable sketch, differentiate between simple gear train and a compound gear train. (2M)

PART -B

2. a) Use the Kutzbach's criterion to determine the mobility of the mechanism shown in figure 1. (6M)

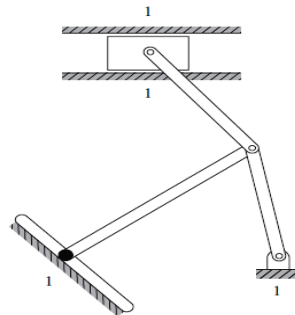


Figure 1

- b) What are the quick return mechanisms? Discuss the functioning of any two of them. (8M)
3. a) What is an automobile steering gear? Derive the condition for correct steering of an automobile? (6M)
- b) Draw a neat sketch of the Scott Russell's mechanism, and explain its working. How this mechanism can be modified to produce Grasshopper mechanism. (8M)
4. In a four bar mechanism ABCD, link AD is fixed and the crank AB rotates at 10 rad/s clockwise. Lengths of the links are AB = 60 mm; BC = CD = 70 mm; DA = 120 mm. When angle DAB = 60° and both B and C lie on the same side of AD, find angular velocities and angular acceleration of BC and CD. (14M)

5. Use the following data in drawing the profile of a cam in which a knife-edged follower is raised with uniform acceleration and deceleration and is lowered with simple harmonic motion: (14M)
Least radius of cam = 60 mm; Lift of follower = 45 mm; Angle of ascent = 60° ;
Angle of dwell between ascent and descent = 40° ; Angle of descent = 75°
If the cam rotates at 180 rpm, determine the maximum velocity and acceleration during ascent and descent.
6. a) Prove that the transmission ratio of two involute gears does not depend on the center distance between them. (6M)
b) A pinion with 24 involute teeth of 150 mm pitch circle diameter drives a rack. (8M)
The addendum of the pinion and rack is 6 mm. What is the least pressure angle which can be used if interference is to be avoided? Using this pressure angle, find the length of arc of contact and the number of teeth in contact.
7. An open belt drive connects two pulleys 1 m and 0.5 m diameter on parallel shafts 3 m apart. The belt has a mass of 1 kg/m length and the maximum tension in it is not to exceed 2 kN. The 1 m pulley, which is the driver, runs at 200 rpm. Due to the belt slip on one of the pulleys, the velocity of the driven shaft is only 450 rpm. If the coefficient of friction between the belt and the pulley is 0.3, find: i) Torque on each of the two shafts, ii). Power transmitted iii). Power lost in friction and iv). Efficiency of the drive. (14M)



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PART -A

1. a) Define the term degrees of freedom of a mechanism. (2M)
- b) What are the disadvantages of a Davis steering gear mechanism? (2M)
- c) Explain the Application of relative velocity method four bar chain (2M)
- d) Why a roller follower is preferred to that of a knife-edged follower? (3M)
- e) Define the terms prime circle, pitch circle, base circle of a cam (3M)
- f) Differentiate between a belt drive and a chain drive. (2M)

PART -B

2. a) Prove that the peaucellier mechanism generates a straight-line motion. (7M)
- b) The track arm of a Davis steering gear is at a distance of 185 mm from the front main axle whereas the difference between their lengths is 90 mm. If the distance between steering pivots of the main axle is 1.2 m, determine the length of the chassis between the front and the rear wheels. Also find the inclination of the track arms to the longitudinal axis of the vehicle. (7M)
3. a) Give the classification of links of a machine. Explain each of them. (7M)
- b) Describe different inversions of double slider crank chain (7M)
4. a) Derive the expression to determine the magnitude of the coriolis component of acceleration (7M)
- b) Explain the procedure to determine the velocity and acceleration of a four-bar mechanism by Klein's construction. (7M)
5. Draw the profile of a cam operating a roller reciprocating follower and with the following data: (14M)
 Minimum radius of cam =25 mm; lift=30mm; Roller diameter= 15mm. The cam lifts the follower for 120° with SHM, followed by a dwell period of 30°. Then the follower lowers down during 150°of cam rotation with uniform acceleration and retardation followed by a dwell period. If the cam rotates at a uniform speed of 150 RPM. Calculate the maximum velocity and acceleration of follower during the descent period.



- 6 The following data relate to a pair of 20° involute gears in mesh: (14M)
 Module = 6 mm, Number of teeth on pinion = 17, Number of teeth on gear = 49; Addenda on pinion and gear wheel = 1 module.
 Find: **a)** The number of pairs of teeth in contact; **b)** The angle turned through by the pinion and the gear wheel when one pair of teeth is in contact, and
c) The ratio of sliding to rolling motion when the tip of a tooth on the larger wheel **(i)** is just making contact, **(ii)** is just leaving contact with its mating tooth, and **(iii)** is at the pitch point.
7. A compound gear is shown in Fig. 2. An input torque of 100 N-m is given to the shaft B at 900 r.p.m. The sun and planet gears are all of the same diameter and pitch. Determine the speed and torque of the output shaft C, if the efficiency is 96%. Also determine the torque required to hold stationary the annulus wheel A1 (14M)

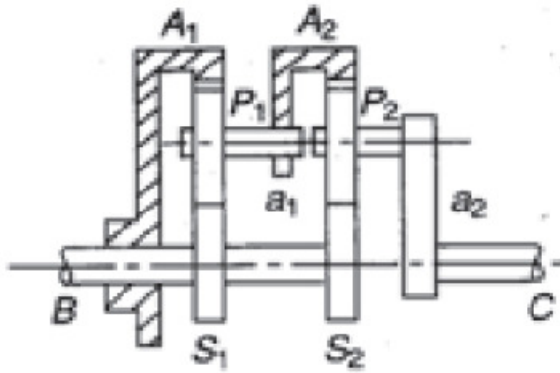


Fig.2

