INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	**ENGINEERING MECHANICS**
Course Code	AME002
Class	B.Tech II Semester
Branch	AE / CE / ME
Year	2017 – 2018
Course Faculty	Mr. B.D.Y. Sunil, Assistant Professor Mr. K. Vishwanth Allamraju, Associate Professor

COURSE OBJECTIVES:

The course should enable the students to:

I	Develop the ability to work comfortably with basic engineering mechanics concepts required for analyzing dynamic structures.
II	Identify an appropriate structural system to studying a given problem and isolate it from its environment, model the problem using good free-body diagrams and accurate equilibrium equations.
III	Identify and model various types of loading and support conditions that act on structural systems, apply pertinent mathematical, physical and engineering mechanical principles to the system to solve and analyze the problem.
IV	Understand the meaning of impulse and momentum, virtual work and solve the field problems.
V	Solve the problem of equilibrium by using the principle of work and energy and vibrations for preparing the students for higher level courses such as, Mechanics of Solids, Mechanics of Fluids etc...

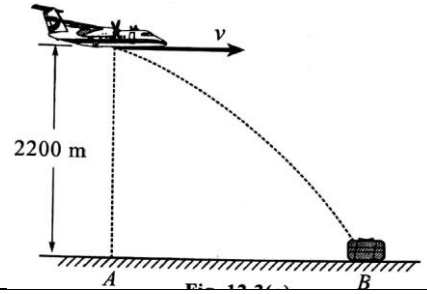
COURSE LEARNING OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

CAME002.01	Understand the concepts of kinematics of the particles and rectilinear motion.
CAME002.02	Demonstrate knowledge of ability to identify & apply fundamentals to solve problems like motion curves, rigid body motion and fixed axis rotation.
CAME002.03	Explore knowledge & ability to solve various particle motion problems.
CAME002.04	Derive the D' Alembert's principle and apply it to various field problems of kinetic motion.
CAME002.05	Discuss the nature of relation between force and mass under the influence of time.
CAME002.06	Develop the relations for motion of body in lift and on inclined plane.
CAME002.07	Determine the impact, impulse and impulsive forces occurring in the system.
CAME002.08	Understand the inter relationship between impulse-momentum and virtual work and an ability to use such relationships to solve practical problems
CAME002.09	Knowledge of the lifting machines and simple framed structures equilibrium criteria, and the knowledge of the equilibrium condition systems.
CAME002.10	Determine the effect of law of conservation of energy and its consideration in field problems.
CAME002.11	Discuss the application of work energy method to particle motion.
CAME002.12	Develop the work energy relations and apply to connected systems.
CAME002.13	Understand the fixed axis rotation theory and solving the field problems by application of work energy method.
CAME002.14	Introduction to concepts of vibration and explain the relation between simple harmonic motion and the equilibrium systems.
CAME002.15	Derive the expressions for the concepts of simple, compound and torsional pendulums.
CAME002.16	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc.

TUTORIAL QUESTION BANK

UNIT – I			
KINEMATICS OF PARTICLES RECTILINEAR MOTION			
S No	**QUESTION**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
Part - A (Short Answer Questions)			
1	Define the terms velocity and acceleration	Remember	CAME002.01
2	Define angular displacement, angular velocity and angular acceleration	Remember	CAME002.02
3	A stone is thrown vertically upwards and returns in 5seconds. How high does it go?	Remember	CAME002.03
4	A body falling freely under the action of gravity passes two points 9m apart vertically in 0.2 seconds. From what height above the higher point did it start to fall?	Understand	CAME002.01
5	Define the terms Kinetics and kinematics	Remember	CAME002.02
6	Define instantaneous centre of velocity	Understand	CAME002.03
7	Write kinematic equations of linear motion with constant acceleration.	Understand	CAME002.01
8	The rectilinear motion of a particle is defined by the displacement-time equation as $x=x_0+v_0t+(1/2)at^2$. Find the displacement and velocity at time t=2s while x_0=250mm, v_0=125mm/s and a=0.5mm/s^2.	Remember	CAME002.02
9	A particle starts from rest and moves along a straight line with constant acceleration a. If it acquires a velocity v=3 mm/s^2, after having travelled a distance S=7.5m, find the magnitude of the acceleration.	Remember	CAME002.03
10	State the assumptions necessary for the analysis of a plane projectile motion.	Remember	CAME002.01
11	A motorist travelling at 18kmph applies brakes suddenly and comes to rest skidding 75mm. Determine the time required to stop the car.	Understand	CAME002.02
12	The location of a particle defined as $r=5+7t^2$ and $\theta=6+3t^2$. Determine the magnitude of velocity and the acceleration of the particle at t=5 s.	Remember	CAME002.03
13	Define the term rigid body	Remember	CAME002.01
14	Write governing equations of velocity and acceleration of rigid body motion.	Understand	CAME002.02
15	At a given instant, a shaft is rotating at 50rpm about a fixed axis and 20s later, it is rotating at 1050 rpm. Determine the average angular acceleration in rad/s^2.	Understand	CAME002.01
16	A flywheel of diameter 50cm starts from rest with constant angular acceleration of 2 rad/s^2. Determine the tangential and the normal components of acceleration of a point on its rim 3s after the motion began.	Remember	CAME002.02
17	Draw the graphical representation of displacement with time and the tangent at any point indicates what quantity?	Remember	CAME002.03
18	List the different types of rigid body motions	Understand	CAME002.01
19	Write the kinematic relation for one rotating and one translating rigid body in contact.	Remember	CAME002.02
20	Write governing equations of velocity and acceleration of fixed axis rotation	Remember	CAME002.03
Part - B (Long Answer Questions)			
S No	**QUESTION**	**Blooms Taxonomy Level**	**Course Learning Outcomes**

