QUESTION BANK

UNIT -I

TWO MARKS QUESTION AND ANSWER

1. **Define Kinematic link.**
   It is a resistive body which go to make a part of a machine having relative motion between them.

2. **Define Kinematic pair.**
   When two links are in contact with each other it is known as a pair. If the pair makes constrain motion it is known as kinematic pair.

3. **Define Kinematic chain.**
   When a number of links connected in space make relative motion of any point on a link with respect to any other point on the other link follow a definite law it is known as kinematic chain.

4. **Write the Grubler's criterion for determining the degrees of freedom of a mechanism having plane motion.**
   n=3(l-1)-2j
   h-Higher pair joint l-Number of links
   j-Lower pair joint

5. **Define degree of freedom, what is meant by mobility. (Ap/May-2008)**
   The mobility of a mechanism is defined as the number of input parameters which must be independently controlled in order to bring the device into a particular position.

6. **Write the Kutzbach's relation. (Ap/May-2008)**
   Kutzbach's criterion for determining the number of degrees of freedom or movability (n) of a plane mechanism is n=3(l-1)-2j-h n-Degree of freedom.
   l-Number of links. h-Higher pair joint j-Lower pair joint.

7. Define Grashoff's law and state its significance. (Ap/May-2008)

It states that in a planar four bar mechanism, the sum of shortest link length and longest link length is not greater than the sum of remaining two links length, if there is to be continuous relative motion between two members.

Significance:

Grashoff's law specifies the order in which the links are connected in a kinematic chain. Grashoff's law specifies which link of the four-bar chain is fixed.(s+1)=(p+q) should be satisfied, if not, no link will make a complete revolution relative to another. s= length of the shorter length
l= length of the longest link

p & q are the lengths of the other two links.

8. Define Inversion of mechanism.

The method of obtaining different mechanism by fixing different links in a kinematic chain is known as inversion of mechanism.

9. What is meant by Mechanical advantage of mechanism?

It is defined as the ratio of output torque to the input torque also defined as the ratio of load to effort.

M.A ideal = TB / TA
TB =driven (resisting torque) TA =driving torque

10. Define Transmission angle.

The acute angle between follower and coupler is known as transmission angle.

11. Define Toggle position.

If the driver and coupler lie in the same straight line at this point mechanical advantage is maximum. Under this condition the mechanism is known as toggle position.

12. List out few types of rocking mechanism.

Pendulum motion is called rocking mechanism.
1. Quick return motion mechanism.
2. Crank and rocker mechanism.
3. Cam and follower mechanism.

13. Define pantograph.

It is device which is used to reproduce a displacement exactly in a enlarged scale. It is used in drawing offices, for duplicating the drawing maps, plans, etc. It works on the principle of 4 bar chain mechanism.

Eg. Oscillating-Oscillating converter mechanism

14. Name the application of crank and slotted lever quick return motion mechanism.

1. Shaping machines.
2. Slotting mechanism.
3. Rotary internal combustion engine.

15. Define structure.

It is an assemblage of a number of resistant bodies having no relative motion between them and meant for carrying loads having straining action.

16. What is simple mechanism?

A mechanism with four links is known as simple mechanism.

17. Define mechanism.

When one of the links of a kinematic chain is fixed, the chain is known as a mechanism.

18. Define equivalent mechanism; and spatial mechanism.

Equivalent mechanism: The mechanism, that obtained has the same number of the degree of freedom, as the original mechanism called equivalent mechanism.

Spatial mechanism: Spatial mechanism have special geometric characteristics in that all revolute axes are parallel and perpendicular to the plane of motion and all prism axes lie in the plane of motion.

19. Define double slider crank chain mechanism.

A kinematic chain which consists of two turning pair and two sliding pair is known as double slider crank mechanism.

20. Define single slider crank chain mechanism.

A single slider crank chain is a modification of the basic four bar chain. It consists of one sliding pair and three turning pair.

Applications:

Rotary or Gnome engines	Crank and slotted lever mechanism
Oscillating cylinder engine	Ball engine
Hand pump	

21. Define Sliding pair.

In a sliding pair minimum number of degree of freedom is only one.

