INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

DEFINITIONS AND TERMINOLOGY QUESTION BANK

Course Name	:	**DYNAMICS OF MACHINERY**
Course Code	:	**AMEB17**
Program	:	**B. Tech**
Semester	:	**FIVE**
Branch	:	**Mechanical**
Section	:	**A & B**
Academic Year	:	**2020 – 2021**
Course Faculty	:	**Dr. K Viswanath Allamraju, Professor**

COURSE OBJECTIVES:

I	The concepts of precision, static and dynamic forces of planer mechanisms by neglecting friction of aero planes, sea vessels, auto mobiles and various force members.
II	The knowledge of engineering mechanics for identifying the coefficient of friction and engine speed of the various contact bodies (Clutches and Brakes) and speed controlled devices, variations of torques and fluctuation of speeds of IC engines.
III	The magnitude and direction of balanced mass for unbalanced rotary and reciprocating engines with the fundamentals of applied physics.
IV	Mathematical modelling of various degree of freedom systems to interpret the various vibration parameters.
V	The affluence of real world engineering problems and examples towards gaining the experience for how dynamics of machinery is applied in engineering practice.

COURSE OUTCOMES:

At the end of the course students are able to:

	Course Outcomes	Knowledge Level (Bloom's Taxonomy)
CO 1	**Discuss** the Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero-planes and ships.	Understand
CO 2	**Determine** the angle of heel to avoid upside down of a two wheeler vehicle while taking in left and right turns.	Evaluate
CO 3	**Illustrate** the static and dynamic force analysis of two and three force members by graphical super position method.	Understand
CO 4	**Apply** the laws of friction on clutches, brakes and dynamometers to reduce the power losses for the effective torque transmission.	Apply
CO 5	**Justify** the importance of torque and fluctuation of speeds for single and multi cylindered engines to increase the mechanical efficiency.	Evaluate
CO 6	**Estimate** the height of a governor to regulate the speed of a prime mover at various load conditions.	Apply

CO 7	**Determine** the balanced mass for unbalanced rotary and reciprocating engines by analytical and graphical methods.	Evaluate
CO 8	**Develop** a mathematical modelling of free and forced vibration systems under damped and un-damped conditions to avoid the vibratory damages of aero-mechanical-civil structures and electrical and electronic components at various operated frequencies.	Apply
CO 9	**Use** the resonance phenomenon to predict the critical or whirling or whipping speeds of various structures under vibrations to avoid catastrophic failures.	Analyze
CO 10	**Apply** the principles of dynamics of machinery to a real world problems for obtaining optimum solutions.	Apply

DEFINITIONS AND TERMINOLOGY QUESTION BANK

S.No	QUESTION	ANSWER	Blooms Level	Course Outcome
MODULE -I				
1	What do you mean by dynamics?	Dynamics refers to the branch of mechanics that deals with the movement of objects and the forces that drive that movement. In physics, dynamics is the study of bodies in motion and changes in that motion, and that idea can be applied to other areas as well.	Remember	CO1
2	What is the difference between dynamics and mechanics?	Mechanics deals with all interactions between the body with forces, and the resultant motion of the body. It's aim is to predict the nature of motion and rest under the action of forces. Mechanics is broader area of study, comprising of Dynamics and statics.	Remember	CO1
3	What are examples of dynamics?	Dynamics is defined as the branch of mechanics that deals with the effect of outside forces on something. An example of dynamics is how the moon affects the ocean waves. An example of dynamics are the effect of individual relationships on a group of friends.	Remember	CO1
4	What is gyroscope used for?	Its design consists of a freely-rotating disk called a rotor, mounted onto a spinning axis in the center of a larger and more stable wheel.	Remember	CO2
5	What is the principle of gyroscope?	When the gyroscope is applied with external torques or rotations about the given axis, the orientation can be measured by a precession phenomenon. When an object rotating about an axis is applied with external torque along a direction perpendicular to the rotational axis, the precession occurs.	Remember	CO 2
6	What is gyroscope couple?	The turning moment which opposes any change of the inclination of the axis of rotation of agyroscope.	Remember	CO 2
7	What is gyroscopic acceleration?	Angular Acceleration is defined as the rate of change of angular velocity with respect to time. It is a Vector quantity. The direction of acceleration vector is not necessarily the same as the displacement and velocity vectors.	Remember	CO 2

