(UAMCC01) - MECHANICS OF MACHINES– QUESTION BANK

UNIT-I

PART-A

1. Define the term “Kinematic link”.
2. Classify kinematic links.
3. What is Mechanism?
4. Define the terms “Kinematic pair”.
5. What is “Kinematic chain”?
6. Define “Degrees of freedom”.
7. What is “Inversion of a mechanism”?
8. State Grashof’s law.
9. Give the equation for Grubler’s criterion.
10. What is Kutzbach criterion?
11. What is “Rubbing velocity” at a pin joint?
12. Define Lower pair.
13. What is higher pair?
14. Define screw pair.
15. What is sliding pair?
16. What is the application of coupling rod of locomotives?
17. What is beam engine?
18. Define completely constrained motion.
19. What is incompletely constrained motion?
20. What is successfully constrained motion?

PART-B

1. Differentiate Machine and Structure.
2. Name the inversions of a 4 bar chain and Single slider crank mechanism.
3. Give the equations for Kutzbach criterion and Grubler’s criterion.
4. Classify kinematic pairs.
5. What are the types of constrained motion?

6. What are lower pair and higher pair?
7. What are sliding pair and turning pair?
8. What are rolling pair and screw pair?
9. Define Spherical pair and higher pair?
10. Define self closed pair and force closed pair.
11. What are the applications of double slider crank mechanisms?
12. What are the inversions of single slider crank mechanisms?
13. Define kinematic pair and kinematic chain.
14. Define kinematic chain and mechanism.
15. What is the difference between completely constrained motion and successfully constrained motion?

PART-C

1. Define Grashof's law for four bar mechanism and explain the inversions of a four bar mechanism with neat sketches?
2. With a neat sketch, derive the equation for velocity of a point on a link by instantaneous centre method.
3. With a neat sketch, give the steps involved in determining the velocity of a point on a link by relative velocity method.
4. How will you determine acceleration in mechanism by graphical method?
5. Explain any 3 inversions of single slider crank mechanism.
6. Explain the inversions of double slider crank mechanism.

UNIT-II

PART-A

1. What is belt drive?
2. Define slip of belt.
3. What is centrifugal tension?
4. Give the expression for maximum tension in belt.
5. What is initial tension?
6. Give 2 examples for positive drives.

7. What are the materials used for belts?
8. What are the advantages of belt drive over other drives?
9. What are the disadvantages of belt drives over other drives?
10. What is the condition for maximum power transmission of belt?
11. What is chain drive?
12. Define the term sprocket.
13. What is pitch of chain?
14. Define PCD of chains.
15. Give the relation between pitch and PCD.
16. What are the advantages of chain drive over other drives?
17. What are the disadvantages of chain drives over other drives?
18. Classify chain drives.
19. What is hoisting chain?
20. Define hauling chain.

PART-B

1. What are the types of belt drives?
2. What are the types of belts?
3. Discuss briefly about the materials used for making belts.
4. Write short notes on the following (i) Centrifugal tension (ii) Initial tension
5. What are the conditions for maximum power of belt drive?
6. Differentiate simple belt drive and compound belt drive.
7. What are centrifugal tension and initial tension?
8. Discuss about hair side and flesh side of a flat belt.
9. What are the merits and demerits of belt drives over other drives?
10. What are the advantages and drawbacks of rope drives over other drives?
11. Discuss brief about the merits and demerits of chain drives over other drives?
12. What is the classification of chains?
13. What are the terms used in chain drives?

14. Define PCD and pitch of a chain.
15. Discuss briefly about the terms used in chain drives.
16. What are hoisting chains and hauling chains?
17. What are power transmitting chains and hoisting chains?
18. Define hauling chains and power transmitting chains.
19. Discuss briefly about the applications of belt drives.
20. What are the applications of chain drives?

