INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**ENGINEERING MECHANICS**				
Course Code	AMEB03				
Program	B. Tech				
Semester	THREE				
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Course Coordinator	Dr. BDY Sunil, Associate Professor				

COURSE OBJECTIVES:

Students will try to learn:	
I	The application of mechanics laws to static and dynamic equilibrium conditions in a body for solving the field problems.
II	The importance of free body diagram for a given system and put in the knowledge of mathematics and science into the vast area of rigid body mechanics.
III	The effects of force and motion while carrying out the innovative design functions of engineering.

COURSE OUTCOMES:

At the end of the course the students should be able to:

Course Outcomes		**Knowledge Level (Bloom's Taxonomy)**
CO 1	**Determine** the reactions and resultants for the system of forces in engineering applications with principles of mechanics.	Apply
CO 2	**Analyze** the unknown forces with the help of free body diagrams to a given force system.	Analyze
CO 3	**Identify** the equilibrium equations for a planar and spatial force systems from the rest or motion condition of the body.	Remember

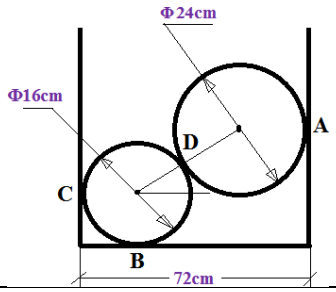
CO 4	**Apply** the static and dynamic friction laws for the equilibrium state of a wedge and ladder applications.	Apply
CO 5	**Apply** the friction laws to a standard and differential screw jack for conditions of self-locking and overhauling.	Apply
CO 6	**Demonstrate** the concepts of equilibrium for truss, beam, frames and machine applications.	Understand
CO 7	**Identify** the centroid, centre of gravity and moment of inertia for the simple plane sections from the first principles.	Apply
CO 8	**Explore** the theorems of moment and the mass moment of inertia of circular plate, cylinder, cone and sphere.	Apply
CO 9	**Apply** the concepts of virtual work and work-energy method for single and connected configured systems.	Apply
CO 10	**Determine** normal and tangential accelerations for a particle in rectilinear and curvilinear motion through kinematic equations.	Apply
CO 11	**Derive** the dynamic equilibrium of a body in motion by introducing inertia force through D' Alembert's principle.	Apply
CO 12	**Compute** the time period and frequencies of simple, compound and torsional pendulums using the basics of free and forced vibrations.	Understand

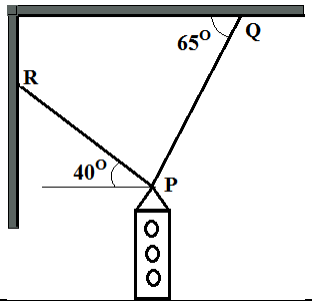
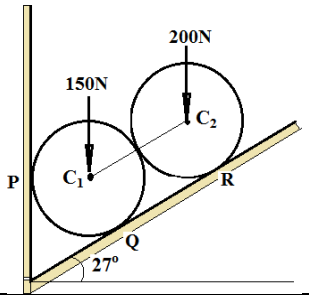
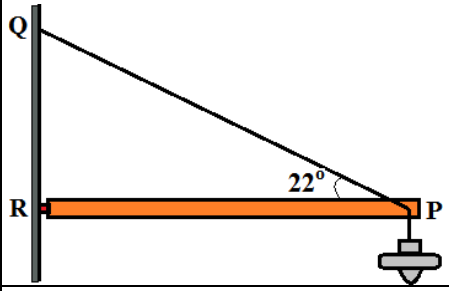
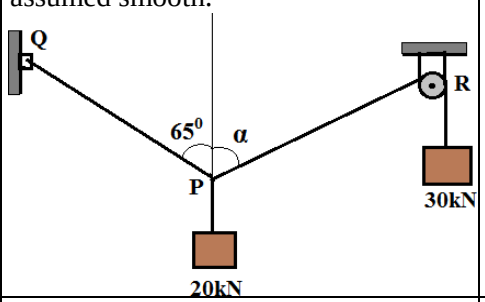
MAPPING OF EACH CO WITH PO(s), PSO(s):

