INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad-500043

CIVIL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**ENGINEERING MECHANICS**				
Course Code	AMEB03				
Programme	B.Tech				
Semester	II	AE			
	III	CE| ME			
Course Type	Foundation				
Regulation	**IARE - R18**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Dr. Ch.Sandeep, Associate Professor				
Course Faculty	Dr. Ch.Sandeep, Associate Professor Dr. U Vamsi Mohan, Professor				

COURSE OBJECTIVES:

The course should enable the students to:	
I	Ability to work comfortably with basic engineering mechanics concepts required for analyzing static 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 centre of gravity (mass)/centroid and moment of Inertia using integration methods and method of moments

COURSE OUTCOMES (COs):

CO 1	Develop the ability to work comfortably with basic engineering mechanics concepts required for analysing rigid bodies and structures. Identify an appropriate structural system for studying a given problem and isolate it from its environment, model the problem using free body diagrams and accurate equilibrium equations.
CO 2	Understand laws of friction and advantages of friction. Can be able to use this knowledge for various engineering applications. Can be able to analyse simple pin-jointed frames under different load conditions.
CO 3	Can be able to locate the centroids and calculate the moments of inertia for various simple cross-sections such as I section , T-scetion, Channel section etc., and composite sections. Mass moments of inertia can also be determined. Can apply principle of virtual work for the analysis of structures.

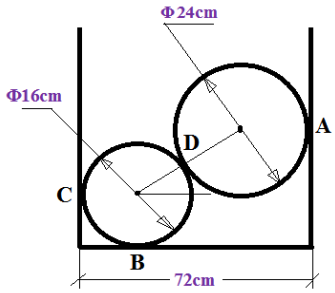
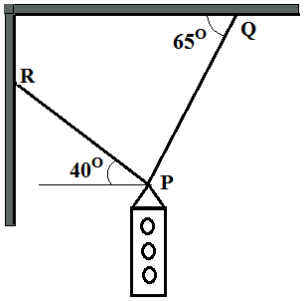
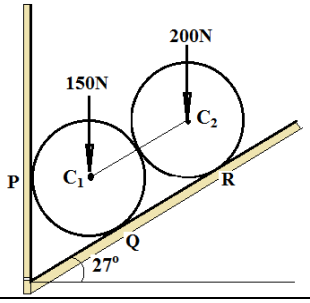
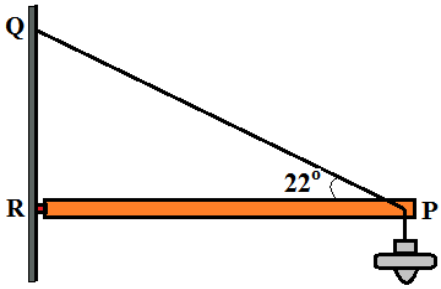
CO 4	Understand the principles (Laws of rigid body motion, Work-energy principle and Impulse-momentum principle etc.,), for analysing the problems related to the motion of rigid bodies with and without considering the forces which causes motion.
CO 5	Understands the concepts related to the free and forced vibrations and can be able to apply the same to real world problems. Also understands the simple harmonic motion of simple pendulum.

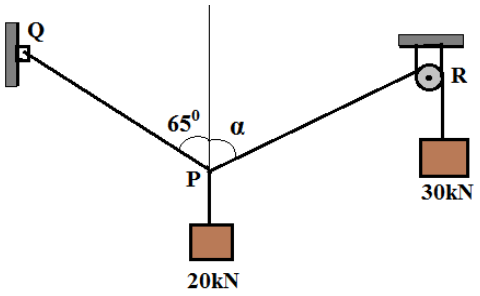
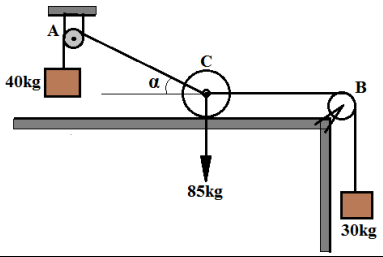
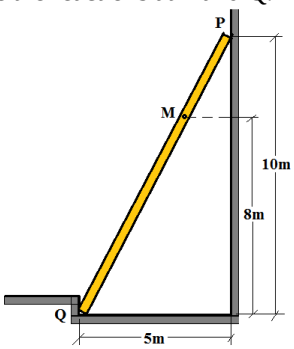
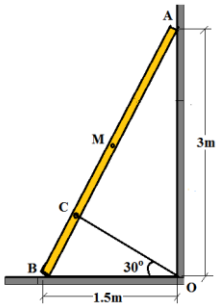
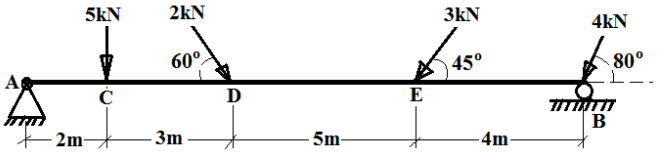
COURSE LEARNING OUTCOMES (CLOs):

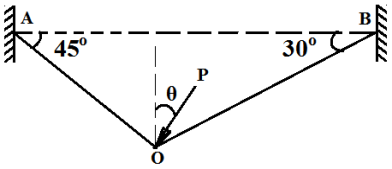
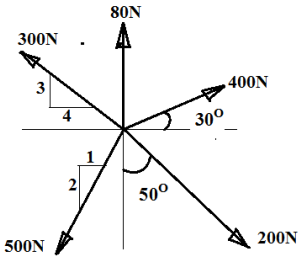
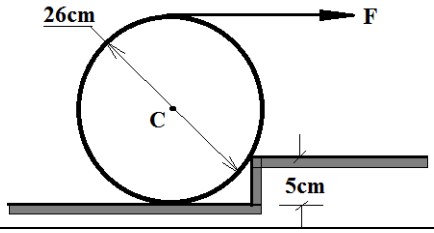
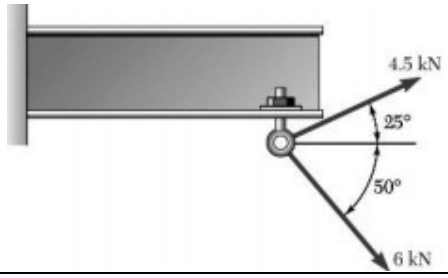
AMEB03.01	A basic understanding of the laws and principle of mechanics.
AMEB03.02	The ability to solve simple force system problems in mechanics
AMEB03.03	Determine the resultant and apply conditions of static equilibrium to a plane force system
AMEB03.04	Can be able to apply the knowledge of forces and force systems in the analysis of more complex problems.
AMEB03.05	Understands the concepts of static and dynamic friction, advantages and disadvantages of friction.
AMEB03.06	Solve the problems of simple systems with friction effect. Calculate the linear moving bodies ingeneral plane motion and applications of friction.
AMEB03.07	Analyze planar and spatial systems to determine the force in the members of truss and frames.
AMEB03.08	Solve the problems on different types of beams.
AMEB03.09	Obtain the centroid, center of gravity and centre of mass for simple and composite objects.
AMEB03.10	Understand the concept of moment of inertia and can calculate second moment of area for simple and composite sections..
AMEB03.11	Can apply the knowledge of first and second moments of area in the analysis and design of complex structures.
AMEB03.12	Understand the concept of virtual work and an ability to solve practical problems using the principle of virtual work.
AMEB03.13	Understand the concepts of kinematics of the particles and rectilinear motion.
AMEB03.14	Explore knowledge & ability to solve various particle motion problems.
AMEB03.15	Derive the D' Alembert's principle and apply it to various field problems of kinetic motion.
AMEB03.16	Determine the impact, impulse and impulsive forces occurring in the system and able to solve the problems.
AMEB03.17	Understands the concepts of vibration and explain the relation between simple harmonic motion and the equilibrium systems.
AMEB03.18	Derive the expressions for the concepts of simple, compound and torsional pendulums.
AMEB03.19	Applies the knowledge of vibrations in the analysis and design of various machine foundations.
AMEB03.20	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc

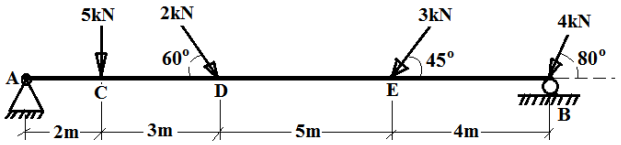
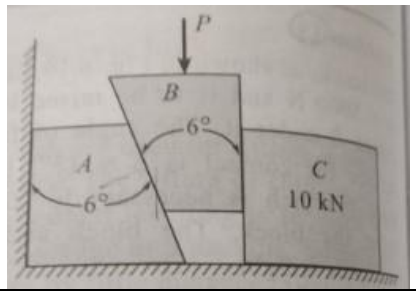
TUTORIAL QUESTION BANK

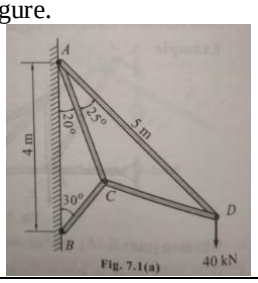
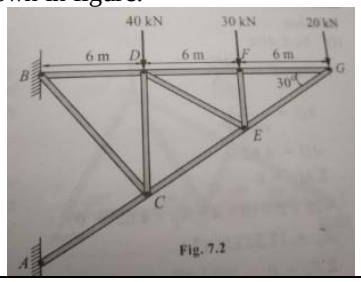
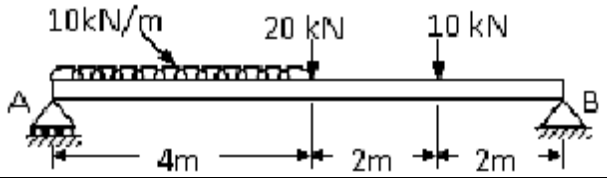
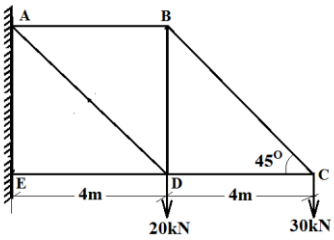
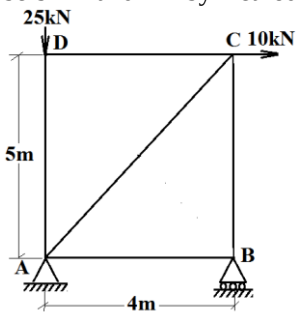
MODULE- I				
INTRODUCTION TO ENGINEERING MECHANICS				
Part - A (Short Answer Questions)				
S No	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Outcomes**	**Course Learning Outcomes (CLOs)**
1	State Varignon's theorem	Remember	CO 1	AMEB03.01
2	What is a couple?	Understand	CO 1	AMEB03.01
3	Define principle of transmissibility.	Remember	CO 1	AMEB03.02
4	State the triangular law of forces?	Remember	CO 1	AMEB03.02
5	What is a moment of a couple?	Remember	CO 1	AMEB03.01
6	State Newton's three laws of motion?	Remember	CO 1	AMEB03.02
7	State and explain Newton's law of gravitation	Remember	CO 1	AMEB03.01
8	Define the term resultant and equilibrant	Remember	CO 1	AMEB03.03
9	What is a rigid body?	Remember	CO 1	AMEB03.01
10	What is a couple? State its characteristics	Remember	CO 1	AMEB03.01
11	Explain coplanar force system with sketch.	Remember	CO 1	AMEB03.03
12	Explain concurrent force system with sketch.	Remember	CO 1	AMEB03.02
13	Define the resultant of a force system.	Understand	CO 1	AMEB03.03
14	Explain the resultant of two like parallel forces.	Understand	CO 1	AMEB03.03
15	Define momentum of a force.	Remember	CO 1	AMEB03.04
16	Resultant of concurrent forces.	Understand	CO 1	AMEB03.03
17	Define Static Indeterminacy.	Understand	CO 1	AMEB03.04
18	Explain the resultant of two unlike parallel forces.	Remember	CO 1	AMEB03.03
19	Define spatial force system.	Understand	CO 1	AMEB03.04
20	List out the equilibrium equations for spatial force system	Remember	CO 1	AMEB03.04
Part - B (Long Answer Questions)				
1	State and prove Lami's theorem with a neat sketch?	Remember	CO 1	AMEB03.02
2	State and prove the Parallelogram law of forces?	Understand	CO 1	AMEB03.02
3	Explain free body diagram with neat sketches.	Remember	CO 1	AMEB03.03
4	What differences exist between Kinetics and Kinematics	Remember	CO 1	AMEB03.01
5	Compare 'Resultant' and 'Equilibrant'	Remember	CO 1	AMEB03.03
6	Distinguish between couple and moment.	Understand	CO 1	AMEB03.01
7	Explain briefly about various types of supports.	Understand	CO 1	AMEB03.04
8	Explain the procedure to find the resultant of several forces acting at a point	Understand	CO 1	AMEB03.03
9	Determine the magnitude and the direction of the resultant of two forces 7N and 8N acting at a point with an included angle of 60^{o} with between them. The force of 7N being horizontal	Understand	CO 1	AMEB03.03
10	Two coplanar forces act towards a point with an angle of 45^{0} between them. If their resultant is 100kN and one of the forces is 20kN calculate the other force	Understand	CO 1	AMEB03.03
11	Two forces act at an angle of 120^{0}. The bigger forces is 60N and the resultant is perpendicular to the smaller one. Find the smaller force.	Understand	CO 1	AMEB03.03

