INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

DEFINITIONS AND TERMINOLOGY

Course Name	:	**KINEMATICS OF MACHINES**
Course Code	:	**AME009**
Program	:	**B.Tech**
Semester	:	**IV**
Branch	:	**Mechanical Engineering**
Section	:	**A,B**
Academic Year	:	**2018– 2019**
Course Faculty	:	**Dr. K.VISWANATH ALLAMRAJU, Professor, ME**

OBJECTIVES

I	To help students to consider in depth the terminology and nomenclature used in the syllabus.
II	To focus on the meaning of new words / terminology/nomenclature

DEFINITIONS AND TERMINOLOGYQUESTION BANK

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
UNIT - I					
1	What is mechanics?	It is that branch of scientific analysis which deals with motion, time and force.	Remember	CLO1	CAME009.01
2	What is Kinematics?	Kinematics is the study of motion, without considering the forces which produce that motion. Kinematics of machines deals with the study of the relative motion of machine parts. It involves the study of position, displacement, velocity and acceleration of machine parts.	Remember	CLO1	CAME009.01
3	What is a Dynamics?	Dynamics of machines involves the study of forces acting on the machine parts and the motions resulting from these forces.	Understand	CLO1	CAME009.01
4	What is a plane motion?	A body has plane motion, if all its points move in planes which are parallel to some reference plane.	Understand	CLO2	CAME009.02
4	What is translation?	A body has translation if it moves so that all straight lines in the body move to parallel positions. Rectilinear translation is a motion wherein all points of the body move in straight lie paths	Understand	CLO2	CAME009.02
5	Define Binary link.	Link which is connected to other links at two points.	Remember	CLO2	CAME009.02
6	Define ternary link.	Link which is connected to other links at three points	Understand	CLO2	CAME009.02
7	Define quaternary link.	Link which is connected to other links at four points	Remember	CLO2	CAME009.02
8	Explain the term' link or element'	It is the name given to anybody which has motion relative to another. All materials have some elasticity. A rigid link is one, whose deformations are so small that they can be neglected in determining the motion parameters of the link.	Understand	CLO3	CAME009.03
9	What is Degrees of freedom?	It is the number of independent coordinates required to describe the position of a body in space. A free body in space can have six degrees of freedom. I.e., linear positions along x, y and z axes and rotational/angular positions with respect to x, y and z axes.	Remember	CLO3	CAME009.03

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10	What is lower pair?	If the joint by which two members are connected has surface contact, the pair is known as lower pair. Eg. pin joints, shaft rotating in bush, slider in slider crank mechanism.	Remember	CLO3	CAME009.03
12	What is higher pair?	If the contact between the pairing elements takes place at a point or along a line, such as in a ball bearing or between two gear teeth in contact, it is known as a higher pair.	Remember	CLO3	CAME009.03
13	What is sliding pair?	It is constituted by two elements so connected that one is constrained to have a sliding motion relative to the other. DOF = 1	Understand	CLO4	CAME009.04
14	Define turning pair.	When connections of the two elements are such that only a constrained motion of rotation of one element with respect to the other is possible, the pair constitutes a turning pair. DOF = 1	Understand	CLO4	CAME009.04
15	Define spherical pair.	A spherical pair will have surface contact and three degrees of freedom. Eg. Ball and socket joint. DOF = 3	Remember	CLO4	CAME009.04
16	Define Helical pair.	Helical pair or screw pair. When the nature of contact between the elements of a pair is such that one element can turn about the other by screw threads, it is known as screw pair. Eg. Nut and bolt. DOF = 1	Remember	CLO4	CAME009.04
UNIT – II					
1	What is velocity?	It is the rate of change of displacement.	Remember	CLO5	CAME009.05
2	What is Acceleration?	It is the rate of change of velocity	Remember	CLO5	CAME009.05
3	What is aAbsolute motion?	The motion of body in relative to another body which is at rest or to a fixed point located on this body.	Understand	CLO5	CAME009.05
4	What is Relative motion?	The motion of body in relative to another moved body.	Remember	CLO5	CAME009.05
5	Describe the concept of velocity analysis?	As dynamic forces are a function of acceleration and acceleration is a function of velocities, study of velocity and acceleration will be useful in the design of mechanism of a machine. The mechanism will be represented by a line diagram which is known as configuration diagram. The analysis can be carried out both by graphical method as well as analytical method.	Remember	CLO5	CAME009.05
6	What is velocity formula?	$V = \frac{dx}{dt}$	Remember	CLO5	CAME009.05