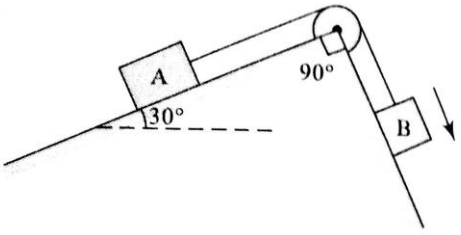
1	Derive all the three kinematic equations of linear motion having constant acceleration.	Remember	CAME002.01
2	Derive the kinematic parameters in angular motion. Establish the relationship with those in linear motion.	Remember	CAME002.02
3	Derive the kinematic equation in angular motion with constant acceleration.	Remember	CAME002.03
4	Explain the possible cases of equation of motion with variable acceleration?	Understand	CAME002.01
5	Derive an expression for the distance travelled in nth second for rectilinear motion.	Remember	CAME002.02
6	Obtain the equation of the trajectory along a horizontal plane.	Understand	CAME002.03
7	Derive the expression for range along an inclined plane. What is the necessary condition for obtaining maximum range along an inclined plane?	Understand	CAME002.01
8	Derive the general equations of velocity and acceleration of a rigid body.	Remember	CAME002.02
9	A roller of radius 5cm rides between two horizontal bars, without any slip. The top bar moves right at 3m/s while the bottom one moves left at 2m/s. Calculate the distance d of instantaneous centre of rotation from the bottom plate.	Remember	CAME002.03
10	An aeroplane is flying in horizontal direction of 540 km/hr and at a height of 2200m as shown in figure. When it is vertically above the point *A* on the ground, a body is dropped from it. The body strike the ground at point *B*. Calculate the distance *AB* ignoring air resistance. Also find velocity at *B* and time taken to reach *B*. 	Remember	CAME002.01
11	A bus starts from rest at point A and accelerates at the rate of $0.9m/s^2$ until it reaches a speed of 7.2m/s. It then proceeds with the same speed until the brakes are applied. It comes to rest at point B, 80m beyond the point where the brakes are applied. Assuming uniform acceleration, determine the time required for the bus to travel from A to B. AB=90m.	Understand	CAME002.01
12	Two stones are projected vertically upwards at the same instant. One of them ascends 80 meters higher than the other and returns to the earth 4 seconds later. Find (i) The velocities of projection (ii) The maximum heights reached by the stones.	Remember	CAME002.02

Part - C (Problem Solving and Critical Thinking Questions)

S No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes

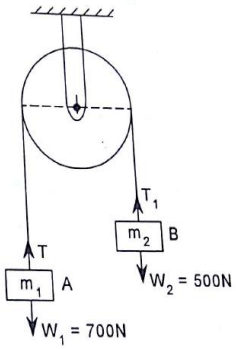
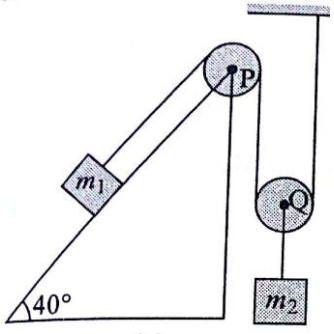
1	A particle starts moving along a straight line with initial velocity of 25m/s, from O under a uniform acceleration of -2.5 m/s2. Deterime (i) Velocity, displacement and the distance travelled at t= 5 sec (ii) How long the particle moves in the same direction? What is its velocity, displacement and the distance covered then? (iii) The instantaneous velocity , displacement and the distance covered at t=15 sec (iv) The time required to come back to O, velocity, displacement and distance covered then (v) Instantaneous velocity, , displacement and distance covered at t=25 sec	Remember	CAME002.01
2	A stone is dropped from the top of a tower. When it has travelled a distance of 10m, another stone is dropped from a point 38m below the top of the tower. If both the stones reach the ground at the same time, calculate (i) The height of the tower and (ii) The velocity of the stone when they reach the ground	Remember	CAME002.02
3	A body *A* is projected vertically upwards from the top of a tower with a velocity of 40m/s, the tower being 180m high. After *t* seconds, another body *B* is allowed to fall from the same point. Both the bodies reach the ground simultaneously. Calculate *t* and the velocities of *A* and *B* on reaching the ground.	Remember	CAME002.01
4	Two cars *A* and *B* travelling in the same direction get stopped at a traffic signal. When the signal turns green, car *A* accelerates at 0.75 m/s^2. 1.75 seconds later, car *B* starts and accelerates at 1.1 m/s^2. Determine (i) when and where *B* will overtake *A* and (ii) The speed of each car at that time.	Understand	CAME002.02
5	A ball is thrown vertically upwards from 12m level in an elevator shaft with initial velocity 18m/s. At the same time an open platform elevator passes 5m level, moving upwards with a constant velocity 2 m/s. Determine (i) When and where the ball will hit the elevator (ii) The relative velocity of the ball with respect to the elevator, when the ball hits it	Remember	CAME002.03
6	A wheel is rotating about its axis with a constant angular acceleration of 1 rad/sec^2. If the initial and final angular velocities are 5.25 rad/sec^2 and 10.5 $rad/sec^{2.}$. Determine the total angle turned through during time interval this change of angular velocity took place.	Understand	CAME002.01
7	A motorist is travelling at 80kmph, when he observes a traffic light 200m ahead of him turns red. The traffic lights are timed to stay red for 10sec. If the motorist wishes to pass the light without stopping, just as it turns green, determine: (i) The required uniform deceleration. (ii) Speed as he passes the light.	Understand	CAME002.02
8	A car is accelerated from rest to a top speed of 100kmph and then immediately decelerated to a stop. If the total elapsed time is 20sec, determine the distance covered. The acceleration and deceleration are both constant but not necessarily of the same magnitude.	Remember	CAME002.03
9	A point is moving with uniform acceleration in the 11^{th} and 15^{th} seconds from the commencement it moves through 7.2m and 9.6m respectively. Find its initial velocity and the acceleration with which it moves.	Remember	CAME002.01
10	When the angular velocity of 1.2 m diameter pulley is 3 rad/sec. The total acceleration of a point on its rim is $9m/s^2$ .Determine the angular acceleration of pulley at this instance.	Remember	CAME002.02