8	What is reactive gyroscopic couple?	Whenever an axis of rotation or spin axis changes its direction a gyroscopic couple will act about the third axis. A reactive gyroscopic couple will be experienced by bearings through the shaft.	Remember	CO 2
9	What is gyroscopic torque?	The phenomenon in which the axis of a spinning object (e.g., a gyroscope) describes a cone in space when an external torque is applied to it. The phenomenon is commonly seen in a spinning toy top, but all rotating objects can undergo precession.	Remember	CO 2
10	What is gyroscopic effect?	Gyroscopic effect is ability (tendency) of the rotating body to maintain a steady direction of its axis of rotation. The gyroscopes are rotating with respect to the axis of symmetry at high speed.	Understand	CO 2
11	What do you mean by static force analysis?	When the inertia forces are neglected in comparison to the externally applied load, one may go for static force analysis. If the body is under equilibrium condition, then this equilibri is known as static equilibrium and this condition is applicable in many machines where the movement is relatively slow.	Remember	CO 2
12	What is static and dynamic force?	(Static = not moving). Dynamic force is the force a moving object puts on an object when it hits it The problem is that "support" relates to a static force. "stopping" relates to a dynamic force. Dynamic forces from a falling object are vastly higher than static forces from the same object.	Remember	CO1
13	What is static force?	A static force refers to a constant force applied to a stationary object. A static force is too weak to move an object because it is being countered by equally strong opposite forces. ... The force is then a kinetic force that is being resisted by kinetic friction.	Remember	CO 3
14	What is an example of static force?	A static force refers to a constant force applied to a stationary object. A static forceis too weak to move an object because it is being countered by equally strong opposite forces. The most common example of a static force is static friction on a stationary object.	Remember	CO 3
15	What is the difference between static and dynamic mechanics?	Dynamics is the study of forces on moving bodies. Application of forces when they are in motion. Statics means study of all the forces couples moments etc. for a stationary object which is in the state of rest. Whereas Dynamics deals with study of all the forces when object is in motion.	Remember	CO 3
MODULE - II				
1	What is clutch and its types?	Centrifugal clutch, hydraulic torque converter and fluid coupling includes in it. This type of clutch is always used with the	Remember	CO2

		automatic transmission box. These are all types of clutches used in automobile industries to transmit power.		
2	What is the purpose of clutch?	Function of transmitting the torque from the engine to the drive train. Smoothly deliver the power from the engine to enable smooth vehicle movement. Perform quietly and to reduce drive-related vibration.	Remember	CO2
3	What causes the clutch to break?	Clutch Failure: Common Causes and Replacement Advice. ... The friction that is created between the clutch disc, pressure plate and flywheel when the clutch engages generates heat and wear, and the more the driver "rides" the clutch pedal or lets it slip excessively, the hotter the clutch disc gets and the faster it wears.	Remember	CO2
4	How do clutches work?	Most cars use friction clutch operated either by fluid (hydraulic) or, more commonly, by a cable. When a car is moving under power, the clutch is engaged. A pressure plate bolted to the flywheel exerts constant force , by means of a diaphragm spring, on the driven plate .	Remember	CO 4
5	Does the clutch stop the car?	You can slow the car down almost to a stop with engine alone, with no brakes, although it will be slow. The other reason is the same racing car drivers always keep the car in proper gear. When you brake, you press the clutch, and go into neutral.	Remember	CO 4
6	How long does a clutch last?	It's a difficult question to answer really, as it all depends on your driving style. Most clutches are designed to last approximately 60,000 miles before they need to be replaced. Some may need replacing at 30,000 and some others can keep going well over 100,000 miles.	Remember	CO 4
7	Do you have to press the clutch when going into neutral?	There is no need to press clutch every time you press the brake pedal. You only press clutch when you switch gears, put the car into neutral speed or come to a stop. Whenever you break it is recommended to avoid braking in neutral speed.	Remember	CO2
8	What is brake function?	Deceleration: The main function of the brake system is to decelerate or decrease the speed of a vehicle. By stepping on the brake pedal, the brake pads compress against the rotor attached to the wheel, which then forces the vehicle to slow down due to friction.	Remember	CO2
9	What is types of brake?	There are basically two types of brakes Drum Brake and Disc Brake. they vary in their construction. Disc Brakes:- Disc brakes consist of a brake rotor which is attached directly to the wheel. ... The	Remember	CO 2