22. Define Turning pair.

In a turning pair also degree of freedom is one. When two links are connected such that one link revolves around another link it forms a turning pair.

23. Define cylindrical pair.

In a cylindrical pair degree of freedom is two. If one link turns and slides along another link it forms a cylindrical pair.

24. Define Rolling pair.

In a rolling pair degree of freedom is two. The object moves both linearly and angularly.

25. Define Spherical pair.

In a spherical pair degree of freedom is three. It can both move left and right,up and down, and rotate along the same point.

26. Define Lower pair.

If contact between two links is surface contact also having degree of freedom one, then the pair is known as lower pair.

Example: Sliding pair.

27. Define higher pair.

If contact between two links is either point contact or line contact then the pair is known as higher pair.

Example: Point contact-Rolling pair.
Line contact-Cylindrical pair.

PART-B (16 Marks)

1. a) Explain different types ofLink.**(8)**

b)Classifyand explain the Kinematicpair.**(8)**

2. a) Explain anytwo inversion of four bar chain.**(8)**

b)Explain the first inversion ofSingle SliderCrank Chain.**(8)**

3. a) Explain first inversion ofDoubleSlider crank chain.**(8)**

b)Explain third inversion of double slider crank chain.**(8)**

4. a) Explain the offset slider crank mechanism.**(8)**

b)Explain Straight line mechanismwith neat sketch**(8)**

5. a)With the help of aneat sketch explain the workingof Oldham's coupling.**(8)**

b)Explain steering gearmechanismwith neat sketch **(8)**

6. With the help of aneatsketch explain the workingof Whitworth quick return mechanism. (16)

7. With the help of aneatsketch explain the workingof Single slider and double slider crankchain mechanism.**(16)**

UNIT -II

TWO MARKS QUESTION AND ANSWER

1. **What are the components of acceleration?**
   Radial component of acceleration
   Tangential component of acceleration

2. **Write an expression for find number of instantaneous centers in a mechanism.**
   N=n(n-1)/2, n-no of links

3. **What is expression for Coriolis componenet of acceleration?**
   a BC
   =2rω
   Where ω=Angular velocity of 'OA' V=Linear velocity of 'B'

4. **How can we represent the direction of linear velocity of any point on a link with respect to another point on the same link?**
   The direction of linear velocity of any point on a link with respect to another point on the same link the direction is perpendicular to the line joining the points.

5. **What is the expression for radial and tangential component of acceleration?**
   Radial component
   Arc OB=ωOB*OB
   Tangential component
   Arc OB=αOB*OB
   Where ωOB=Angular velocity of link OB
   αOB=Angular acceleration of link OB OB=Length of link OB.
   (Radial component of acceleration is perpendicular to the velocity of the component and tangential component is perpendicular to link position)

6. **Define instantaneous center and instantaneous axis?**

Instantaneous center of a moving body may be defined as that center which goes on changing from one instant to another.

Instantaneous axis is a line drawn through an instantaneous center and perpendicular to the plane of motion.

7. What are the names of instantaneous center?

Virtual center Centro

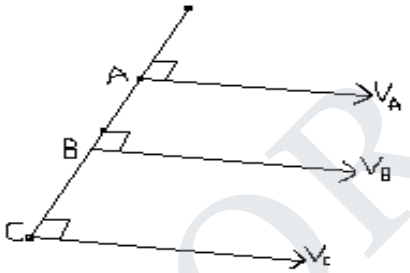
Rotopole.

8. How can we apply instantaneous center method to determine velocity?

Consider three points A, B, C on a rigid link. I am being instantaneous Center. Let VA,

VB, VC be the points A, B & C. Then we have

$$VA/IA=VB/IB=VC/IC$$



9. What is the objective of Kinematic analysis?

The objective of Kinematic analysis is to determine the Kinematic quantities such as displacement, velocity and acceleration of the element in a mechanism.

10. Write any two rules to locate Instantaneous center.

When two links are connected by a pin joint the instantaneous center lies on the center of the pin.