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7	What is acceleration(f) formula?	$f = \frac{dv}{dt} = \frac{d^2x}{dt^2}$	Understand	CLO5	CAME009.05
8	What is linear velocity formula?	$V = r\omega$	Remember	CLO5	CAME009.05
9	Explain the term' angular velocity?	Angular velocity is Rate of change of angular displacement	Remember	CLO5	CAME009.05
10	What is the relation between linear and angular velocity?	$V = r\omega$	Understand	CLO6	CAME009.06
11	List the points of velocity analysis by using graphical method.	Draw the configuration design to a suitable scale. Locate all fixed point in a mechanism as a common point in velocity diagram. Choose a suitable scale for the vector diagram velocity. The velocity vector of each rotating link is perpendicular to the link. Velocity of each link in mechanism has both magnitude and direction. Start from a point whose magnitude and direction is known. The points of the velocity diagram are indicated by small letters.	Remember	CLO6	CAME009.06
12	What are the components of Coriolis Acceleration?	It has been seen that the acceleration of a body may have two components. Centripetal acceleration and Tangential acceleration.	Understand	CLO6	CAME009.06
13	What is the formula for I-center?	n(n-1)/2	Understand	CLO6	CAME009.06
14	What is the full form of I-center?	Instantaneous center	Remember	CLO7	CAME009.07
15	What is the velocity of point on fixed link?	Zero	Understand	CLO7	CAME009.07
16	What is the velocity of acceleration on a fixed link?	Zero	Understand	CLO7	CAME009.07
UNIT – III					

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
1	Robert's mechanism is what type of mechanism?	It is an approximate straight line motion mechanism.	Understand	CLO8	CAME009.08
2	What is An intermittent-motion mechanism?	An intermittent-motion mechanism is a linkage which converts continuous motion into intermittent motion	Understand	CLO8	CAME009.08
3	What is the use of Ratchets?	Ratchets are used to transform motion of rotation or translation into intermittent rotation or translation.	Remember	CLO8	CAME009.08
4	When to use toggle mechanism?	Toggle mechanisms are used, where large resistances are to be overcome through short distances	Remember	CLO9	CAME009.09
5	What is the use of pantograph?	Pantographs are used for reducing or enlarging drawings and maps. They are also used for guiding cutting tools or torches to fabricate complicated shapes.	Remember	CLO9	CAME009.09
6	What is the use of Hook's joint?	Hook's joins is used to connect two nonparallel but intersecting shafts.	Remember	CLO9	CAME009.09
7	Explain about steering gear mechanism.	The steering mechanism is used in automobiles for changing the directions of the wheel axles with reference to the chassis, so as to move the automobile in the desired path. Usually, the two back wheels will have a common axis, which is fixed in direction with reference to the chassis and the steering is done by means of front wheels. In automobiles, the front wheels are placed over the front axles (stub axles), When the vehicle takes a turn, the front wheels, along with the stub axles turn about the pivoted points. The back axle and the back wheels remain straight. Always there should be absolute rolling contact between the wheels and the road surface. Any sliding motion will cause wear of tyres. When a vehicle is taking turn, absolute rolling motion of the wheels on the road surface is possible, only if all the wheels describe concentric circles. Therefore, the two front wheels must turn about the same instantaneous centre I which lies on the axis of the back wheel.	Remember	CLO10	CAME009.10
8	What is the condition of perfect steering?	The condition for perfect steering is that all the four wheels must turn about the same instantaneous centre. While negotiating a curve, the inner wheel makes a larger turning angle θ than the angle φ subtended by the axis of the outer wheel.	Remember	CLO10	CAME009.10