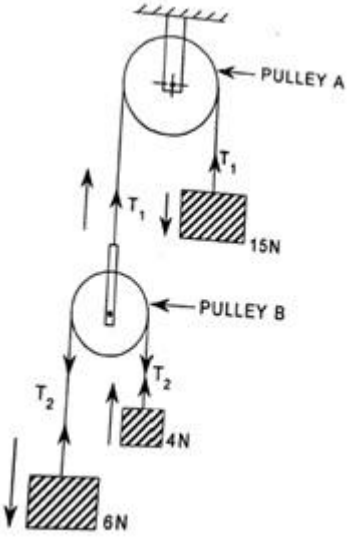
UNIT - II			
KINETICS OF PARTICLE			
Part – A (Short Answer Questions)			
S No	**QUESTION**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Define the term kinetics	Remember	CAME002.04
2	Define the term particle	Remember	CAME002.05
3	Distinguish between mass and weight.	Remember	CAME002.06
4	Define the term inertia of a body with units	Understand	CAME002.04
5	Define the term momentum of a body with units	Remember	CAME002.05
6	Define the term force with units	Understand	CAME002.06
7	Write the relation between force and mass.	Understand	CAME002.04
8	State law of inertia	Remember	CAME002.05
9	State Newton's second law of motion	Remember	CAME002.04
10	State D'Alembert's principle.	Remember	CAME002.05
11	Compare Newton's second law with D'Alembert's principle.	Understand	CAME002.06
12	Differentiate between kinematics and kinetics	Remember	CAME002.04
13	Derive an expression F=ma	Remember	CAME002.05
14	State the effect of translation motion on rigid bodies	Understand	CAME002.06
15	State the effect of rotational motion on rigid bodies	Understand	CAME002.04
16	State the effect of general plane motion on rigid bodies	Remember	CAME002.05
17	Write the expression for motion of lift moving upwards	Remember	CAME002.06
18	Write the expression for motion of lift moving downwards	Understand	CAME002.04
19	Draw the FBD for the condition where a body is moving on a rough inclined plane(upwards and downwards)	Remember	CAME002.05
20	State the relation between torque and moment of inertia	Remember	CAME002.06
Part - B (Long Answer Questions)			
S No	**QUESTION**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Derive the expression for velocity and acceleration of a particle subjected to a force as a function of velocity.	Understand	CAME002.04
2	A car of mass 1000kg moves on a level road under the action of 981 N of propelling force. Find the time taken by the car to increase its velocity from 24 to 48 kmph and the distance travelled during this time.	Understand	CAME002.05
3	A bullet of mass 81gms and moving with a velocity of 300m/s is fired into a log of wood and it penetrates to a depth of 10cms. If the bullet moving with same velocity were fired into a similar piece of wood 5cms thick, with what velocity it emerge? Find also the force of resistance, assuming to be uniform.	Understand	CAME002.06
4	An elevator weighing 4900N is ascending with an acceleration of 3 m/s^2. During the ascent its operator whose weight is 686N is standing on the scales placed on the floor. What is the scale reading? What will be total tension in the cable of the elevator during this motion?	Understand	CAME002.04
5	A car of mass 1000kg hauls a trailer of mass 500kg with a common acceleration of 0.15m/s^2. Calculate the tension in horizontal tow rope.	Understand	CAME002.05

6	A car is travelling at a speed of 110kmph. The driver suddenly applies brake and halts after skidding 70m. determine: (a) The time required to stop the car. (b) The coefficient of friction between the tyres and road.	Remember	CAME002.06
7	A lift has an upward acceleration of 1.225m/s^2: (a) What pressure will a man weighing 500N exert on the floor of the lift? (b) What pressure would be exerted if the lift had an acceleration of 1.225m/s^2 downwards? (c) What upward acceleration would cause his weight to exert a pressure of 600N on the floor?	Remember	CAME002.04
8	Two bodies of weight 40N and 25N are connected to the two ends of a light inextensible string, passing over a smooth pulley. The weight of 40N is placed on the horizontal surface while the weighty of 25N is hanging free in air. If the angle of the plane is 15^o, determine (i) The acceleration of the system (ii) The tension in the string (take coefficient of friction as 0.2) (iii) The distance moved by the weight 25N in 3s starting from rest.	Remember	CAME002.04
9	Two blocks A and B are connected by an inextensible string moving over a frictionless pulley as shown in the figure given below. If the blocks are released from rest, determine the velocity of the system after the travel of 4s. Take the masses of blocks A and B as 20 and 60 kg respectively and coefficient of friction for all the contiguous surfaces as 0.3  	Understand	CAME002.05
10	A car is travelling at a speed of 70kmph. The driver suddenly applies brake and halts after skidding 50m. determine: (c) The time required to stop the car. (d) The coefficient of friction between the tyres and road.	Remember	CAME002.04
11	A lift has an upward acceleration of 2.45m/s^2. (a) What pressure will a man weighing 1000N exert on the floor of the lift (b) What pressure would he exert if the lift had an acceleration of 2.45 m/s^2 downwards (c) What upward acceleration would cause his weight to exert a pressure of 1200N on the floor	Understand	CAME002.05
12	A mass of 2.5 Kg projected with a speed of 4m/s up a plane inclined 15^o with the horizontal. After travelling 1.2m, the mass comes to rest. Determine the coefficient of friction.	Understand	CAME002.06
13	In a circus show a motor cyclist is moving inside a spherical cage of radius 3m. The motor cycle and man together weights 7357.5N. Find the least velocity with which the motor cyclist must pass the highest point on the cage without losing inside the cage.	Remember	CAME002.04