When two links have a sliding contact, the instantaneous center lies at infinity in a direction perpendicular to the path of motion of slide.

11. Define Kennedy's theorem.

The Kennedy's theorem states that if three bodies move relatively to each other, they have three instantaneous centers and lie on a straight line.

12. What is meant by efficiency of a mechanism?

Efficiency of a mechanism is defined as the ratio of the product of force and velocity in

driven link to the product of force and velocity in driving link.

13. A pin joins two links A & B. A rotates with ωA angular velocity and B rotates with ωB
angular velocity in opposite direction. What is the rubbing velocity of that point?

Rubbing velocity of pin = (ωA + ωB) * r
Where 'r' is the radius of pin.

14. What is the magnitude of linear velocity of a point B on a link AB relative to A?

The magnitude of linear velocity of a point B on a link AB, which rotates with 'ω'
angular velocity with respect to A is:
VB/A =ω A/B *AB

PART-B (16 Marks)

1. TheCrank ofaslider crank mechanisms rotatesclockwise at a Constant speed of 600 r.p.m. The crank is 125 mmand connectingrodis 500 mmlong. Determine1. Linear velocityand acceleration ofthe mid Pointof the connecting rod, and 2. Angular velocityandangular acceleration ofthe connecting rod, at acrankangle
of45° from innerdead centreposition.

2.Ina four link mechanism, thedimensions of thelinks areAB=200 mm, BC=400mm, CD=450 mm and AD=600mm. At the instant when DAB=90°, the link ABhasangularvelocityof36 rad/s in the clockwisedirection. Determine (i) The velocityof pointC, (ii) Thevelocityof pointEonthe link BC When BE =200 mm (iii) the angularvelocities oflinks BC and CD, iv)acceleration oflink oflink BC

3. Thedimensions of thevarious links of amechanism, as shown in fig. are as follows: OA=300 mm; AB=1200;BC=450 mmand CD=450 mm. ifthe crank OA rotates at 20 r.p.m. in theanticlockwise direction and gives motion to the sliding blocks Band D,find, forgivenconfiguration: (1)Velocityof slidingatBand D, (2) Angular velocityof CD (3)Linearacceleration ofD and (4)angularacceleration of CD.

4 a)Derivethe expressions forVelocityandacceleration ofpiston in

reciprocating steam engine mechanismwith neat sketch

b).Derivethe expression for Coriolis component of acceleration with neat sketch

5.Inaslider crankmechanism, the length of thecrank and theconnectingrod are100 mmand 400 mmrespectively./ Thecrank [position is 45° fromIDC, the crank shaft speed is 600 r.p.m. clockwise.Using analytical method Determine

(1)Velocityandacceleration of theslider,and (2)Angular velocityandangular acceleration oftheconnectingrod**.**

6.Locate allinstantaneous centers of theslider crank mechanism; thelength of crank OBand Connecting rod ABare125 mmand 500 mm respectively. Thecrank speed is 600 rpm clockwise. When thecrank has turned 45° from theIDC. Determine(i)velocityof . slider'A' (ii)Angular Velocityofconnecting rod_AB'.

UNIT -III

TWO MARKS QUESTION AND ANSWER

1. **What is a cam? Give some examples?**
   A Cam is a rotating machine element, which gives reciprocating or oscillating motion to another element known as follower. Examples are:
   Radial or Disc, Cylindrical or Barrel, End or Face cams and Wedge cams.

2. **What is the Classification of cams?**
   - According to cam shape
   - According to follower movement
   - According to manner of constraint of the follower

3. **Classify cams based on their shape.**
   - Wedge cam
   - Radial cams
   - Spiral cams
   - Drum cams
   - Spherical cams

4. **What is the classification of followers?**
   (i) According to follower shape
   (ii) According to motion of follower

5. **What is a roller follower?**
   In place of a knife edge roller is provided at the contacting end of the follower

6. **What is a Spherical follower?**
   In the contacting end of the follower is of spherical shape.