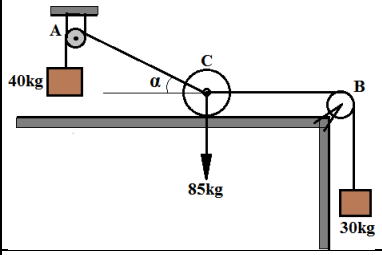
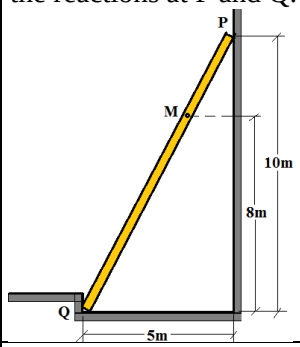
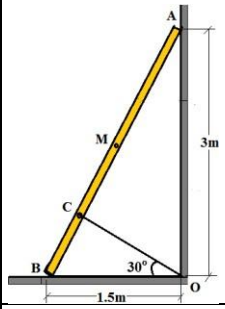
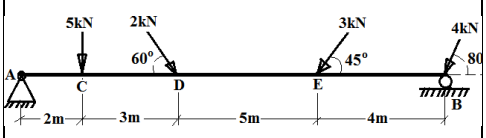
Course Outcomes	Program Outcomes												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	4	-	2	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	-	3	-	2	-	-	-	-	-	-	-	-	2	-	-
CO 7	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 8	2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 9	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 10	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 11	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 12	2	-	-	3	-	-	-	-	-	-	-	-	2	-	-

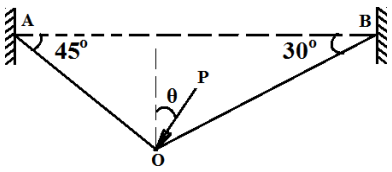
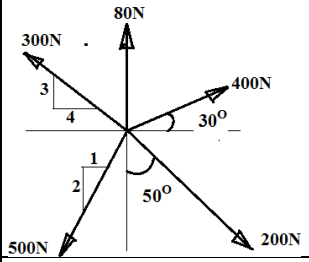
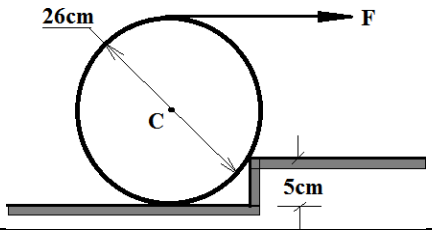
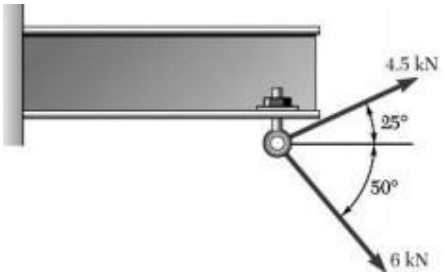
TUTORIAL QUESTION BANK