14	Two weights 800N and 200N are connected by a thread and they move along a rough horizontal plane under the action of 400N applied to 800N weight from left to right direction. The coefficient of friction between the sliding surface of the weights and the plane is 0.3. Using D-Alembert's principle, determine the acceleration of the weights and tension in the thread.	Remember	CAME002.05

Part – C (Problem Solving and Critical Thinking)

S No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes
1	A mass of 5kg projected with a speed of 8m/s up a plane inclined at 15^{o} with the horizontal. After travelling 2.4m, the mass comes to rest. Determine the coefficient of friction.	Remember	CAME002.04
2	A pulley whose axis passes through the centre 'O' carries a load as shown in figure given below. Neglect the inertia of pulley and assuming that the cord is inextensible; determine the acceleration of the block A. How much weight should be added to or taken away from the block A if the acceleration of the block A is required to be g/3 downwards? 	Remember	CAME002.05
3	Two bodies of weight 20N and 10N are connected to the two ends of a light inextensible string, passing over a smooth pulley. The weight of 20N is placed on the horizontal surface while the weighty of 10N is hanging free in air. The horizontal surface is a rough one having coefficient of friction between the weight 20N and the plane surface equal to 0.3, determine (i) The acceleration of the system (ii) The tension in the string	Remember	CAME002.06
4	Determine the tension in the inextensible string of the system shown the figure below while m_1= 200Kg and m_2=100Kg. Consider the pulley as mass less and coefficient of friction as 0.2. 	Remember	CAME002.04
5	A solid cylinder of weight W and radius r rolls down an inclined plane which makes θ degrees with horizontal axis. Determine the minimum coefficient of friction and the acceleration of the mass centre for the rolling, without slipping.	Understand	CAME002.04

6	A block having a mass of 50 kg has a velocity of 15m/sec horizontally on a smooth frictionless surface. Determine the value of horizontal force to be applied to the block for bringing it to rest in 5 seconds.	Remember	CAME002.05
7	A man weighing 750N dives into a swimming pool from a tower of height 25m. He was found to go down in water by 2.5 m and then started rising. Find the average resistance of water. Neglect the resistance of air	Remember	CAME002.06
8	An elevator weighing 4500N is ascending with an acceleration of 3 m/s^2. During the ascent its operator whose weight is 600N is standing on the scales placed on the floor. What is the scale reading? What will be total tension in the cable of the elevator during this motion?	Remember	CAME002.04
9	A system of weights connected by string passing over pulleys A and B is shown in figure given below. Find the acceleration of three weights assuming weightless strings and ideal conditions for pulleys 	Understand	CAME002.04
10	A mass of 9 Kg projected with a speed of 10m/s up a plane inclined 15^o with the horizontal. After travelling 3 m, the mass comes to rest. Determine the coefficient of friction.	Remember	CAME002.05

UNIT-III

IMPULSE AND MOMENTUM, VIRTUAL WORK

CIE-I

Part - A (Short Answer Questions)

S No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes
1	Define the term impulsive force	Remember	CAME002.07
2	Define the term coefficient of restitution	Remember	CAME002.08
3	Write a short note on central and non central impacts and their types.	Remember	CAME002.09
4	Define the term impact. State the differences between direct central impact and oblique central impact	Understand	CAME002.07
5	Define the terms impulse and momentum	Remember	CAME002.08
6	State the differences between elastic and inelastic impact	Understand	CAME002.09
7	State the principle of conservation of linear momentum of a particle	Understand	CAME002.07
8	State law of conservation of momentum	Remember	CAME002.08
9	Write the impulse momentum equation and state for what kind of problems it is used.	Remember	CAME002.09

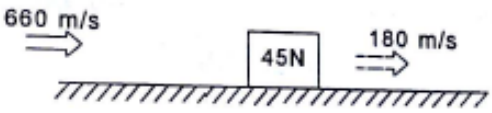
10	In ice hockey the puck moves at 10m/s and when intercepted by a player its velocity changes to 20m/s in opposite direction. What is the impulse on the puck if mass of puck is 0.12 Kg?	Remember	CAME002.07

Part – B (Long Answer Questions)

S No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes
1	Derive the relationship between impulse and linear momentum. From this relation how can you deduce the principle of conservation of linear momentum?	Remember	CAME002.07
2	Starting from the basics, derive the relationship between linear impulse and momentum.	Remember	CAME002.08
3	Explain the mechanism of impact with reference to direct central impact	Remember	CAME002.09
4	How will you formulate the loss of kinetic energy for a direct central impact? Can it be possible to comment on the change in KE in case of a perfectly elastic collision?	Understand	CAME002.07
5	Explain the steps for analysing a force system using virtual work principle	Remember	CAME002.08
6	A body of mass 175Kgs is resting on a horizontal surface and is subjected to a horizontal force of 350N. Find the time elapsed before the block reaches a velocity of 15m/s. Assume coefficient of friction between the surface and the block is 0.2. Use impulse momentum equation.	Understand	CAME002.09
7	A 1500N log is in contact with a level plane, the coefficient of friction between 2 contact surfaces being 0.1. If the block is acted upon by a horizontal right side force of 300N, what time will elapse before the block reaches 16m/s starting from rest? If 300N force is then removed, how much longer will the block continue to move? Solve the problem using impulse momentum equation.	Understand	CAME002.07
8	A gun of mass 30 tonnes fires a 456Kg projectile with a velocity of 305 m/s. With what initial velocity will the gun recoil? If the recoil is overcome by an average force of 600KN, how far will the gun travel? How long will it take?	Remember	CAME002.08
9	A body of mass 2Kg is moving at a speed of 0.5m/s to the right collides with a mass of 3.5Kg which is at rest. After collision, the 3.5Kg mass moves to right at a speed of 0.25m/s, determine the coefficient of restitution.	Remember	CAME002.09
10	A 0.025 Kg bullet travelling at 400m/s passes through a target which is free to move up an inclined track. The bullet leaves the target at 50% of its original velocity and enters a sand bank having a resistance of 10KN. Calculate (a) The vertical distance moved by the 20Kg target (b) The depth of penetration of the bullet into the sand bank	Remember	CAME002.07