7. What is meant by angle of ascend?

The angle of rotation of the cam from the position when the follower begins to rise till it reaches its highest points. It is denoted by θ

8. What is meant by angle of descend?

The angle through which the cam rotates during the time the follower returns to the initial position. It is denoted by θr.

9. What is angle of dwell?

It is the angle through which the cam rotates while the follower remains stationary at the highest or the lowest.

10. What is meant by angle of action?

The total angle moved by the cam during its rotation between the beginning of rise and the end of return of the follower.

11. What is radial or disc cams?

In radial cams the follower reciprocates or oscillates in a direction perpendicular to the cam axis. The cams are all radial rams. In actual practice, radial cams are widely used due to their simplicity and compactness.

12. What is dwell?

The zero displacement or the absence of motion of the follower during the motion of the cam is called dwell.

13. What are the classifications of follower according to follower shape?

- Knife edge follower
- Roller follower
- Mushroom or flat faced follower and
- Spherical faced or curved shoe follower

14. What are the classifications of follower according to the motion of the follower?

- Reciprocating or translating follower
- Oscillating or rotating follower

15. What are the classifications of followers according to the path of motion?

- Radial follower
- Offset follower

16. What is the motion of the follower?

The follower can have any of the following four types of motions

- Uniform velocity
- Simple harmonic motion

- Uniform acceleration and retardation
- Cycloidal motion.

17. What is the application of cam?

Closing and opening of inlet and exit valve operating in IC engine .

18. What are the necessary elements of a cam mechanism?

Cam-The driving member is known as the cam
Follower-The driven member is known as the follower. Frame-It supports the cam and guider the follower.

19. Where are the roller follower extensively used? (Ap/May-2008)

Roller followers are extensively used where more space is available such as in stationary gas oil engines and aircraft engines.

20. Write the formula for maximum velocity.

$$V_{o\,(max)} = \frac{2\omega s}{\theta o}$$

$$V_{r\,(max)} = \frac{2\omega s}{}$$

PART-B (16 Marks)

1.A cam is to give the followingmotion to aknifeedgedfollower:

(a) Outstrokeduring60°of cam rotation

(b)Dwellfor thenext 45° of cam rotation

(c) Return strokeduring next 90° of cam rotation and

(d)Dwellfor theremainingofcam rotation

Thestrokeof thefollower is 40 mmand the minimumradius of the cam is50 mm. The followermoves with uniform velocityduringboth theoutstrokeand return strokes.Draw the profileof thecam when (a) theaxis of the follower passes through theaxis of the cam shaft, and (b)the axis of the follower is offset by20mmfrom the axis of the cam shaft.

2. Draw theprofileofacam operatingaKnife-edgedfollower from the following data: (a)Follower to moveoutward through 40 mm during60° ofa cam rotation;(b) Follower to dwellforthenext 45° (c) Followertoreturn its original position during next 90° (d)Follower to dwellforthe rest of camrotation. Thedisplacement of the

follower is to takeplacewith simple harmonic motion duringboth theoutward and return strokes. Theleast radius of the cam is 50mm.If the cam rotates at 300 r.p.m., determinethe maximum velocityand accelerationof the follower duringtheoutward stroke and return stroke.

3. A cam, with aminimum radius of 50 mm, rotatingclockwise at a uniform speed, is required togiveraknife-edgedfollower themotion as described below: (a) To moveoutwards through 40 mmduring100° rotation of the cam; (b)to dwellfornext 80° (c) To return to its startingposition duringnext 90 ° and (d)Todwellforthe rest periodof revolution. Draw theprofileof the cam (i) When thelineof strokeof the follower passes through the centreof the cam shaft and (ii)When the line ofstrokeof the follower is to takeplacewith Uniform acceleration and uniform retardation. Determinethe maximum velocity and acceleration of the followerwhen the cam shaft rotates at 900 r.p.m.