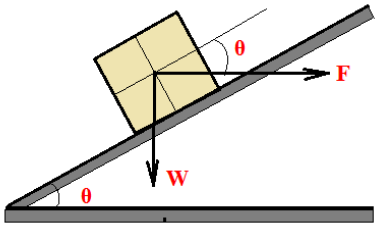
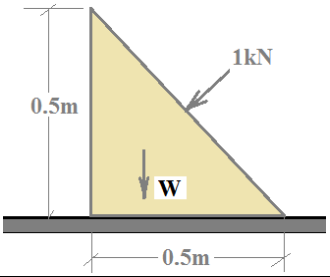
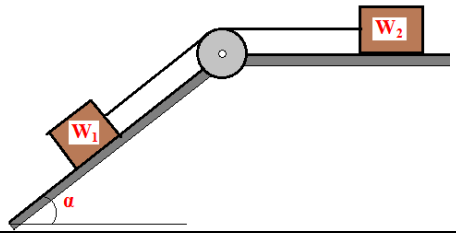
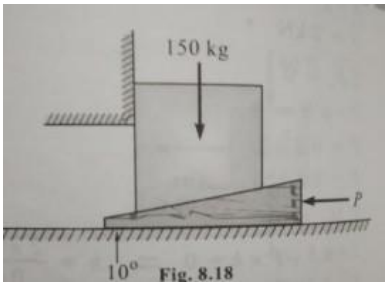
12	Two homogeneous spherical balls rest between two vertical walls as shown in figure. The radius of smaller ball is 16 cm and its weight is 1.15kN. The radius of the larger ball is 24cm and weight is 3.45kN. The distance between the walls is 72 cm. Assuming the contact surfaces to be smooth, Determine the reactions at A, B and C.  	Understand	CO 1	AMEB03.04
13	A traffic signal of mass 50kg is hung with the help of two strings, as shown in figure. Find the forces induced in the strings.  	Apply	CO 1	AMEB03.03
14	Two spheres are kept in a conical channel, as shown in figure. All contact surfaces are smooth. Determine the reactions at all the contact surfaces. Sizes of spheres are same but with different weight.  	Understand	CO 1	AMEB03.04
15	An electric light fixture is held with the arrangement shown in figure. If the weight of the fixture is 20 kg and the hinge is an ideal one, determine the axial forces in the bar and the string.  	Understand	CO 1	AMEB03.03

16	Two weights are suspended as shown in figure. Determine the tension in String PQ. Pulley is assumed smooth. 	Understand	CO 1	AMEB03.03
17	In the arrangement shown in figure, all pulleys are assumed to be smooth and frictionless. Determine the angle 'α' and the reactive force on the ball from the floor. 	Understand	CO 1	AMEB03.04
18	A ladder of weight 30kg is supported at wall and floor as shown in figure. A man of weight 72kg rides on a rung 8m above the floor level. Considering all contact surfaces smooth, determine the reactions at P and Q. 	Understand	CO 1	AMEB03.04
19	A 75kg man stands on the middle rung of ladder AB of weight 25kg, which is supported on smooth wall and smooth floor. A string OC holds the ladder in position preventing from slipping. Determine the tension in the string and the reactions at the supports. 	Understand	CO 1	AMEB03.04
20	Neglecting the thickness and mass of the beam, determine the support reactions for the beam loaded as shown in figure. 	Understand	CO 1	AMEB03.04

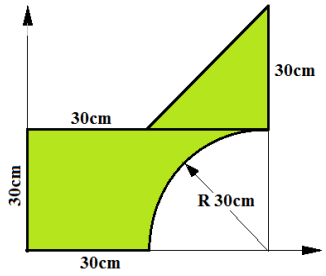
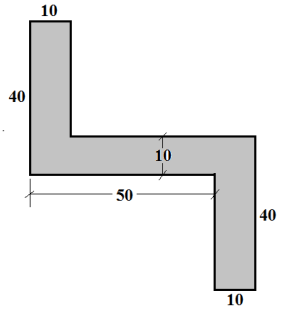
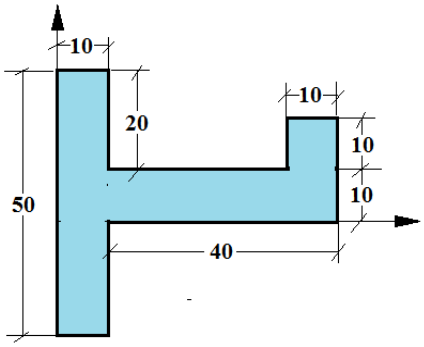
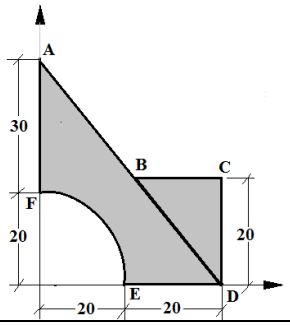
Part - C (Problem Solving and Critical Thinking Questions)				
1	A force P is applied at 'O' to the string AOB as shown in figure. If the tension in each part of string is 50N, Find the direction and magnitude of force P for equilibrium conditions. 	Remember	CO 1	AMEB03.03
2	Determine the resultant of system of forces acting as shown in figure. 	Remember	CO 1	AMEB03.03
3	A heavy cylinder of mass 280kg is to be pulled over a curb of height 5cm by a horizontal force F applied by means of a rope wound around the cylinder as shown in figure. Determine the magnitude of pull for impending motion over the curb, while the radius of the cylinder is 13cm.. 	Remember	CO 1	AMEB03.03
4	Two forces are applied to an eye bolt fastened to a beam. Determine the magnitude and direction of their resultant. 	Remember	CO 1	AMEB03.03
5	Find the magnitude of two forces such that if they act at right angle, their resultant is $\sqrt{10}$, but they act at 600 their resultant is $\sqrt{13}$	Remember	CO 1	AMEB03.03
6	The five forces 20N, 30N, 40N, 50N and 60N are acting at one of the angular points of a regular hexagon, towards the other five angular points taken in order. Find the direction and magnitude of the resultant force	Understand	CO 1	AMEB03.03
7	The following forces act at a point a. 30kN inclined at 35^0 towards North to East. b. 22kN towards North c. 30kN inclined at 30^0 towards North to West d. 35kN inclined at 25^0 towards South to West. Find the magnitude and direction of the resultant force.	Understand	CO 1	AMEB03.03
8	Determine the horizontal force P to be applied to a block of weight of 1800N to hold it in position on a smooth inclined plane, which makes an angle 30^0 with horizontal reference line.	Understand	CO 1	AMEB03.04
9	A uniform plank ABC of weight of 30N and 2m long is supported one end A and at a point B 1.4m from A. find the maximum weight W that can be placed at C, so that the plank does not topple	Understand	CO 1	AMEB03.04