Part – C (Problem Solving and Critical Thinking)

S No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes
1	A hammer of mass 700Kg drops from a height of 1.5m on a pile of mass 25Kg. Find the depth of penetration of the pile into the ground, if the average resistance of the ground is 80KN. Assume the impact between the hammer and the pile to be plastic.	Remember	CAME002.07

2	The bullet weighing 0.3N and moving at 660m/s penetrates the 45N body emerges with a velocity 180m/s as shown in the figure given below. How far and how long does the body moves/ assume μ=0.4 	Remember	CAME002.08
3	A 10Kg shell is moving at a constant speed of 21m/s. When it explodes into two parts, the largest part of the masses, 7Kg immediately comes to rest. Calculate the energy supplied in the explosion, assuming it is translated into kinetic energy.	Remember	CAME002.07
4	A block weighing 130N is on an incline, whose slope is 5 vertical to 12 horizontal. Its initial velocity down the incline is 2.4m/s. What will be its velocity 5 seconds later? Take coefficient of friction at contact surface as 0.3.	Remember	CAME002.08
5	A ball is dropped from a height of 1.6m on a floor rebounds to a height of 0.9m, find the coefficient of restitution.	Understand	CAME002.07
6	A cricket ball of mass 10 gm moving with a velocity of 20m/s is brought to rest by a player in 0.05sec. Find the impulse of the ball and average force applied by the player.	Remember	CAME002.08
7	A gun mass 2500Kg fires horizontally, a shell of mass 40Kg with a velocity of 350m/s. What is the velocity with which the gun recoils? Also determine the force required to stop the gun in 0.8m. In how much time will it stop?	Understand	CAME002.09

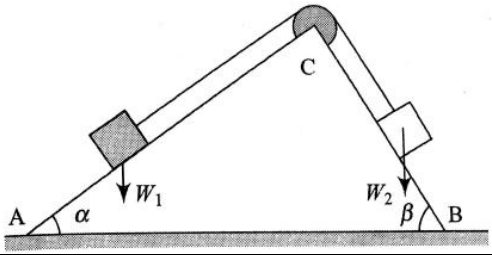
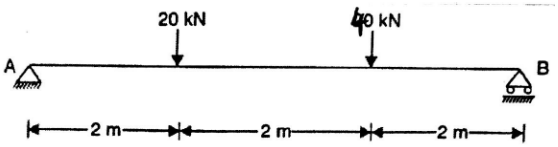
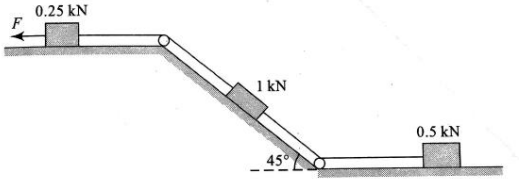
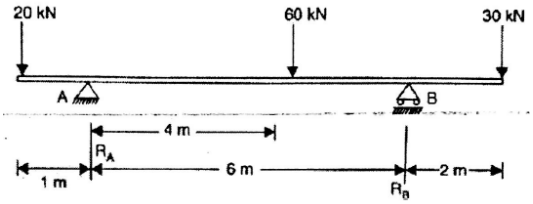
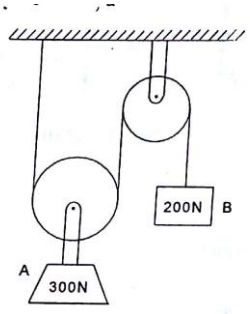
CIE-II

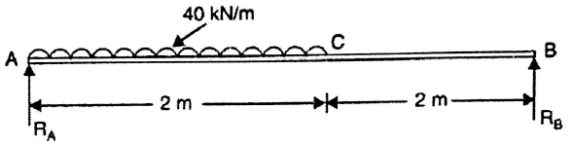
PART –A (Short Answer Questions)

S No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes
1	State the principle of virtual work. What is its converse statement?	Remember	CAME002.08
2	Differentiate between work done and virtual work done	Remember	CAME002.08
3	Write a short note on virtual rotation	Remember	CAME002.09
4	Write a short note on virtual displacement	Understand	CAME002.07
5	List the forces and the effects which do not yield non-zero work	Remember	CAME002.09
6	Discuss the mathematical conditions for attaining different types of equilibrium.	Understand	CAME002.07
7	A body of mass 2.5Kg has an initial velocity of 4m/s is acted upon by a force of magnitude 20N for 5 seconds. What is the final velocity of the mass?	Understand	CAME002.07
8	Velocity of the body of mass 16Kg changes from 10m/s to 25m/s in 10s. What is the average force acting on the body during these 10s?	Remember	CAME002.08
9	A man of mass 70Kg runs and jumps into a boat in water with horizontal velocity of 5m/s. Find the velocity with which boat and man will move away after the jump, if boat mass is 150 Kg.	Remember	CAME002.08
10	A rocket burns 50gm of fuel per second ejecting it as a gas with a velocity of $5x10^5$ cm/s, find the force on the rocket.	Remember	CAME002.09

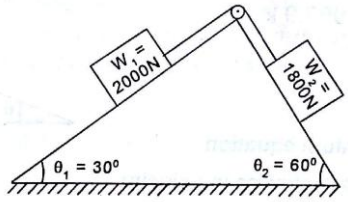
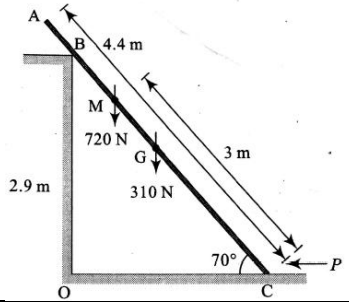
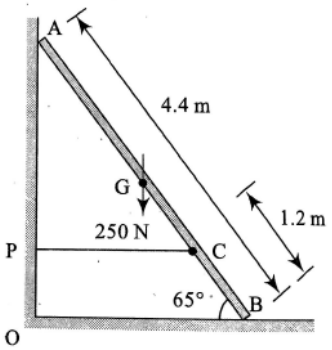
Part – B (Long Answer Questions)