		friction between the pads and the rotor causes the vehicle to slow and stop.		
10	How do breaks work?	As the pedal moves down, it pushes a class 2 lever (a kind of simple machine), increasing your pushing force. The lever pushes a piston (blue) into a narrow cylinder filled with hydraulic brake fluid (red) When the brake pad touches the brake disc, friction between the two generates heat (red COud).	Remember	CO 2
11	Why do brakes stop working when hot?	This is the most common and main cause of brake fade. his heat buildup causes the friction surfaces of the brake pads and rotor to stop working correctly.	Remember	CO 4
12	Is brake fade permanent?	Loss of stopping power, or fade, can be cause friction fade, mechanical fade, or fluid fade. Disc brakes are much more resistant to brake fade because the heat can be vented away from the rotor and pads more easily, and have come to be a standard feature in front brakes for most vehicles.	Understand	CO 4
13	What is a dynamometer and how does it work?	A dynamometer, or "dyno" for short, is a device for measuring force, moment of force (torque), or power. For example, the power produced by an engine, motor or other rotating prime mover can be calculated by simultaneously measuring torque and rotational speed (rpm).	Understand	CO 4
14	Dynamometer	A dynamometer is a device used for measuring the torque and brake power required to operate a driven machine.	Remember	CO 4
15	Why dynamometer is used?	A dynamometer or "dyno" for short, is a device for measuring force, torque, or power. For example, the power produced by an engine, motor or other rotating prime mover can be calculated by simultaneously measuring torque and rotational speed (RPM).	Remember	CO4
MODULE - III				
1	What are the uses of turning moment diagram?	Turning Moment (Or Crank Effort) Diagram (TMD) Turning moment diagram is a graphical representation of turning moment or torque (along Y-axis) versus crank angle (X-axis) for various positions of crank. Uses of TMD 1. The area under the TMD gives the work done per cycle.	Remember	CO 5
2	What is the difference between flywheel and governor?	Flywheel stores rotational energy when the mechanical energy supplied is more than that's required for operation, whereas a governor regulates the fuel supply according to the varying load conditions. While hypothetically both serve the same	Remember	CO 5

		purpose, that is speed control, they do it very differently.		
3	What is mean resisting torque?	The resisting torque is the maximum torque above which the flywheel starts to rotate. Generally fly wheel has ver large mass,so a greater amount of torque is required to rotate the flywheel.	Remember	CO 5
4	What is fluctuation of energy?	Fluctuation of energy, co-efficient of fluctuation of energy, co-efficient of fluctuation speed,maximum fluctuati on of energy. Answer: Fluctuations of energy: The variations of energy above and below the mean resisting torque line are called fluctuations of energy.	Remember	CO 5
5	Where is flywheel used?	For dynamic balancing of the engine and to store energy. A flywheel is a rotating mechanical device that is used to storerotational energy. Flywheels have an inertia called the moment of inertia and thus resist changes in rotational speed.	Remember	CO 5
6	How does a flywheel Work?	A flywheel is a mechanical device specifically designed to efficiently store rotational energy. Flywheels resist changes in rotational speed by their moment of inertia. ... For example, flywheels are used in reciprocating engines because the active torque from the individual pistons is intermittent. Energy storage systems.	Remember	CO 5
7	What is meant By turning moment?	Moment. The turning effect of a force is known as the moment. It is the product of the force multiplied by the perpendicular distance from the line of action of the force to the pivot or point where the object will turn.	Remember	CO 5
8	Why flywheel is used in punching machine?	A flywheel is the heavy rotating mass which is placed between the power source and the driven machine to act as a reservoir of energy. It is used to store the energy when the demand of energy of energy is less and deliver it when the demand of energy is high.	Remember	CO 5
9	How energy is stored in flywheel?	In batteries, initially energy is stored by other electrical energy sources or energy is stored from a result of some chemical reaction. Flywheel energy storage can be compared to the battery in the same way. The flywheel energy storage system uses electrical energy and stores it in the form of kinetic energy.	Remember	CO 5
10	What is Governor and its type?	Governor is a device used to maintain the speed of an engine within specified limits when the engine works in varying of different loads. Based on the source of controlling force, the governors can be classified into two types. Governor types are centrifugal governors and inertia governors.	Remember	CO 6