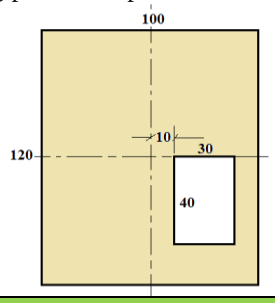
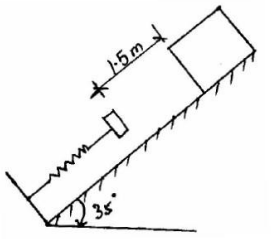
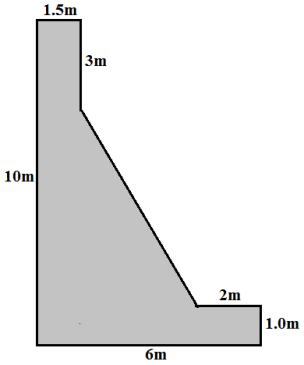
10	The force of magnitudes 10KN, 20KN, 25KN & 40KN are concurrent in space and are directed through the points A(3,2,5), B(1,7,4), C(4,-2,4) & D(-2,4,-3) respectively. Determine the resultant of the force system of forces. Given that system of forces are concurrent at the origin.	Understand	CO 1	AMEB03.03
	MODULE-II			
	FRICTION AND BASIC STRUCTURAL ANALYSIS			
	Part – A (Short Answer Questions)			
1	Explain the types of friction with examples?	Understand	CO 2	AMEB03.05
2	Define Friction	Understand	CO 2	AMEB03.05
3	Define the following (i)Angle of Repose (ii)Coefficient of frictions	Understand	CO 2	AMEB03.05
4	Differentiate between static and dynamic friction?	Understand	CO 2	AMEB03.05
5	State laws of solid friction.	Understand	CO 2	AMEB03.05
6	What do you understand by the limiting friction?.	Remember	CO 2	AMEB03.06
7	What is the principle of a screw jack?	Remember	CO 2	AMEB03.06
8	Define a beam? And explain different types of beams with neat sketches.	Remember	CO 2	AMEB03.08
9	Explain the classification of friction.	Understand	CO 2	AMEB03.05
10	Differentiate between beam and column.	Remember	CO 2	AMEB03.08
11	Explain types of friction.	Understand	CO 2	AMEB03.05
12	Explain rolling friction.	Understand	CO 2	AMEB03.06
13	Under what conditions can a cylinder roll down and under what conditions can it slide down an inclined plane.	Understand	CO 2	AMEB03.06
14	Differentiate between angle of repose and angle of friction.	Understand	CO 2	AMEB03.05
	Part - B (Long Answer Questions)			
1	Derive an expression for the minimum effort required along the inclined plane to keep a body in equilibrium position when it is at point of sliding downwards on a inclined plane.	Remember	CO 2	AMEB03.06
2	Solve reactions at points A & B 	Understand	CO 2	AMEB03.08
3	Explain the difference between coefficient of friction and angle of friction	Remember	CO 2	AMEB03.05
4	Derive an expression for the maximum force required along the horizontal plane to keep a body in equilibrium position when it is at point of sliding downwards on a inclined plane.	Remember	CO 2	AMEB03.06
5	Two 6^0 of wedges are used to push a block horizontally as shown in figure. Calculate the minimum force required to push the block of weight 10kN. Take coefficient of friction as 0.25 for all contact surfaces. 	Remember	CO 2	AMEB03.06
6	A body of weight 300N is lying on a rough horizontal surface having coefficient of friction as 0.3. Find the magnitude of force, which can move the body, while acting at an angle $25^0$with the horizontal.	Remember	CO 2	AMEB03.06
7	A body resting on a rough horizontal plane, required a pull of 180N inclined at 30^0 to the plane just to move it. It is found that a push of 220N inclined at 30^0 to the plane just to move the body. Determine the weight of the body and coefficient of friction.	Remember	CO 2	AMEB03.06
8	A object of weight 100N is kept in position on a inclined 30^0 to the horizontal by a horizontal applied force. If the coefficient of friction of the surface of the inclined plane is 0.25. determine the minimum magnitude of force.	Remember	CO 2	AMEB03.06

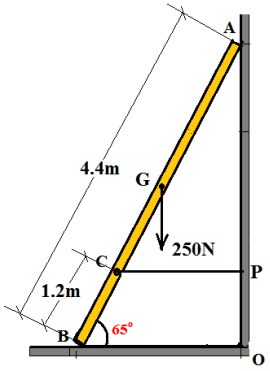
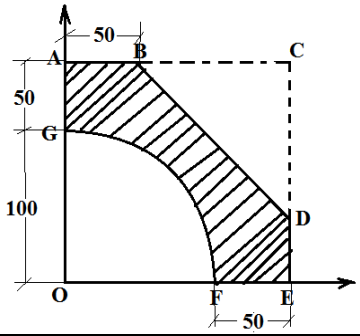
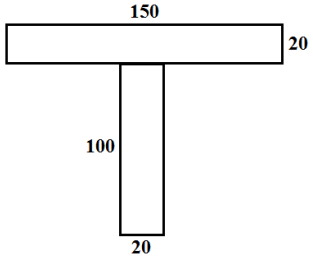
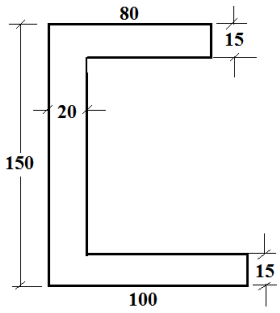
9	Find the force and its nature in member AD and BC for given cantilever truss loaded by 40KN as shown figure.  Fig. 7.1(a)	Remember	CO 2	AMEB03.07
10	Find the forces in the members DF, DE, CE, and EF by method of joints for the pin-jointed frame as shown in figure.  Fig. 7.2	Understand	CO 2	AMEB03.07
11	A beam AB is supported and loaded as shown in fig.1. Find the reactions at the supports. 	Understand	CO 2	AMEB03.08
12	Explain the Coulomb's laws of friction.	Remember	CO 2	AMEB03.05
13	Explain Cone of friction.	Remember	CO 2	AMEB03.05
14	Explain wedge friction.	Remember	CO 2	AMEB03.06
15	Find the forces in the members AB and BD by method of sections. 	Understand	CO 2	AMEB03.07
16	Find the forces in the members AB and BD by method of sections. 	Understand	CO 2	AMEB03.07
17	A screw thread of a screw jack has a mean diameter of 10cm and a pitch of 1.25cm. The coefficient of friction between the screw and its nut housing is 0.25. Determine the force F that must be applied at the end of a 50cm lever arm to raise a mass of 5000kg. Is the device self-locking? Also determine its efficiency.	Understand	CO 2	AMEB03.06