4. Draw theprofileofacam operatingaroller reciprocatingfollowerand with the followingdata:

Minimum radius of cam =25 mm;lift=30mm; Rollerdiameter=15mm. Thecam lifts the follower for 120° with SHM, followed byadwellperiod of30°. Thenthe follower lowers down during150°of cam rotation with uniform acceleration and retardation followed byadwellperiod.If thecam rotates atauniform speed of 150 RPM. Calculate the maximumvelocityand accelerationof follower duringthe descent period.

5.It is required to set outthe profileof a cam togivethe followingmotion to the reciprocating follower with a flat mushroom contact surface: (i)Follower to haveastrokeof 20mm during120° ofcam rotation, (ii) Follower to dwellfor30° ofcam rotation,(iii) Follower to return to its initial position during120° of cam rotation, (iv)Follower to dwellfor remaining90°of cam rotation. Theminimum radius of the cam is 25 mm. Theout strokeof the follower is performed with SHM and return strokewith equal uniform acceleration andretardation.

6. A tangent cam to drivea roller follower throughatotal lift of 12.5 mm fora cam rotation of75°.Thecam speed is 600rpm . Thedistancebetweencam centre and

follower centre atfull lift is 45 mm and the roller is 20 mmin diameter. Find the cam proportions and plot displacement, velocityandacceleration for one full cycle.

UNIT -IV

TWO MARKS QUESTION AND ANSWER

1. **Define spur gear.**
   A spur gear is a cylindrical gear whose tooth traces are straight line generation of the reference cylinder. They are used to transmit rotary motion between parallel shafts.
2. **Define addendum and dedendum.**
   Addendum is the radial distance of a tooth from the pitch circle to the top of the tooth.
   Dedendum is the radial distance of a tooth from the pitch circle to the bottom of the tooth.
3. **Define circular pitch.**
   It is the distance measured on the circumference of the pitch circle from a point of one tooth to the corresponding point on the next tooth. It is denoted by Pc
   Circular pitch Pc= Π/DT
   Where D = Diameter of pitch circle. T = Number of teeth on the wheel.
4. **Define I) path of contact. II) Length of path of contact.**
   Path of contact: It is the path traced by the point of contact of two teeth from the beginning to the end of engagement.
   Length of path of contact: It is the length of common normal cut- off by the addendum circles of the wheel and pinion.
5. **State the law of gearing.**
   Law of gearing states that, the common normal at the point of contact between a pair of teeth must always pass through the pitch point.
6. **Define conjugate action.**
   When the tooth profiles are so shaped so as to produce a constant angular velocity ratio during Meshing, then the surface are said to de conjugate.
7. **Define angle of approach.**
   The angle of approach is defined as the angle through which a gear rotates from the instant a pair of teeth comes into contact until the teeth are in contact at the pitch point.

8. List out the characteristics of in volute action.

a) Arc of contact. b) Length of path of contact. c) Contact ratio.

9. Define contact ratio.

Contact ratio is defined as the ratio of the length of arc of contact to the circular pitch.

Mathematically.

Contact ratio = length of arc of conta

[Pc] Where Pc = circular path.

10. What is the advantage of involute gear?

The most important advantage of involutes gear is that the center distance for a pair of involute gears can be varied within limits without changing the velocity ratio.

11. What are the conditions to be satisfied for interchangeability of all gears?

For interchangeability of all gears, the set must have the same circular pitch, module, diameter pitch, pressure, angle, addendum and dedendum and tooth thickness must be one half of the circular pitch.

12. Define gear tooth system.

A tooth system is a standard which specifies the relationship between addendum, dedendum, working depth, tooth thickness and pressure angle to attain interchangeability of gears of tooth numbers but of the same pressure angle and pitch

13. Define cycloid.

A cycloid is the curve traced by a point on the circumference of a circle which rolls without slipping on a fixed straight line.

14. Define clearance.

The amount by which the dedendum of a gear exceeds the addendum of the mating gear is called clearance.

15. When in volute interference occurs.

If the teeth are of such proportion that the beginning of contact occurs before the interference point is met then the involute proportion of the driven gear will mate a non in volute portion of the driving gear and involute interference is said to occur.

16. What is the principle reason for employing non standard gears?

a) To eliminate the undercutting.
b) To prevent interference.
c) To maintain reasonable contact ratio.