11	How does speed governor work?	Like many functions on modern, fuel-injected cars, speed limiters operate through electronic sensors and the engine computer. Once you reach a pre-determined top speed, the computer steps in and restricts the flow of air and fuel to the engine and even the sparks that cause combustion.	Remember	CO 6
12	What is the main function of governor?	The functions of a governor is to regulate the mean speed of an engine, when there are variations in the load. When the load on an engine increases, its speed decreases, therefore it becomes necessary to increases the supply of working fluid.	Remember	CO 5
13	What is the Purpose of governor?	A centrifugal governor is a specific type of governor with a feedback system that controls the speed of an engine by regulating the flow of fuel or working fluid, so as to maintain a near- constant speed. It uses the principle of proportional control.	Remember	CO 6
14	What is the difference between flywheel and governor?	Flywheel stores rotational energy when the mechanical energy supplied is more than that's required for operation, whereas a governor regulates the fuel supply according to the varying load conditions. While hypothetically both serve the same purpose, that is speed control, they do it very differently.	Remember	CO 5
15	Where is flywheel used?	For dynamic balancing of the engine and to store energy. A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheels have an inertia called the moment of inertia and thus resist changes in rotational speed.	Remember	CO 5
MODULE - IV				
1	Why do we do Balancing of rotating masses?	A rotating system of mass is in dynamic balance when the rotation does not produce any resultant centrifugal force or couple. ... If a system is initially unbalanced, to avoid the stress upon the bearings caused by the centrifugal couple, counterbalancing weights must be added.	Remember	CO 7
2	What is static Balancing of rotating masses?	Static Balancing A rotating mass is said to be statically balanced if the rotating mass can rest, without turning, at any angular position in its bearings. This condition is attained when the sum of the centrifugal forces on the rotating mass due to unbalanced masses is zero in any radial direction.	Remember	CO 7
3	How the different masses rotating in different planes are balanced?	When several masses rotate in different planes, the centrifugal forces, in addition to being out of balance, also form couples. A system of rotating masses is in dynamic balance when there does not exist any	Remember	CO 7

		resultant centrifugal force as well as resultant couple.		
4	Why is balancing necessary?	Balancing of rotating parts is necessary for every engine, only in high speed engines it becomes very important. The force exerted by the rotating parts is proportional to the square of the rotational speed, omega. ... If the rotating parts are not balanced, then the vibrations caused by the parts will be too much.	Remember	CO 7
5	Why Balancing of dynamic forces are necessary?	The balancing of rotating bodies is important avoid vibration. Dynamic and Static Balancing in Heavy Industrial machinery such as generators and motors can cause catastrophic failure, as well as noise and discomfort. To help with balancing, it involves simply moving the centre of gravity to the centre of rotation.	Remember	CO 7
6	What is rotating mass?	Rotating unbalance is the uneven distribution of mass around an axis of rotation. Arotating mass, or rotor, is said to be out of balance when its center of mass (inertia axis) is out of alignment with the center of rotation (geometric axis).	Remember	CO 7
7	What are the two types of wheel balancing?	There are two types of wheel balancing, static and dynamic.	Remember	CO 7
8	Which balancing exercise is best for improving dynamic balance?	Balance is especially important for older adults hoping to reduce the risk of falls and injuries. Core stability is essential to both static and dynamic balance. Unfortunately, many traditional core-training exercises, such as crunches and leg raises, do little to improve stability.	Remember	CO 7
9	What is Reference plane in balancing?	When several masses revolve in different planes, they may be transferred to are ference plane and this reference plane is a plane passing through a point on the axis of rotation and perpendicular to it. the couples about the reference plane must balance i.e., the resultant couple must be zero.	Remember	CO 7
10	Why is a shaft dynamically balanced at one rotational speed also balanced at any other speed?	A shaft dynamically balanced at one rotational speed is also balanced at any other speed because the tangential velocity is constant. This means that only the acceleration due to changes of direction will affect the dynamical balance. It also shows that a shaft statically balance may also be dynamic ally balance.	Remember	CO 7
11	Is balancing an engine necessary?	Street engines do not necessarily need balancing. Except for a couple of rare occasions, almost no factory engine ever came fully balanced, even most "performance" engines weren't balanced.	Remember	CO 7