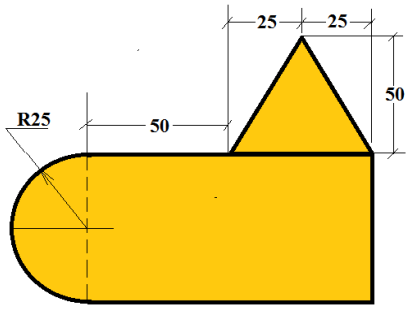
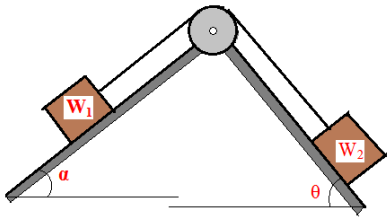
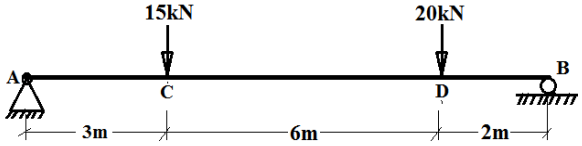
18	A horizontal force F is applied to a block which rests on an inclined plane, as shown in figure. Find the force required to initiate motion up the plane. 	Understand	CO 2	AMEB03.06
19	Find the minimum weight W of the triangular block such that it remains in equilibrium under the action of the force 1kN applied to it as shown in figure. Take μ = 0.25. 	Understand	CO 2	AMEB03.06
20	Two rectangular blocks of weights W_1 aand W_2 connected by a flexible cord resting upon a horizontal plane and an incline are shown in figure. In a particular case when $W_1 = W_2$ and coefficient of static friction being same for all contiguous surfaces, find the angle of inclination of the incline at which motion of the system will impend. 	Understand	CO 2	AMEB03.06
	Part - C (Problem Solving and Critical Thinking Questions)			
1	A ladder 6m long and with 300N weight is resting against a wall at an angle of 600 to the ground. A man weighing 750N climbs the ladder. At what position along the ladder from bottom does he induce slipping? The coefficient of friction for both wall and the ground with ladder is 0.2.	Understand	CO 2	AMEB03.06
2	A uniform ladder of length of 3.25m & weight of 250N is placed against a smooth wall with its lower end 1.25M from the wall. Coefficient of friction between the ladder and floor is 0.3. what is the frictional force acting on the ladder at the point of contact between the ladder and the floor? Show that the ladder will remain in equilibrium in this position.	Understand	CO 2	AMEB03.06
3	A block of mass 150kg is raised by a 100wedge weight 50kg under it and by applying a horizontal force at its end. Taking coefficient of friction between all surfaces of contact as 0.3, find minimum force that should be applied to raise the block. 	Remember	CO 2	AMEB03.06

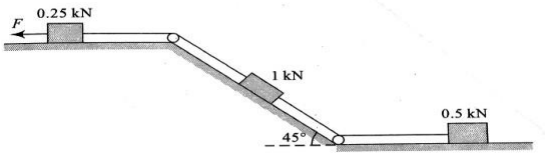
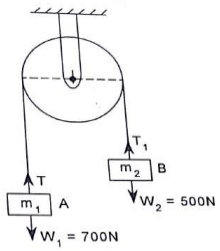
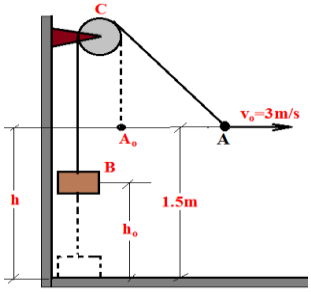
4	A ladder of 7m length rests against a vertical wall with which it makes an angle of 450. The coefficient of friction for wall and the floor are 0.33 and 0.50 respectively. If a man whose weight is one half of that of the ladder. How far he will be able to climb the ladder.	Remember	CO 2	AMEB03.06
5	A screw jack has mean diameter of 50mm and pitch 10mm. if the coefficient of friction between its screw and nut is 0.15, find the effort required at the end of the 700mm long handle to raise a load of 10KN	Remember	CO 2	AMEB03.06
6	A screw press is used to compress books. The thread is a double thread (square head) with a pitch of 4mm and a mean diameter of 25mm. the coefficient of friction for the contact surface of the thread is 0.3. Find the torque for a pressure of 500N.	Understand	CO 2	AMEB03.06
7	A screw jack with single start square threads has outside and inside diameters of the thread 68mm and 52mm respectively. The coefficient of friction is 0.1for all the pairs of surfaces in contact. If the length of lever is 0.5M, find the force required to lift the load of 2KN.	Understand	CO 2	AMEB03.06
8	A mean radius of the screw of a square threaded screw jack is 25mm. the pitch of thread is 7.5mm. if the coefficient of the friction is 0.12, what effort applied at the end of the lever 60cm length is needed to raise a weight of 2KN	Understand	CO 2	AMEB03.06
9	A differential screw jack has a pitch of 12mm, 10mm and 300mm arm length. What will be the efficiency of the machine, if it can lift a load of 7.5KN by an effort of 30N.	Understand	CO 2	AMEB03.06
10	In a differential screw jack has pitch of 10mm and 7mm. if the efficiency of machine is 28%. Find the effort required at the end of the arm 360mm long to lift a load of 5KN.	Understand	CO 2	AMEB03.06
	MODULE -III			
	CENTROID AND CENTRE OF GRAVITY AND VITUAL WORK AND ENERGY METHOD			
	Part - A (Short Answer Questions)			
1	Distinguish between centroid and centre of gravity	Understand	CO 3	AMEB03.09
2	Define polar moment of inertia	Remember	CO 3	AMEB03.10
3	Define Radius of gyration	Remember	CO 3	AMEB03.10
4	State the parallel axis theorem	Remember	CO 3	AMEB03.10
5	State the perpendicular axis theorem	Remember	CO 3	AMEB03.10
6	State Pappus – Guildinus theorem.	Remember	CO 3	AMEB03.09
7	Determine the moment of inertia of rectangular lamina about base using parallel axis theorem.	Understand	CO 3	AMEB03.10
8	Determine the polar moment of inertia of circular lamina about centroidal axis.	Understand	CO 3	AMEB03.10
9	Describe the various methods of finding the centre of gravity of a body	Understand	CO 3	AMEB03.09
10	List out the solid of revolution.	Remember	CO 3	AMEB03.09
11	Give the location of centroids of rectangle, right angled triangle, parabola, semi-circle, quarter circle.	Remember	CO 3	AMEB03.09
12	Determine the volume and surface area of cylinder of height ‘h’ and radius ‘r’ using Pappus – Guildinus theorems.	Understand	CO 3	AMEB03.09
13	Define mass moment of inertia	Remember	CO 3	AMEB03.10
14	Determine the moment of inertia of a square lamina about its diagonal.	Understand	CO 3	AMEB03.10
15	Determine the moment of inertia of Triangular lamina, using parallel axis theorem.	Understand	CO 3	AMEB03.10
16	Define the term power	Remember	CO 3	AMEB03.12
17	State the principle of conservation of energy	Understand	CO 3	AMEB03.12
18	Explain the term work done by friction force	Understand	CO 3	AMEB03.12
19	Explain the term work done by spring force	Understand	CO 3	AMEB03.12
20	State the principle of virtual work.	Remember	CO 3	AMEB03.12
	Part – B (Long Answer Questions)			
1	State and prove the parallel axis theorem.	Remember	CO 3	AMEB03.10
2	State and prove the perpendicular axis theorem	Remember	CO 3	AMEB03.10
3	State and prove the Pappus guildlinus theorem for area and volume	Remember	CO 3	AMEB03.09