S No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes

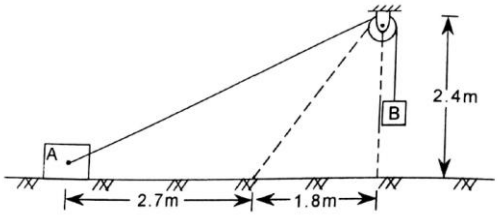
1	Two blocks W_1 and W_2 are resting on inclines AC and BC respectively. The blocks are connected with the inextensible cord passing over a smooth pulley as shown in the figure given below. The coefficient of friction on AC and BC are μ_1 and μ_2 respectively. By using the method of virtual work, determine the ratio of W1 and W_2 for equilibrium. 	Remember	CAME002.08
2	Determine the reactions R_A and R_B developed in the simply supported beam shown in figure. 	Remember	CAME002.08
3	For the system of connected bodies as shown in the figure given below, calculate the force F required to make the motion impending to the left. Use the method of virtual work and take coefficient of friction for all contiguous surfaces except pulleys as 0.25. 	Remember	CAME002.07
4	Determine the reactions in the overhanging beam shown in the figure. 	Understand	CAME002.08
5	Find the velocity of block B shown in figure given below, after 5 seconds starting from rest. 	Remember	CAME002.08

6	Determine the reaction at A in the simply supported beam shown in the figure. 	Understand	CAME002.08

Part – C (Problem Solving and Critical Thinking)

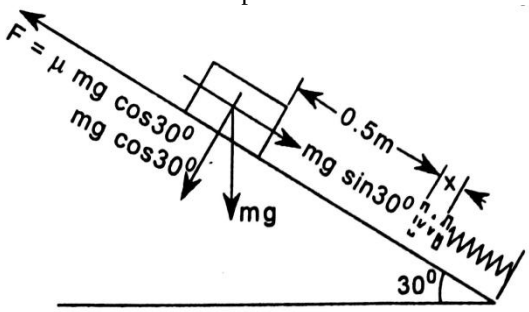
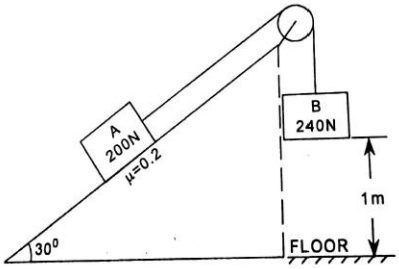
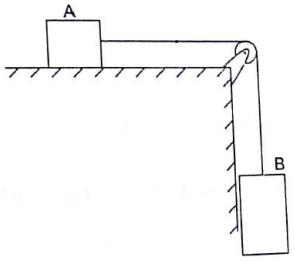
S No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes
1	Find the time required for the blocks shown in figure given below to attain a velocity of 10m/s. Taking μ=0.2 for both surfaces of constant, find the tension in the string. 	Remember	CAME002.08
2	A 4.4 m long ladder of weight 310N is kept supported on 2.9m high wall and floor. A man of weight 720N stands on a particular rung of the ladder shown in the figure given below. Considering all constant surfaces to be smooth, determine the force P necessary to maintain the system in equilibrium. Use the principle of virtual work. 	Remember	CAME002.09
3	A ladder of length 4.4m and weight 250N is placed at one end on wall and the other end o floor. To prevent slipping of the ladder, a rope PC is tied with the wall. Using the method of virtual work, determine the tension of the rope.(refer figure given below) 	Remember	CAME002.07

UNIT-IV			
WORK ENERGY METHOD			
Part – A (Short Answer Questions)			
S No	**QUESTION**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Define work. What are the units of work?	Remember	CAME002.10
2	Define the term kinetic energy.	Remember	CAME002.11
3	Define the term potential energy.	Remember	CAME002.12
4	State the law of conservation of energy	Understand	CAME002.13
5	State Work –energy principle	Remember	CAME002.10
6	Write the expression for kinetic energy of a body rotating about a fixed axis.	Understand	CAME002.11
7	Write work energy equation for translation	Understand	CAME002.12
8	Write work energy equation for fixed axis of rotation	Remember	CAME002.13
9	Write the expression for kinetic energy of a body in plane motion.	Remember	CAME002.10
10	Define the term energy.	Remember	CAME002.11
11	Define the term power and give its units	Understand	CAME002.12
12	150N force is applied at the radius of 0.4m. If it rotates one complete revolution, find the work done.	Remember	CAME002.13
13	A body is pulled through a distance 15m along a level track. The force applied is 400N (a) in the direction of motion (b) at 30^{o} to the direction of motion. Find the work done	Remember	CAME002.10
14	Find the work done to pull a roller of mass 50Kg a distance of 8m up a gradient inclined at 6^{o} to the horizontal. Neglect frictional resistance.	Understand	CAME002.11
15	A spring of stiffness 25KN/m is compressed by an initial load of 5KN gradually applied and then further loaded gradually to compress it an additional distance of 500mm. What is the total work done on the spring?	Understand	CAME002.12
16	List the different forms of energy?	Remember	CAME002.13
17	List the different forms of mechanical energy?	Remember	CAME002.10
18	State salient features of conservative force?	Understand	CAME002.11
19	A block having a mass of 50Kg has a velocity of 15m/s horizontally on smooth frictionless surface. What force to be applied to the block for bringing the block to rest after moving a distance of 37.5m?	Remember	CAME002.12
20	A body of mass 6kg is moving with a velocity of 40m/s. What will be the kinetic energy?	Remember	CAME002.13
Part – B (Long Answer Questions)			
S No	**QUESTION**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Determine the work done by electric motor in winding up a uniform cable which hangs from a hoisting drum if its free length is 10m and weighs 500N. The drum is rotated by the motor.	Remember	CAME002.10
2	An engine and a train having a load of 300 tonnes are moving on a straight horizontal track with uniform speed of 48 kmph. If the frictional resistance is 68N per tonne, Calculate the power exerted by the engine. If the train moves up a gradient of 1 in 200, what additional power is required to maintain the speed?	Remember	CAME002.11