		Balancing helps an engine run smoother with less vibration which creates less havoc on main bearings and helps things last longer.		
12	What are the causes and Effect of vibration?	As machine speed increases, the effects of imbalance become greater. Imbalance can severely reduce bearing life as well as cause undue machine vibration. Misalignment: Vibration can result when machine shafts are out of line.	Remember	CO 7
13	How do you calculate torque to rotate a mass?	To calculate torque, start multiplying the mass of the object exerting force by the acceleration due to gravity, which is 9.81. When the force is COckwise, its torque is negative, and when it's moving counterCOckwise, it's positive.	Remember	CO 7
14	How do you find the center of mass?	center of mass formula to find the exact location of the center of mass between a system of objects, you add all the masses times their positions and divide by the total mass, the position can be measured relative to any point you call X equals zero and the number you get out of that.	Remember	CO 7
15	How are mass and rotational inertia related?	Rotational inertia plays a similar role in rotational mechanics to mass in linear mechanics. Indeed, the rotational inertia of an object depends on its mass. It also depends on the distribution of that mass relative to the axis of rotation.	Remember	CO 7
MODULE - V				
1	Period of oscillation.	The time taken to complete one cycle of motion is known as the period of oscillation $\tau=2\pi/\omega$. Time period and is denoted by τ Rotate through an angle of 2π The circular frequency ω	Remember	CO 8
2	Frequency of oscillation.	The number of cycles per unit time is called the frequency of oscillation	Remember	CO 8
3	synchronous	Consider two vibratory motions denoted by $x1 = A1 \sin \omega t$ $x2 = A2 \sin(\omega t + \varphi)$ The two harmonic motions given by above Eqs. are called synchronous	Remember	CO 8
4	Periodic motion.	Oscillatory motion may repeat itself regularly, as in the case of a simple pendulum, or it may display considerable irregularity, as in the case of ground motion during an earthquake. If the motion is repeated after equal intervals of time, it is called periodic motion.	Remember	CO 8
5	Harmonic motion	The simplest type of periodic motion is harmonic motion.	Remember	CO 8
6	Distributed or continuous systems	Systems where mass, damping, and elasticity were assumed to be present only at certain discrete points in the system. In many cases, known as distributed or continuous systems.	Understand	CO 8

7	System of infinite degrees of freedom	A continuous system is also called a system of infinite degrees of freedom.	Remember	CO 8
8	Wave equation	The Equation $c^2\frac{\partial^2 w}{\partial x^2} = \frac{\partial^2 w}{\partial t^2}$ is also known as the wave equation.	Remember	CO 8
9	Frequency or characteristic equation	Equation $\sin\frac{\omega l}{c} = 0$ is called the frequency or characteristic equation.	Remember	CO 8
10	Eigenvalues	Equation is called the frequency or characteristic equation and is satisfied by severalvalues of ωThe values of ωare called the eigenvalues (or natural frequencies orcharacteristic values) of the problem.	Remember	CO 8
11	Fundamental mode	The mode corresponding to n = 1 is called the fundamental mode.	Remember	CO 8
12	Fundamental frequency.	The mode corresponding to n = 1 is called the fundamental mode, and ω_1 is called the fundamental frequency.	Remember	CO 8
13	Why do we Use Fourier transform? What is it used for?	Almost every imaginable signal can be broken down into a combination of simple waves This break down, and how much of each wave is needed, is the Fourier Transform. Fourier transforms (FT) take a signal and express it in terms of the frequencies of the waves that make up that signal.	Remember	CO 8
14	What is time domain analysis?	Time domain is the analysis of mathematical functions, physical signals or timeseries of economic or environmental data, with respect to time. In the time domain, the signal or function's value is known for all real numbers, for the case of continuous time, or at various separate instants in the case of discrete time.	Remember	CO 8
15	What is vibration analysis?	Vibration Analysis refers to the processmeasuring the vibration levels and frequencies of industrial machinery, and using that information to determine the "health" of the machine, and its components. This vibration can be measured, using a device called an accelerometer.	Remember	CO 8
16	Resonance	Whenever the natural frequency of vibration of a machine or structure coincides with the frequency of the external excitation, there occurs a phenomenon known as resonance	Remember	CO 8
17	vibration	Any motion that repeats itself after an interval of time is called vibration or oscillation	Remember	CO 8
18	generalized coordinates	The coordinates necessary to describe the motion of a system constitute a set of generalized coordinates. These are usually denoted as and may represent Cartesian and/or non-Cartesian coordinates	Remember	CO 8
19	Resonance	Whenever the natural frequency of vibration of a machine or structure	Remember	CO 8

		coincides with the frequency of the external excitation, there occurs a phenomenon known as resonance.		
20	Natural frequency.	If a system, after an initial disturbance, is left to vibrate on its own, the frequency with which it oscillates without external forces is known as its natural frequency.	Remember	CO 8

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