17. What are the advantages and disadvantages of gear drive?

Advantages:

a) It transmits exact velocity ratio. b) It has high efficiency.

Disadvantages:

The manufacture of gears require special tool and equipment.

The error in cutting teeth may cause vibrations and noise during operation.

18. Define helix angle (β).

It is the angle between the line drawn through one of the teeth and the center line of the shaft on which the gear is maintained.

19. Define gear ratio.

The quotient of the number of teeth on the wheel divided by the number of threads on the worm.

20. Define gear train.

A combination of gears that is used for transmitting motion from one shaft to another shaft is known as gear train. eg. spur gear, spiral gear.

21. Define velocity ratio.

Velocity ratio of a simple gear train is defined as the ratio of the angular velocity of the first gear in the train to the angular velocity of the last gear.

PART-B (16 Marks)

1. a) Two matingspurgear with modulepitch of 6.5 mmhave19 ad 47 teeth of 20° pressureangle and 6.5 mm addendum. Determinethe number ofpair of teethand angleturned through bythelarger wheel foronepair ofteeth in contact. Determinealso theslidingvelocityat theinstant (i)engagement commences (ii) engagement terminates. When the pitch line velocityis 1.2 m/s.**(8)**

b)Thenumberof teeth on each of thetwo spurgears in mesh is 40. Theteeth have 20° involuteprofile and the module is6mm.If thearcof contact is 1.75 times the circularpitch. Find theaddendum. **(8)**

2. a) Two 20° involutespurgears haveamoduleof 10 mm. The addendumis one module. Thelargergear has 50 teeth and pinion 13 teeth. Does the interferenceoccur?Ifitoccurs, to whatvalue should thepressureanglebe changed to eliminate interference?**(8)**

b)Twomatinginvolute spur gears 20° pressure angle haveagearratio of2.the numberof teeth on thepinion is 20 and its speed is 250 rpm. Themodulepitch of the teeth is 12 mm. if theaddendum on each wheelwheel recess on each side arehalf themaximum possible lengtheach, find(1)the addendum forpinion and gearwheel(2)the length of arcof contact(30 themaximum velocityof slidingduringapproachand recess.Assume pinion to bedriver**. (8)**

3.a) Apair of spurgearwith involuteteeth is to give agear ratio of 4:1. The arcof approach is not be less than the circular pitch and thesmaller wheel is the driver. The angleof pressureis 14.5What is the least number ofteeth can beusedoneach wheel? What is the addendum of thewheel in terms ofcircularpitch?**(8)**

b). A pair 20° fulldepth involutespur gear having 30 and 50 teeth respectively module4 mmarcin mesh, thesmaller gearrotates at 1000 rpm. Determine (a) Slidingvelocities at engagementand disengagement of apair ofteethand (b) Contact ratio.**(8)**

3.Inan epicyclicgear train theinternal wheels Aand Band compound wheels Cand D rotateindependentlyabout axis O. Thewheels E andFrotateon pins fixed to the arm G. E gears withA and C . Wheel Fgearwith B and D. Allthe wheels havethe same module and the numberof teeth are: T_C=28 T_D=26;T_E=T_F=18.(1) Sketch the arrangement, (2) Find thenumber ofteeth on A and B,(3)Ifthe armG makes 100 rpm clockwise and A is fixed, find thespeed ofB, and (4)If thearm Gmakes 100 rpm clockwise and wheel A makes 10rpm counter clockwise; Find the speed ofwheelB**. (16)**

4. Twogearwheels meshexternallyandaretogiveavelocityratio of 3to 1. The teeth areof involute form;module=6mm, addendum=onemodule, pressureangle=20°. The pinion rotates at 90 rpm. Determine (1) thenumber ofteeth on thepinion toavoid interferenceon itand the correspondingnumber

ofteeth on thewheel, (2)Thelength of path andarc of contact, (3)the numberof pairs of teeth in contact.**(16)**