3	An engine of mass 100tonne is going up an inclination of 1 in 100 while pulling a train of mass 200 tonnes. At an instant when this unit is moving with a speed of 32kmph, the acceleration amounts to 0.15m/s2. Frictional resistance in this path amounts to 40N per tonne. What can be the power exerted by this engine during the pull?	Remember	CAME002.12
4	Body A starts from rest in the position as show in figure given below. Determine its velocity after it has moved 2.7m along the smooth surface. Body A weighs 1335N while body B weighs 890N. 	Remember	CAME002.10
5	A railway 4 wheeler wagon of mass 15 metric tonne runs down a gradient of one in hundred. Determine its speed when it has rolled down one kilometre on a straight track. The axle friction is 50N/metric tonne. The mass of axles and wheels is 2 metric tonnes. The wheels have a radius of gyration of 30cm.	Remember	CAME002.11
6	A solid cylindrical roller starts from rest and rolls a distance of 2.286 m down an incline in 3seconds. Calculate the angle of the incline given that k=r/2.	Remember	CAME002.12
7	A fly wheel of 50KN and having a radius of gyration of 1m ,loss its speed from 400 rpm to 280 rpm in 2 minutes. Calculate (i) Torque acting on it (ii) Change in kinetic energy (iii) Change in angular momentum	Understand	CAME002.13
8	Derive work energy equation for translation.	Remember	CAME002.10
9	Derive the expression for kinetic energy of a body rotating about a fixed axis.	Understand	CAME002.11

Part – C (Problem Solving and Critical Thinking)

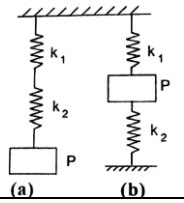
S No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes
1	A car of mass 1000kg descends a hill of $\sin^{-1}(1/6)$. The frictional resistance to motion is 200N. Calculate using work energy method, the average braking effort to bring the car to rest from 48kmph in 30m.	Remember	CAME002.10
2	A body weighing 20N is projected up to 20^{o} inclined plane with a velocity of $12m/s^{2}$, coefficient of friction is 0.15. Find (i) The maximum distance the body will move up the inclined plane. (ii) Velocity of the body when it returns to its original position.	Remember	CAME002.11
3	A hammer of mass 400kg falls through a height of 3m on a pile of negligible mass. If it drives the pile 1m into the ground, find the average resistance of the ground for penetration.	Remember	CAME002.12
4	A block of weight 20N falls at a distance of 0.75m on top of the spring. Determine the spring constant if it is compressed by 150mm to bring the weight momentarily to rest.	Understand	CAME002.13
5	A mass of 5kg is dropped from a height of 2 metres upon a spring whose stiffness is 10N/mm. Calculate the speed of the mass when a spring is compressed through a distance of 100mm.	Remember	CAME002.10

6	A block of mass 5kg resting a 30^o inclined plane is released. The block after travelling a distance of 0.5m along inclined plane hits a spring of stiffness 15N/cm as shown in figure given below. Find the maximum compression of spring. Assume coefficient of friction between block and the inclined plane as 0.2.  	Remember	CAME002.10
7	Two blocks of A (200N) and B (240N) are connected as shown in figure given below. When the motion begins, the block B is 1m above the floor. Assuming the pulley to be frictionless and weightless, determine (i) The velocity of block A when the block B touches the floor (ii) How far the block A will move up the plane?  	Remember	CAME002.11
8	A sphere of 4.5kg mass is rolling along the ground at a velocity of 1.2m/s. For solid sphere moment of inertia is 0.072 kgm^2 and its radius is 0.2m. Find the total kinetic energy.	Remember	CAME002.10
9	Two blocks A and B are connected with inextensible string as shown in figure given below. If the system is released from rest, determine the velocity of block A after if has moved 1.5m. Assume the coefficient of friction between block A and the plane is 0.25. Masses of block A and B are 200kg and 300kg respectively.  	Understand	CAME002.11
10	A homogeneous circular disc of 1.25m diameter has a mass of 275kg and is made to revolve about an axis passing through its centre by a force of 250N applied tangentially to its circumference. Determine the angular acceleration of the disc.	Remember	CAME002.12