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9	Describe toggle mechanisms.	Toggle mechanisms are used, where large resistances are to be overcome through short distances. Here, effort applied will be small but acts over large distance.	Understand	CLO10	CAME009.10
10	What is the formula for the angle of toggle mechanism?	$\tan\alpha = \frac{F/2}{P}$	Understand	CLO10	CAME009.10
12	What is resistant body?	A resistant body is that which does not suffer appreciable distortion or change in physical form by forces acting on it. Some flexible bodies like belts, ropes and chains etc. may be treated as resistant bodies.	Understand	CLO11	CAME009.11
13	Define Kinematic link.	Each part of machine which moves relative to other is called kinematic link or element. A link or an element may consist of a number of parts connected in such a way that they form one unit and have no relative motion with each other. For example, piston, piston rod and cross-head of steam engine constitute one unit and will be taken as one link or element.	Understand	CLO11	CAME009.11
14	Name of types of links.	Rigid link Flexible link Fluid link	Remember	CLO11	CAME009.11
15	What is flexible link?	A flexible link is that which, while transmitting motion, is partly deformed in such a manner that transmission of motion is not affected. Such a link transmits motion in one direction only (push or pull). Examples are belts, ropes, springs, chains etc.	Remember	CLO11	CAME009.11
16	What is fluid link?	It is formed by having fluid in a receptacle and motion is transmitted through the fluid b pressure or compression. Examples are hydraulic jacks, Hydraulic presses etc.	Remember	CLO12	CAME009.12
17	What is frame?	It is a structure which supports the moving parts of a machine	Remember	CLO12	CAME009.12
UNIT - IV					
1	What is cam?	A cam is a mechanical device used to transmit motion to a follower by direct contact. The driver is called the cam and the driven member is called the follower. In a cam follower pair, the cam	Remember	CLO12	CAME009.12

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		normally rotates while the follow er may translate or oscillate. A familiar example is the cam shaft of an automobile engine, where the cams drive the push rods (the followers) to open and close the valves in synchronization with the motion of the pistons.			
2	What is Disk or plate cam?	The disk (or plate) cam has an irregular contour to impart a specific motion to the follower. The follower moves in a plane perpendicular to the axis of rotation of the camshaft and is held in contact with the cam by springs or gravity.	Remember	CLO12	CAME009.12
3	What is cylindrical cam?	The cylindrical cam has a groove cut along its cylindrical surface. The roller follows the groove, and the follower moves in a plane parallel to the axis of rotation of the cylinder.	Understand	CLO12	CAME009.12
4	Define translating cam.	The translating cam is a contoured or grooved plate sliding on a guiding surface(s). The follower may oscillate or reciprocate .The contour or the shape of the groove is determined by the specified motion of the follower.	Remember	CLO12	CAME009.12
5	List types of followers.	(a) Knife edge follower (b) Roller follower (c) Flat faced follower (d) Spherical follower	Remember	CLO13	CAME009.13
6	Define Cam Profile.	The contour of the working surface of the cam.	Understand	CLO13	CAME009.13
7	Define Tracer point.	The point at the knife edge of a follower, or the center of a roller, or the center of a spherical face.	Remember	CLO13	CAME009.13
8	What is Pitch Curve?	The path of the tracer point.	Understand	CLO14	CAME009.14
9	What is base circle?	The smallest circle drawn, tangential to the cam profile, with its center on the axis of the camshaft. The size of the base circle determines the size of the cam.	Remember	CLO14	CAME009.14
10	What is Prime Circle?	The smallest circle drawn, tangential to the pitch curve, with its center on the axis of the camshaft.	Remember	CLO14	CAME009.14