5. The arm ofan epicyclicgear train rotatesat 100rpm in the anticlock wisedirection. The arm carries two wheels AandBhaving36 and 45 teeth respectively. Thewheel A is fixed and the arm rotates about thecentreof wheel A. Find thespeed of wheelB. What will be the speed ofB, if thewheelA instead of beingfixed, makes 200 rpm (clockwise).**(16)**

6.Ina revertedepicyclictrain, the armF carries two wheels Aand D anda compound wheel B-C. Wheel A meshes with wheelBand Wheel D meshes with wheel C. Ther numberof teeth on wheel A, Dand C are80,48, and 72. Find thespeed and direction ofwheel D , when wheel A is fixed and arm Fmakes 200 rpm clockwise.**(16)**

7. An epicyclictrain is composed of afixed annularwheel A having150 teeth. Meshingwith A is awheel Bwhich drives wheel D throughan idlewheel C, D being concentricwith A. Wheels B and C are carried onarm which revolves clockwise at 100 rpm about the axis of A orD.Ifthe wheels Band D arehaving25 teeth and 40 teeth respectively,find thenumberof teeth of C and the speed and sense ofrotation of C. **(16)**

8. Thesun planetgear ofan epicyclicgear train, the annularD has 100 internal teeth, the sun gear Ahas 50 external teethand planetgear Bhas 25external teeth.Thegear Bmeshes withgear Dand gear A. ThegearBis carried onarm E, which rotatesabout the centreof annulargearD.If thegear Dis fixedand arm rotates at 20 rpm, then find the speeds ofgear AandB.**(16)**

UNIT -V

TWO MARKS QUESTION AND ANSWER

1. **Define clutch.**

Clutch is a transmission device of an automobile which is used to engage and disengage
the power from the engine to the rest of the system.

2. **What are the types of friction clutches?**

Types of friction clutches are:
*Disc or plate clutches.
*Cone clutches.
*Centrifugal clutches.

3. **Define centrifugal clutch.**
   Centrifugal clutch is being increasingly used in automobile and machines obviously it works on the principle of centrifugal force.

4. **What are the types of flat drives?**
   The types of flat drives are:
   *Compound belt drive.
   *Stepped or cone pulley drive.
   *Fast and loose pulley.

5. **Define slip.**
   Slip is defined as the relative motion between the belt and pulley.

6. **Define law of belting.**
   Law of belting states that the centre line of the belt, as it approaches the pulley lie in a plane perpendicular to the axis of that pulley or must lie in the plane of the pulley, otherwise the belt will run off the pulley.

7. **What is the use of rope drive?**
   The rope drives are widely used when large power is to be transmitted continuously from one pulley to another over a considerable distance. One advantage of rope drives is that a number of separate driver may be from the driving pulley.

8. **What is the use of belt drive?**
   Belt drive is commonly used for transmission of power when exact velocity ratio is not required. Generally, belt drives are used to transmit power from one pulley to another, when the two pulleys are not more than 10 meters apart.

9. **What are the types of ropes?**
   The types of ropes are: *Fiber ropes. *Wire ropes.

10. **What is the use of quarter turn left drive?**
    The quarter turn left drive is used with shafts arranged at right angles and rotating in one definite direction.

11. **Define the velocity ratio of the belt drive.**
    The velocity ratio of the belt drive is defined as the ratio between the velocities of the driver and the follower or the driven.

12. What are the advantages of V-belt?

*Power transmitted is more due to wedging action in the grooved pulleys.
*V-belt is more compact, quite and shock absorbing.
*The V-belt drive is positive because of negligible slip between the belt and the groove.
*High velocity ratio may be obtained.

13. What are the disadvantages of V-belt?

*It cannot be used with large center distances.
*It is not as durable as flat belt.
*It is a costlier system.

14. What is the use of circular belts or ropes?

*Ropes are circular in cross section.
*It is used to transmit more power.
*Distance between two pulleys is more than 8metres.

15. Specify the various belt materials.

BELT TYPES	BELT MATERIALS
Flat belts	Leather, canvas, cotton & rubber.
V-belts	Rubberized fabric & rubber.
Ropes	Cotton, hemp & manila.