PART-C

1. A shaft which rotates at a constant speed of 160 rpm is connected by belting a parallel shaft 720 mm apart which has to run at 60, 80 and 100 rpm. The smallest pulley on the driving shaft is 40 mm in radius. Determine the remaining radii of the two stepped pulleys for (i) a crossed belt and (ii) an open belt. Neglect the thickness and slip of belt.
2. Two pulleys, one 450 mm in diameter and the other 200 mm in diameter are on parallel shafts 1.95 m apart and are connected by a crossed belt. Find the length of belt required and the angle of contact. What power can be transmitted by the belt when the larger pulley rotates at 200 rpm if the maximum permissible tension on the belt is 1 KN and the coefficient of friction between the belt and pulley is 0.25?
3. An open flat belt drive connects 2 parallel shafts 1.2 m apart. The driving and the driven shafts rotate at 350 rpm and 140 rpm respectively and the driven pulley is 400 mm in diameter. The belt is 5 mm thick and 80 mm wide. The coefficient of friction between the belt and pulley is 0.3 and the maximum permissible stress in belting is 1.4 MN/m^2. Determine (i) diameter of the driving pulley (ii) maximum power that can be transmitted (iii) required initial tension.
4. Two parallel shafts whose centre lines are 4.8 m apart are connected by an open belt drive. The diameter of the larger pulley is 1.5 m and that of smaller pulley is 1 m. Initial tension in the belt is 3 KN. The mass of the belt is 1.5 kg per meter length. Coefficient of friction between the belt and pulley is 0.3. Taking centrifugal tension into account, calculate the power transmitted when the smaller pulley rotates at 400 rpm.

5. An open belt running over 2 pulleys 600 mm and 240 mm in diameter connects 2 parallel shafts, 3 m apart and transmits 4 KW from the smaller pulley that rotates at 300 rpm. Coefficient of friction between belt and pulley is 0.3 and the safe working tension is 10 N per mm of width. Determine (i) minimum width of the belt (ii) initial tension and (iii) length of the belt required.
6. An engine shaft running at 120 rpm is required to drive a machine shaft by means of a belt. The pulley on the engine shaft is 2 m diameter and that of the machine shaft is 1 m diameter. If the belt thickness is 5 mm, determine the speed of the machine shaft when (i) there is no slip and (ii) when there is a slip of 3%.

UNIT-III

PART-A

1. Define Cams.
2. What are the types of cams?
3. What is cylindrical cam?
4. Define radial cam.
5. What is the difference between cylindrical cam and radial cam?
6. What do you mean by reciprocating follower?
7. What is oscillating or rotating follower?
8. Define radial follower.
9. Define off set follower.
10. Define pitch circle of cam?
11. Define prime circle of cam.
12. What is lift or stroke of the follower?
13. What are the types of motions of the follower?
14. Define uniform velocity.
15. Define SHM.
16. Define uniform acceleration and retardation.

17. What is cycloidal motion?
18. Draw a neat diagram of a cam and follower.
19. Define trace point.
20. Give 4 examples for radial followers.

PART-B

1. Define the following. (i) Maximum fluctuation of energy (ii) Maximum fluctuation of speed.
2. Explain the function of a flywheel in a machine.
3. Differentiate flywheel with a governor.
4. Explain the types of cams in brief.
5. Classify followers.
6. How followers are classified according to the surface in contact?
7. Define the following (i) Cylindrical cam (ii) Radial cam.
8. What are (i) Reciprocating follower (ii) Oscillating follower.
9. Define radial follower and off set follower.
10. What are base circle and prime circle of cams?
11. Define the terms Trace point and Pressure angle of cams.
12. What are the terms used in cams?
13. Define the following. (i) Pitch point and (ii) Pitch circle.
14. Define lift or stroke of follower and pressure angle.
15. What are the different motions of the follower?