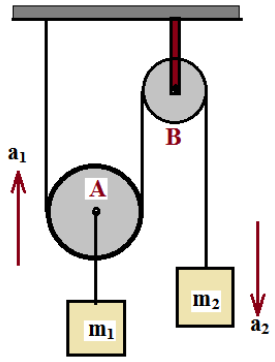
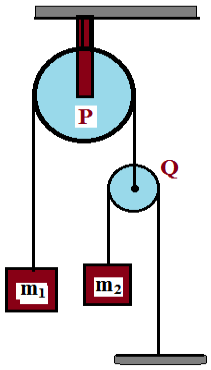
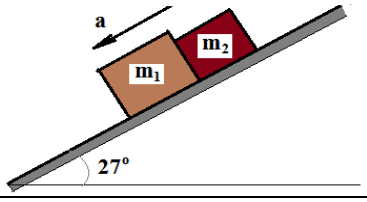
4	Determine the coordinates of centroid of the shaded area shown in figure. 	Remember	CO 3	AMEB03.09
5	Determine the Moment of Inertia about the centroidal coordinate axes of plane area shown in fig. Also find Polar Moment of Inertia. 	Remember	CO 3	AMEB03.11
6	Derive an expression for centroid of semi-circle.	Remember	CO 3	AMEB03.09
7	Derive an expression for MI for a rectangle section.	Remember	CO 3	AMEB03.11
8	State and explain Pappus-Guldinus theorems for surface of revolution and Volume of revolution.	Understand	CO 3	AMEB03.09
9	Locate the centroid of the composite area shown in figure. 	Understand	CO 3	AMEB03.09
10	Locate the centroid of the composite area shown in figure. 	Understand	CO 3	AMEB03.09

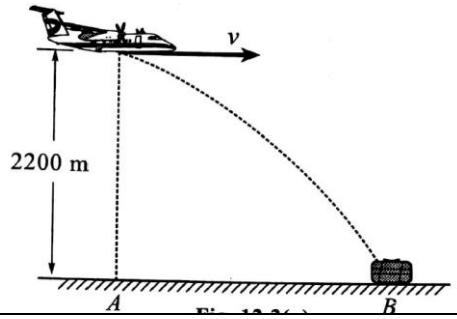
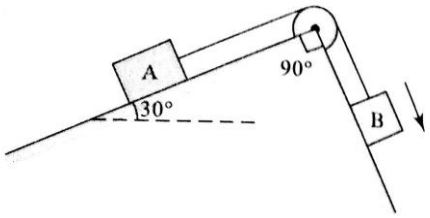
11	In a rectangular plate of 100 x 120 mm and of negligible thickness, a rectangular cut of dimensions 30 x 40mm is made as shown in figure. Determine the position of centroid of the remaining part of the plate. 	Understand	CO 3	AMEB03.09
12	A block of mass 50 kg slides down a 35° incline and strikes a spring 1.5 m away from it as shown in Fig. The maximum compression of the spring is 300 mm when the block comes to rest. If the spring constant is 1N/cm, Solve the coefficient of kinetic friction between the block and the plane. 	Remember	CO 3	AMEB03.12
13	State and prove work energy principle	Remember	CO 3	AMEB03.12
14	Explain the following terms 1. Work done by weight force 2. Work done by friction force and 3. Work done by spring force	Remember	CO 3	AMEB03.12
15	A force of 500N is acting at 30^0 to the horizontal on a block of mass 50kg resting on a horizontal surface. Determine the velocity after the block has travelled a distance of 10m. Coefficient of kinetic friction is 0.5.	Understand	CO 3	AMEB03.12
16	A pump lifts $40m^3$ of water to a height of 50m and delivers it with a velocity of 5m/s. what is the amount of energy spent during the process? If the job is done in half an hour, what is the input power of the pump which has an overall efficiency of 70%.	Understand	CO 3	AMEB03.12
17	Locate the centroid of the dam cross section shown in figure with respect to its base and vertical face. 	Understand	CO 3	AMEB03.09
18	A block of mass 50 kg slides down a 35° incline and strikes a spring 1.5 m away from it as shown in Fig. The maximum compression of the spring is 300 mm when the block comes to rest. If the spring constant is 1N/cm, Solve the coefficient of kinetic friction between the block and the plane.	Understand	CO 3	AMEB03.12