16. Name the types of friction.

*Static friction. *Dynamic friction.

17. Define the angle of repose.

If the angle of inclination 'α' of the plane to horizontal is such that the body begin to move down the plane. Then the angle α is called the angle of repose.

18. What is meant by frictional force?

Force of friction is always acting in the direction opposite to the direction of motion.

19. Why self locking screws have lesser efficiency?

Self locking needs some friction on the thread surface of the screw and hence it needs higher effort to lift a body and hence automatically the efficiency decreases.

20. What is static friction?

It is the friction experienced by a body, when at rest.

21. What is dynamic friction?

It is the friction experienced by the body, when in motion. The dynamic friction is also called as kinematic friction.

22. What is co-efficient of friction?

It is defined as the ratio of the limiting friction (F) to the normal reaction (RN) between the two bodies. It is generally denoted by μ. μ=F/RN.

23. Define screw jack.

The screw jack is the device used to lift the heavy loads by applying a comparatively small effort at its handle. The working principle of screw jack is similar to that of an inclined plane.

Part B

1. a) For a flat belt, prove that $T_1/T_2=e^{\mu\alpha}$ Where T_1 and T_2= Tension in the tight and slack sides of the belt, α= Angle of contact between the belt and the pulley, and μ= Coefficient of friction between the belt and the pulley. **(8)**

b) An open belt running over two pulley of 1.5 m and 1.0 m diameters connects two parallel shafts 4.8 m apart. The initial ten in the belt is 3000 N. The smaller pulley is rotating at 600 rpm. The mass of belt is 0.6703 kg/m length. The coefficient of friction between the belt and pulleys is 0.3. Find (1) the exact length of the belt required (2) the power transmitted taking c.f tension into account.**(8)**

2.a) A multiplate disc clutch transmits 55 KW of power at 1800 rpm. Coefficient of friction for the friction surfaces is 0.1. Axial intensity at pressure is not to exceed 160 KN/m^2. The internal radius is 80 mm and is 0.7 times the external radius. Find the number of plates needed to transmit the required torque **(8)**

b) A rope drive is required to transmit 230 KW from a pulley of 1m diameter running at 450 rpm. The safe pull in each rope is 800 N and the mass of the rope is 0.4 kg per meter length. The angle of lap and groove angle 160^0 and 45^0 respectively. If coefficient of friction is 0.3, find the number of ropes required. **(8)**

3.The mean diameter of the screw jack having pitch of 10 mm is 50 mm. A load of 20 KN is lifted through a distance of 170 mm. Find the work done in lifting the load and efficiency of the screw jack when (i) the load rotates with the screw, and (ii) the load rests on the loose head which does not rotate with screw. The external and internal diameter of the bearing surface of the loose head is 60 mm and 10mm respectively. The coefficient of friction for the screw as well as the bearing surface may be taken as

0.08. **(16)**

4.a).A leather belt is required to transmit 7.5 kw from a pulley 1.2 m in diameter, running at 250 rpm. The angle entranced is 165_0 and the coefficient of friction between the belt6 and the pulley is 0.3. If safe working stress for the leather belt is 1.5 MPa, density of leather is 1 kg/ m_3 end thickness of belt is 10 mm. Determine the width of the belt taking C.F tension into account. **(8)**

b).Two pulley one 450 mm diameter and other 200mm dia are on parallel shaft 2.1 m apart and are connected by a cross belt. The larger pulley rotates at 225 rpm. The maximum permissible tension in the belt is 1 KN and the coefficient of friction between the belt and the pulley is 0.25. Find the length of the belt required and the power can be transmitted. **(8)**

5.Two shaft whose centers are 1m apart are connected by a V belt drive. The driving pulley is supplied with 100 KW and has an effective diameter of 300 mm. It runs at 375 rpm. The angle of groove on the pulley is 40_0 The permissible tension in 400 mm_2 cross sectional area of the belt is 2.1 MPa. The density of the belt is 1100 kg/ mm_3 coefficient of friction is 0.28. Estimate number of belts required. **(16)**