PART-C

1. A cam with 30 mm as minimum diameter rotates clockwise at a uniform speed of 1200 rpm and has to give the following motion to a roller follower of 10 mm diameter. (i) Follower to complete outward stroke of 25 mm during 120° of cam rotation with SHM. (ii) Follower to dwell for 60° of cam rotation (iii) Follower to return to its initial position during 90° of cam rotation with equal SHM (iv) follower to dwell for the remaining 90° of cam rotation. Draw the cam profile if the axis of the roller follower passes through the axis of the cam.
2. A cam, with a minimum radius of 40 mm, rotating clockwise at a uniform velocity is required to give a knife edge follower the motion as described below. (i) To move outwards through 40 mm during 100° rotation of the cam (ii) To dwell for next 80° (iii) To return to its starting position during next 90° and (iv) To dwell for the rest period of revolution. Draw the profile of the cam when the axis of the cam shaft passes through the axis of the follower.
3. A cam, with a minimum radius of 50 mm, rotating clockwise is required to give a knife edge follower the motion as described below. (i) To move outwards through 40 mm during 100° rotation of the cam with uniform velocity (ii) To dwell for next 80° (iii) To return to its starting position during next 90° with SHM and (iv) To dwell for the rest period of revolution. Draw the profile of the cam when the axis of the cam shaft passes through the axis of the follower
4. Design a cam for operating the exhaust valve of an oil engine. It is required to give equal uniform acceleration and retardation during opening and closing of the valve each of which corresponds to 60° of cam rotation. The valve must remain in the fully open position for 20° of cam rotation. The lift of the valve is 40 mm and the least radius of the cam is 25 mm. The follower is provided with a roller of radius 20 mm and its line of stroke passes through the axis of the cam.
5. A cam rotating clockwise at a uniform speed is required to give a roller follower. 1) the follower to move outwards through 40mm during 120 degree of cam rotation, 2) follower to dwell for next 60 degree, 3) follower to return to its initial position during 90 deg of cam rotation . The min. radius of cam is 45mm and diameter of roller is 30mm. The offset is 15mm. Draw the profile of cam and the displacement the follower takes with simple harmonic motion for both outward and return strokes.

6. A cam is to give the following motion to a knife edged follower (1) the follower to move outwards through 40mm during 120 degree of cam rotation (2) follower to dwell for next 60 degree (3) follower to return to its initial position during 90 deg of cam rotation . The min. radius of cam is 45mm. The offset is 15mm. Draw the profile of cam when follower takes with simple harmonic motion for both outward and return strokes.

UNIT –IV

PART-A

1. What is crank effort diagram?
2. What is fluctuation of energy?
3. Give the expression to determine the maximum fluctuation of energy.
4. Give the expression of coefficient of fluctuation of energy.
5. Define flywheel.
6. What is the function of a flywheel?
7. Define gear or toothed wheel.
8. What do you mean by pinion?
9. What are the advantages of gear drives over other drives?
10. List out the drawbacks of gear drives.
11. Define pitch circle of gears.
12. What do you mean by PCD of gears?
13. What is pitch point of gears?
14. Define Addendum.
15. Define dedendum.
16. What is addendum circle?
17. What is dedendum circle?
18. Define circular pitch.
19. Define gear train.
20. What are the types of gear trains?

PART-B

1. What is the function of a flywheel? Draw a neat sketch and explain how it differs from that of a speed governor.
2. Draw the turning moment diagram of a single cylinder double acting steam engine.
3. Explain the turning moment diagram of a four stroke IC engine.
4. Discuss the turning moment diagram of a multi cylinder engine.
5. List out the advantages and drawbacks of gear drives over other drives.
6. Classify gears.
7. Explain the types of gear trains.
8. What are Length of path of contact and length of arc of contact?
9. Write a short note on materials used for gears.
10. Define (i) simple gear train (ii) compound gear train.
11. What are epicyclic gear train and reverted gear train?
12. Write short notes on the following (i) Sliding velocity (ii) Pitch line speed.
13. Discuss briefly about sun and planet gear.
14. List out the terms used in gears.
15. Draw a neat sketch of a spur gear and indicate the terms used in it.

PART-C

1. A pair of involute spur gears with 16° pressure angle and a module of 6 mm are in mesh. The number of teeth in pinion is 16 and its rotational speed is 240 rpm. The gear ratio is 1.75. In order to avoid the interference, determine (1) addenda on pinion and wheel (2) length of path of contact (3) maximum velocity of sliding on either side of pitch point.
2. Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm, and the pitch line speed is 1.2 m/s, determine the angle turned through by pinion, when one pair of teeth is in mesh. Also calculate the maximum velocity of sliding. Take addendum as one module.
3. In an epicyclic gear train an arm carries two gears A and B having 40 and 60 teeth. If arm rotates at 200 rpm in clockwise direction about the centre of gear A which is fixed makes 300 rpm in the anticlockwise direction, what will be the speed of gear B.