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11	What is Pressure Angle?	The angle between the normal to the pitch curve and the direction of motion of the follower at the point of contact.	Remember	CLO14	CAME009.14
12	What is standard follower motions?	(a) Uniform velocity (b) Modified uniform velocity (c) Uniform acceleration and acceleration (d) Simple harmonic motion e) Cycloidal motion	Remember	CLO15	CAME009.15
13	Explain displacement diagram.	In a cam follower system, the motion of the follower is very important. Its displacement can be plotted against the angular displacement θ of the cam and it is called as the displacement diagram. The displacement of the follower is plotted along the y-axis and angular displacement θ of the cam is plotted along x-axis. From the displacement diagram, velocity and acceleration of the follower can also be plotted for different angular displacements θ of the cam. The displacement, velocity and acceleration Diagrams are plotted for one cycle of operation i.e., one rotation of the cam. Displacement diagrams are basic requirements for the construction of cam profiles. Construction of displacement diagrams and calculation of velocities and accelerations of followers with different types of motions are discussed in the following sections.	Understand	CLO15	CAME009.15
14	What is cam joint?	A connection between two links that is formed by general surfaces in contact is called a cam-joint.	Remember	CLO16	CAME009.16
15	What is cam follower mechanism?	A cam-follower mechanism has a two degree of freedom cam joint that connects the input and output links. The relative shape of the cam and follower define the displacement function of the mechanism.	Remember	CLO16	CAME009.16
16	What is the degree of freedom of cam follower mechanism?	Two	Remember	CLO16	CAME009.16
UNIT - V					

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
1	What is gear train?	A gear train is two or more gear working together by meshing their teeth and turning each other in a system to generate power and speed. It reduces speed and increases torque. To create large gear ratio, gears are connected together to form gear trains. They often consist of multiple gears in the train.	Remember	CLO16	CAME009.16
2	What is module?	M= d/T	Remember	CLO16	CAME009.16
3	What is the ideal diameter of gear?	Pitch circle diameter	Remember	CLO16	CAME009.16
4	What is Reverted Gear train?	The driver and driven axes lies on the same line. These are used in speed reducers, clocks and machine tools.	Remember	CLO17	CAME009.17
5	What is Epicyclic gear train?	Epicyclic means one gear revolving upon and around another. The design involves planet and sun gears as one orbits the other like a planet around the sun.	Understand	CLO17	CAME009.17
6	What is dedendum circle?	It is the circle drawn through the bottom of the teeth and is concentric with the pitch circle. Dedendum circle is also called root circle.	Remember	CLO17	CAME009.17
7	What is dedendum?	It is the radial distance from the pitch circle to the bottom of the tooth. Its standard value is 1.157m	Remember	CLO18	CAME009.18
8	What is Backlash?	It is the amount by which the width of a tooth space exceeds the thickness of the engaging tooth on the pitch circles.	Remember	CLO18	CAME009.18
9	What is the formula for Backlash?	Backlash = Tooth space – Tooth thickness	Remember	CLO19	CAME009.19
10	Define gear nomenclature.	It is the surface of the top of the tooth	Remember	CLO19	CAME009.19

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
11	Define face width.	It is the length of the tooth parallel to the gear axis	Understand	CLO19	CAME009.19
12	Define face.	It is the tooth surface between the pitch circle and the top land.	Remember	CLO19	CAME009.19
13	Define flank.	It is the tooth surface between the pitch circle and the bottom land.	Remember	CLO20	CAME009.20
14	Define bottom land.	It is the surface of the bottom tooth between adjacent fillets.	Remember	CLO20	CAME009.20
15	What is fillet?	It is the curved portion of the tooth flank at the root circle.	Remember	CLO20	CAME009.20
16	Define total depth.	It is the radial distance between the addendum circle and the dedendum circle of a gear. It is equal to the sum of addendum and the dedendum of Gear. It is also represented as Whole depth.	Remember	CLO20	CAME009.20

Signature of the Faculty **Signature of the HOD**