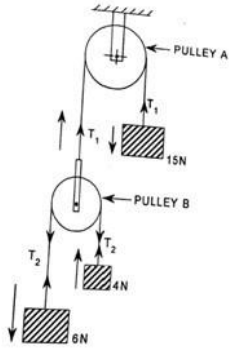
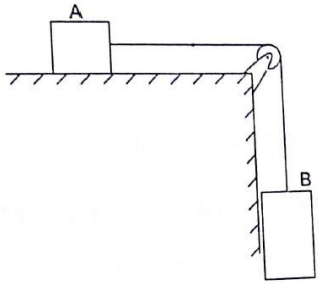
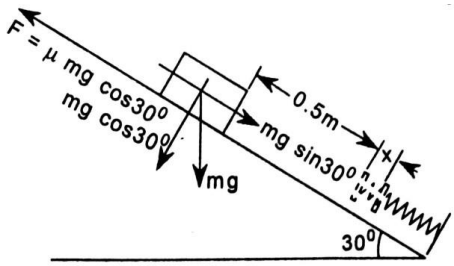
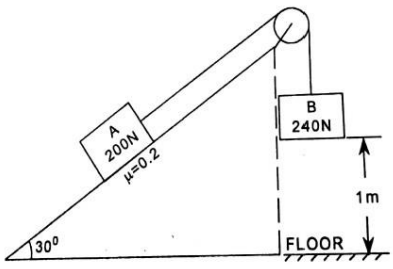
19	A ladder of length 4.4m and weight 250N is placed at one end on wall and other end on floor. To prevent slipping of the ladder, a rope PC is tied with the wall. Using the method of virtual work, determine the tension of the rope.  	Understand	CO 3	AMEB03.12
20	Determine the centroid of the shaded area ABDEFG shown in figure.  	Understand	CO 3	AMEB03.09
	Part – C (Problem Solving and Critical Thinking)			
1	Find the centre of gravity of the "T "lamina as shown in figure. All dimensions are in mm.  	Remember	CO 3	AMEB03.09
2	Find the centroid of the plane lamina shown in Figure  	Remember	CO 3	AMEB03.09

3	Uniform lamina shown in fig consists of rectangle, a semi-circle and a triangle. Find the centre of gravity. 	Remember	CO 3	AMEB03.09
4	Derive an expression for centroid of triangular area	Remember	CO 3	AMEB03.09
5	Derive an expression for centroid of circle.	Remember	CO 3	AMEB03.09
6	Derive an expression for centroid of rectangle area.	Understand	CO 3	AMEB03.09
7	Determine the distance in which a car moving at 90kmph can come to rest after the power switched off if coefficient of friction is 0.8 on road and tyres.	Understand	CO 3	AMEB03.12
8	Derive the expression for range along an inclined plane. What is the necessary condition for obtaining maximum range along an inclined plane?	Remember	CO 3	AMEB03.12
9	Two blocks are placed on two smooth inclined planes as shown in figure. The string connecting the blocks passing over a smooth pulley is inextensible. If W_1 = 75N, W_2 = 65N and $\alpha = 37^0$ determine using the method of virtual work, the angle θ. 	Understand	CO 3	AMEB03.12
10	Using the method of virtual work, determine the reaction at supports A and B of the transversely loaded beam shown in figure. 	Remember	CO 3	AMEB03.12
	MODULE –IV			
	PARTICLE DYNAMICS AND INTRODUCTION TO KINETICS			
	Part – A (Short Answer Questions)			
1	Define the terms velocity and acceleration	Understand	CO 4	AMEB03.13
2	Define angular displacement, angular velocity and angular acceleration	Understand	CO 4	AMEB03.13
3	Define the terms Kinetics and kinematics.	Understand	CO 4	AMEB03.13
4	Define the term rigid body	Remember	CO 4	AMEB03.13
5	State D'Alembert's principle..	Remember	CO 4	AMEB03.15
6	Compare Newton's second law with D'Alembert's principle	Remember	CO 4	AMEB03.05
7	Define the term momentum of a body with units	Remember	CO 4	AMEB03.16
8	Distinguish between mass and weight.	Remember	CO 4	AMEB03.16
9	Write governing equations of velocity and acceleration of fixed axis rotation	Remember	CO 4	AMEB03.14
10	Define instantaneous centre of velocity	Remember	CO 4	AMEB03.13
11	State the assumptions necessary for the analysis of a plane projectile motion.	Remember	CO 4	AMEB03.13
	Part – B (Long Answer Questions)			
1	Derive an expression F=ma	Understand	CO 4	AMEB03.14
2	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	CO 4	AMEB03.13

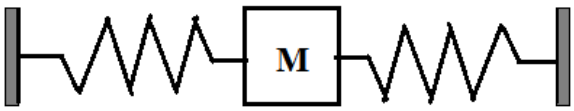
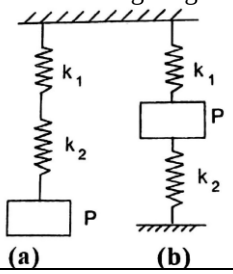
3	A particle starts from rest and moves along a straight line with constant acceleration a. If it acquires a velocity v=3 mm/s^2, after having travelled a distance S=7.5m, find the magnitude of the acceleration.	Remember	CO 4	AMEB03.14
4	A flywheel of diameter 50cm starts from rest with constant angular acceleration of 2 rad/s2. Determine the tangential and the normal components of acceleration of a point on its rim 3s after the motion began	Understand	CO 4	AMEB03.14
5	Derive the expression for range along an inclined plane. What is the necessary condition for obtaining maximum range along an inclined plane?	Understand	CO 4	AMEB03.14
6	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.	Understand	CO 4	AMEB03.16
7	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	Apply	CO 4	AMEB03.14
8	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.	Understand	CO 4	AMEB03.14
9	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. 	Understand	CO 4	AMEB03.15
10	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? 	Understand	CO 4	AMEB03.15
11	A rope AB is attached to a small block of negligible dimensions at B and passes over a pulley C so that its free end A hangs 1.5 m above ground when the block rests on the floor. The end A of the rope is moved horizontally in a straight line by a man walking with a uniform velocity v_0= 3 m/s. Deduce the generalised expression for velocity. Also find the time required for the block to reach the pulley if h=4.5m and the pulley is negligibly small. 	Understand	CO 4	AMEB03.14