4. The number of teeth on each of the two spur gears in mesh is 40. The teeth have 20° involute profile and the module is 6mm. If the arc of contact is 1.75 times the circular pitch. Find the addendum.
5. Two mating involute spur gears 20° pressure angle have a gear ratio of 2. The number of teeth on the pinion is 20 and its speed is 250 rpm. The module pitch of the teeth is 12 mm. if the addendum on each wheel recess on each side are half the maximum possible length each, find (1) the addendum for pinion and gear wheel (2) the length of arc of contact (3 the maximum velocity of sliding during approach and recess. Assume pinion to be driver.
6. The arm of an epicyclic gear train rotates at 100 rpm in the anticlock wise direction. The arm carries two wheels A and B having 36 and 45 teeth respectively. The wheel A is fixed and the arm rotates about the centre of wheel A. Find the speed of wheel B. What will be the speed of B, if the wheel A instead of being fixed, makes 200 rpm (clockwise).

UNIT-V

PART-A

1. Define static balancing.
2. What do you mean by dynamic balancing?
3. What do you mean by primary balancing?
4. Define secondary balancing.
5. State the conditions for static balancing.
6. State the conditions for dynamic balancing.
7. Why rotating masses are to be dynamically balanced?
8. What is meant by primary balancing of reciprocating masses?
9. Define the term whirling speed of a shaft.
10. State on what parameters does whirling speed depend?
11. What is the function of governor?
12. What is meant by sensitiveness of a governor?
13. What is the effect of friction on the governor?
14. What is meant by hunting?

15. Write short notes on Critical speed
16. What are the causes of vibration?
17. List out the effects of vibration?
18. Define free vibration.
19. What do you mean by forced vibrations?
20. What is vibration isolation?

PART-B

1. What is the difference between balancing of rotating masses and balancing of reciprocating masses?
2. What is meant by primary and secondary crank?
3. Define static balancing and dynamic balancing.
4. What do you mean by primary and secondary balancing?
5. State the conditions for static and dynamic balancing.
6. Why rotating masses are to be dynamically balanced?
7. Differentiate static balancing and dynamic balancing.
8. Define the term 'whirling speed' of a shaft and state on what parameters does it depend?
9. What is the function of governor?
10. Classify governors.
11. Differentiate governor and fly wheel.
12. What are the causes and effects of vibration?
13. Differentiate free and forced vibrations.
14. Explain vibration isolation and transmissibility.
15. Define (i) hunting and (ii) sensitivity of governor.

PART-C

1. A shaft carries 4 rotating masses A, B, C and D in this order along its axis. The mass A may be assumed concentrated at a radius 12 cm, B at 15 cm, C at 14 cm and D at 18 cm. The masses of A, C and D are 15 kg, 10 kg and 8 kg respectively. The planes of revolution of A and B are 15 cm apart and of B and C are 18 cm apart. The angle between A and C is 90 deg. If the shaft is in complete dynamic balance, determine the angles between radii of A, B and D and the distance between the planes of revolution of C and D.
2. Four masses m1, m2, m3, and m4 are 200 kg, 300 kg, 240 kg and 260 kg, respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m, respectively and the angle between successive masses are 45°, 75°, and 135°. Find the position and magnitude of the balance mass required if its radius of rotation is 0.2 m.
3. A rotating shaft carries 4 unbalanced masses 18kg, 14kg, 16kg and 12kg at radii 50mm, 60mm, 70mm and 60mm respectively. The 2nd , 3rd and 4th masses revolve in planes 80mm, 160mm and 270mm respectively measured from the plane for the first mass and are angularly located at 60 deg, 135 deg and 270 deg respectively measured clockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by 2 masses both located at 50mm radii and revolving in planes mid way between those 1st and 2nd masses and midway between those of the 3rd and 4th masses. Determine the magnitudes of the masses and their respective angular position.
4. With a neat sketch, explain the function of a centrifugal governor. Also derive an expression for determining the height of the governor.
5. A shaft 50 mm diameter and 3 metres long is simply supported at the ends
   and carries three loads of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from the left support. The Young's modulus for shaft material is 200 GN/m^2. Find the frequency of transverse vibration.
6. Calculate the whirling speed of a shaft 20 mm diameter and 0.6 m long carrying a mass of 1 kg at its mid-point. The density of the shaft material
   is 40 Mg/m3, and Young’s modulus is 200 GN/m2. Assume the shaft to be freely supported.