UNIT-V			
MECHANICAL VIBRATIONS			
Part - A (Short Answer Questions)			
S No	**QUESTION**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Define simple harmonic motion. Give examples	Remember	CAME002.14
2	Define the terms amplitude and Oscillations.	Remember	CAME002.15
3	Define the terms periodic time and frequency and give their units.	Remember	CAME002.14
4	Write the equation of simple harmonic motion with notations	Understand	CAME002.15
5	Draw the graphical representation for displacement, velocity and acceleration equations of SHM	Remember	CAME002.14
6	Discuss the different types of vibrations?	Understand	CAME002.15
7	Write the expression for time period of a simple pendulum	Understand	CAME002.14
8	Write the expression for time period of a compound pendulum	Remember	CAME002.15
9	Write the expression for time period of a torsional pendulum	Remember	CAME002.14
10	Write the expression for time period of a conical pendulum	Remember	CAME002.15
11	A point describes simple harmonic motion in a 0.6m long. Find the maximum velocity if the time period is 0.3s	Understand	CAME002.14
12	If a displacement of a particle in simple harmonic motion is x=0.3 sin(0.4t) metre, find its displacement and velocity when t= 10s.	Remember	CAME002.14
13	Write the expression for equivalent stiffness of a spring system when springs are arranged in series.	Remember	CAME002.15
14	Write the expression for equivalent stiffness of a spring system when springs are arranged in parallel.	Understand	CAME002.14
15	Find the length of second pendulum assuming the value of g as 9.81 m/s^2.	Understand	CAME002.15
16	Define the term free vibration.	Remember	CAME002.14
17	Calculate the length of a simple pendulum to make one complete oscillation per second.	Remember	CAME002.15
Part - B (Long Answer Questions)			
S No	**QUESTION**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Derive an expression for the time period of a simple pendulum.	Remember	CAME002.14
2	Derive an expression for the time period of a compound pendulum.	Remember	CAME002.15
3	Derive an expression for the time period of a torsional pendulum.	Remember	CAME002.14
4	Derive an expression for the time period of a conical pendulum.	Understand	CAME002.15
5	Derive an expression for the time period for a spring mass system when springs are arranged in series.	Remember	CAME002.14
6	Derive an expression for the time period for a spring mass system when springs are arranged in parallel.	Understand	CAME002.15
7	A body performing simple harmonic motion has a velocity 12m/s when the displacement is 50mm and 3m/s when the displacement is 100mm, the displacement measured from the midpoint. Calculate the frequency and amplitude of the motion. What is the acceleration when the displacement is 75mm.	Understand	CAME002.14
8	A body moving with SHM has amplitude of 1m and period of oscillation of 2 seconds. What will be its velocity and acceleration at 0.4s after passing an extreme position?	Remember	CAME002.15

9	A body moving with SHM has amplitude of 30cm and the period of one complete oscillation is 2s. What will be the speed and acceleration of the body 2/5 of a second after passing the mid position	Remember	CAME002.14
10	A pendulum having a time period of 1s is installed in a lift. Determine its time period when (a) The lift is moving upwards with an acceleration of g/10m/s^2 (b) The lift is moving downwards with an acceleration of g/10m/s^2	Remember	CAME002.15
11	A conical pendulum rotates at 100 rev/min. The cord is 150mm long and the mass of bob1.35Kg. Find (a) The amount of which the bob rises above its lowest position (b) The period (c) The tension in the cord	Remember	CAME002.14
12	A vertical shaft 5mm in diameter and 1.2m in length has its upper end fixed to the ceiling. At the lower end it carries a rotor of diameter 180mm and weight 30N. The modulus of rigidity for the material of the rotor is 0.85x10^5 N/mm^2. Calculate the frequency of torsional vibrations for the system.	Remember	CAME002.14
13	Derive an expression for the time period for a spring mass system subjected to free vibration.	Understand	CAME002.15
14	A weight of 10N attached to a spring oscillates at a frequency of 60 oscillations per minute. If the maximum amplitude is 30mm, find the tension induced in the spring. Also find the spring constant and the maximum velocity in the spring.	Remember	CAME002.14

Part – C (Problem Solving and Critical Thinking)

S No	QUESTION	Blooms Taxonomy Level	Course Learning Outcomes
1	In a mechanism, a cross head moves in straight guide with simple harmonic motion. At distance of 125mm and 200mm from its mean position, it has velocities of 6m/s 3m/s respectively. Find the amplitude, maximum velocity and period of vibration. If the cross head weighs 2N, calculate the maximum force on it in the direction of motion.	Remember	CAME002.14
2	A clock with compound pendulum is running correct time at a place where the acceleration due to gravity is 9.81 m/s2. Find the length of the pendulum. This clock is taken at a place where the acceleration due to gravity is 9.8m/s2. Find how much the clock will lose or gain in a day at this place?	Remember	CAME002.15
3	A load is suspended from a vertical spring. At rest it deflects the spring 12mm. Calculate the time period. If the it is displaced further 25mm below the ret position and then released.	Remember	CAME002.14
4	The frequency of free vibrations of a weight W with spring constant k is 12 cycles/s. When the extra weight of 20N is coupled with weight W, the frequency reduced to 10 cycles/s. Find the weight W and stiffness k of the spring.	Understand	CAME002.15
5	Determine the period of vibration of a weight P attached to springs of stiffness k1 and k2 in two different cases as shown in figure given below.  	Remember	CAME002.14

6	A particle is moving with its acceleration directed to and proportional to its distance from a fixed point. When the distance of the particle from equilibrium position has values of 1.3m and 1.8m, the corresponding velocities are 5m/s and 2 m/s. Determine (a) Amplitude and time period of oscillations (b) Maximum velocity and maximum acceleration	Understand	CAME002.15
7	A vertical shaft 5mm in diameter and 1m in length has its upper end fixed to the ceiling. At the lower end it carries a rotor of diameter 200mm and weight 20N. The modulus of rigidity for the rotor is $0.85x10^5$ N/mm^2. Calculate the frequency of torsional vibration for the system.	Remember	CAME002.14
8	A vertical shaft 7mm in diameter and 1.7m in length has its upper end fixed to the ceiling. At the lower end it carries a rotor of diameter 180mm and weight 50N. The modulus of rigidity for the material of the rotor is $0.95x10^5$ N/mm^2. Calculate the frequency of torsional vibrations for the system.	Remember	CAME002.15
9	A body moving with SHM has amplitude of 50cm and the period of one complete oscillation is 3s. What will be the speed and acceleration of the body 1/5 of a second after passing the mid position	Remember	CAME002.14
10	A body performing simple harmonic motion has a velocity 20m/s when the displacement is 40mm and 3m/s when the displacement is 120mm, the displacement measured from the midpoint. Calculate the frequency and amplitude of the motion. What is the acceleration when the displacement is 85mm.	Understand	CAME002.15

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