12	The position of a particle moving along a straight line is defined by the relation $x = t^3-9t^2+15t+18$ where x is expressed in metres m and t in seconds. Determine the time, position and acceleration of the particle when its velocity becomes zero.	Understand	CO 4	AMEB03.13
13	The velocity of a body moving along a straight line follows the law $v=1.25t - 0.125t^2$ where the velocity is expressed in m/s and time in seconds. Determine the (i) maximum acceleration and the (ii) distance traversed in 10 s.	Understand	CO 4	AMEB03.13
14	A ball is thrown vertically upwards at 20m/s from a window 50m above the ground. Determine the (i) maximum rise of the ball from ground and (ii) time and velocity of the ball hitting the ground.	Understand	CO 4	AMEB03.13
15	Two masses are inter-connected with a pulley system, as shown in figure. Neglecting inertial and frictional effect of pulleys and cord, determine the acceleration of the mass m_2. Take m_1 = 40kg, m_2 = 30kg. 	Understand	CO 4	AMEB03.14
16	Neglecting the inertial and frictional effects of two pulleys P and Q as shown in figure, determine the acceleration of mass m_2. Assume $m_1 = m_2$. 	Understand	CO 4	AMEB03.14
17	Two blocks , as shown in figure, slide down a 27° incline. If the coefficient of friction at all contiguous surfaces are 0.17, determine the pressure between the blocks. Take m_A = 20kg and m_B = 30kg. 	Understand	CO 4	AMEB03.15
18	The acceleration of a particle along a straight line is given by the equation $a = (4 – t^2/9)$. If the particle starts with zero velocity from a position x = 0, find (i) its velocity after 6 s and (ii) distance travelled in 6 s.	Understand	CO 4	AMEB03.13
19	An automobile starting from rest increases its speed from 0 to v with a constant acceleration α, runs at this speed for a time t_1 and finally comes to rest with a constant retardation β. If the total distance travelled is S, find the total time t required.	Understand	CO 4	AMEB03.13
20	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.	Understand	CO 4	AMEB03.14

	Part – C (Problem Solving and Critical Thinking)			
1	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*.  	Understand	CO 4	AMEB03.14
2	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. Determine (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 s	Remember	CO 4	AMEB03.13
3	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	Understand	CO 4	AMEB03.13
4	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	CO 4	AMEB03.15
5	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.	Understand	CO 4	AMEB03.14
6	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/s2. 1.75 seconds later, car *B* starts and accelerates at 1.1 m/s2. Determine i) when and where *B* will overtake *A* and ii) The speed of each car at that time.	Understand	CO 4	AMEB03.14

7	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.  	Apply	CO 4	AMEB03.15
8	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	CO 4	AMEB03.15
9	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.  	Understand	CO 4	AMEB03.14
10	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?  	Understand	CO 4	AMEB03.15

	MODULE -V			
	MECHANICAL VIBRATIONS			
	Part - A (Short Answer Questions)			
1	Define simple harmonic motion. Give examples	Remember	CO 5	AMEB03.17
2	Define the terms Amplitude and Oscillations	Understand	CO 5	AMEB03.17
3	Define the terms periodic time and frequency and give their units.	Remember	CO 5	AMEB03.17
4	Write the equation of simple harmonic motion with notations	Understand	CO 5	AMEB03.17
5	Draw the graphical representation for displacement, velocity and acceleration equations of SHM	Remember	CO 5	AMEB03.17
6	Discuss the different types of vibrations?	Understand	CO 5	AMEB03.18
7	Write the expression for time period of a simple pendulum	Understand	CO 5	AMEB03.18
8	Write the expression for time period of a compound pendulum	Understand	CO 5	AMEB03.18
9	Write the expression for time period of a torsional pendulum	Understand	CO 5	AMEB03.18
10	Write the expression for time period of a conical pendulum	Remember	CO 5	AMEB03.18
11	Define the term free vibration.	Understand	CO 5	AMEB03.19
12	A point describes simple harmonic motion in a 0.6m long. Find the maximum velocity if the time period is 0.3s	Understand	CO 5	AMEB03.17
13	If a displacement of a particle in simple harmonic motion is x=0.3sin(0.4t) metre, find its displacement and velocity when t= 10s.	Remember	CO 5	AMEB03.17
14	Write the expression for equivalent stiffness of a spring system when springs are arranged in series	Remember	CO 5	AMEB03.19
15	Write the expression for equivalent stiffness of a spring system when springs are arranged in parallel.	Understand	CO 5	AMEB03.19
16	Find the length of second pendulum assuming the value of g as 9.81 m/s^2	Understand	CO 5	AMEB03.18
17	Define the term free vibration	Remember	CO 5	AMEB03.19
18	Calculate the length of a simple pendulum to make one complete oscillation per second	Remember	CO 5	AMEB03.18
	Part - B (Long Answer Questions)			
1	Derive an expression for the time period of a simple pendulum.	Remember	CO 5	AMEB03.18
2	Derive an expression for the time period of a compound pendulum	Remember	CO 5	AMEB03.18
3	Derive an expression for the time period of a torsional pendulum	Remember	CO 5	AMEB03.18
4	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.	Remember	CO 5	AMEB03.17
5	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	CO 5	AMEB03.17
6	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	CO 5	AMEB03.17
7	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 0.85x105 N/mm2. Calculate the frequency of torsional vibrations for the system	Remember	CO 5	AMEB03.19
8	Derive an expression for the time period for a spring mass system subjected to free vibration.	Understand	CO 5	AMEB03.19
9	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.	Understand	CO 5	AMEB03.19
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/s2 b The lift is moving downwards with an acceleration of g/10m/s2	Remember	CO 5	AMEB03.18
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	CO 5	AMEB03.18

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 0.85x105 N/mm2 . Calculate the frequency of torsional vibrations for the system	Remember	CO 5	AMEB03.19
13	Derive an expression for the time period for a spring mass system subjected to free vibration.	Understand	CO 5	AMEB03.19
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	CO 5	AMEB03.19
15	A simple pendulum swings 5 oscillations in the same time as another 0.48m longer swings 3 oscillations. Determine their lengths.	Remember	CO 5	AMEB03.18
16	A spring of stiffness 10N/m is cut into two halves and fixed with a mass M, so that the system can vibrate, as shown in figure. If the cyclic frequency of the system is 7 cps, determine the magnitude of M. 	Understand	CO 5	AMEB03.19
	Part – C (Problem Solving and Critical Thinking)			
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	CO 5	AMEB03.19
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	CO 5	AMEB03.18
3	A load is suspended from a vertical spring. At rest it deflects the spring 12mm. Calculate the time period. lift is displaced further25mm below the ret position and then released.	Remember	CO 5	AMEB03.19
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.	Remember	CO 5	AMEB03.19
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. 	Understand	CO 5	AMEB03.19
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	CO 5	AMEB03.19
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 0.85x105 N/mm2. Calculate the frequency of torsional vibration for the system.	Remember	CO 5	AMEB03.19
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 0.95x105 N/mm2. Calculate the frequency of torsional vibrations for the system.	Understand	CO 5	AMEB03.19

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	Understand	CO 5	AMEB03.17
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	CO 5	AMEB03.17

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