MODULE - I				
INTRODUCTION TO ENGINEERING MECHANICS				
Part - A (Short Answer Questions)				
S No	**QUESTIONS**	**Blooms Taxonomy Level**	**How does this subsume the level**	**Course Outcome**
1	State Varignon's theorem	Remember	--	CO 1
2	What is a couple?	Understand	--	CO 1
3	Define principle of transmissibility.	Remember	--	CO 1
4	State the triangular law of forces?	Remember	--	CO 1
5	What is a moment of a couple?	Remember	--	CO 1
6	State Newton's three laws of motion?	Remember	--	CO 1
7	State and explain Newton's law of gravitation	Remember	--	CO 1
8	Define the term resultant and equilibrant	Remember	--	CO 1
9	What is a rigid body?	Remember	--	CO 1
10	What is a couple? State its characteristics	Remember	--	CO 1
11	Explain coplanar force system with sketch.	Remember	Learner to **Recall** the concept of force system and explain the coplanar force system	CO 2
12	Explain concurrent force system with sketch.	Remember	Learner to **Recall** the concept of force system and explain the concurrent force system	CO 2
13	Define the resultant of a force system.	Understand	--	CO 2
14	Explain the resultant of two like parallel forces.	Understand	Learner to **Recall** like parallel forces and explain how to determine the resultant of the same	CO 2
15	Define momentum of a force.	Remember	--	CO 2
16	Resultant of concurrent forces.	Understand	--	CO 2
17	Define Static Indeterminacy.	Understand	--	CO 2
18	Explain the resultant of two unlike parallel forces.	Remember	Learner to **Recall** unlike parallel forces and explain how to determine the resultant of the same	CO 2
19	Define spatial force system.	Understand	--	CO 3
20	List out the equilibrium equations for spatial force system	Remember	--	CO 3

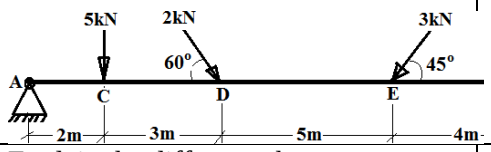
Part - B (Long Answer Questions)				
1	State and prove Lami's theorem with a neat sketch?	Remember	--	CO 1
2	State and prove the Parallelogram law of forces?	Understand	--	CO 1
3	Explain free body diagram with neat sketches.	Remember	--	CO 2
4	What differences exist between Kinetics and Kinematics	Remember	--	CO 1
5	Compare 'Resultant' and 'Equilibrant'	Remember	--	CO 3
6	Distinguish between couple and moment.	Understand	--	CO 1
7	Explain briefly about various types of supports.	Understand	--	CO 1
8	Explain the procedure to find the resultant of several forces acting at a point	Understand	Learner to **explain** the detailed procedure of how to determine the resultant when several forces are acting at a point	CO 2
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	Learner to **find** the magnitude and direction of resultant by **identifying** the required formulae to be used.	CO 2
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	Learner to **find** the magnitude and direction of the second force by **identifying** the required formulae to be used.	CO 2
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	Learner to **find** the magnitude and direction of the second force by **identifying** the required formulae to be used.	CO 2
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	Learner to **find** the magnitude and direction of the reactions by **identifying** the required formulae to be used.	CO 2
13	A traffic signal of mass 50kg is hung with the help of two strings, as shown in figure. Find the forces induced in	Apply	Learner to **find** the magnitude and direction of the forces in the strings by **identifying** the	CO 2

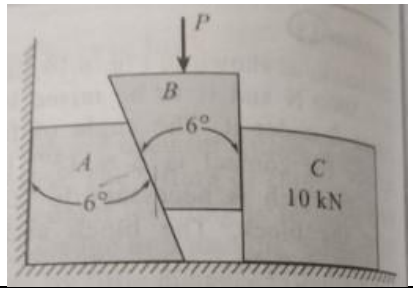
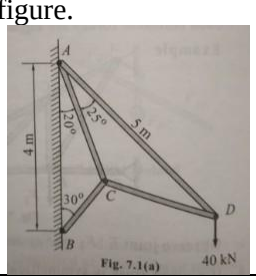
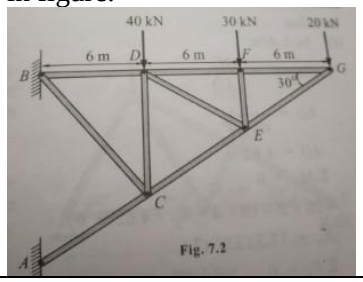
	the strings. 		required formulae to be used.	
14	Two spheres are kept in a conical channel, as shown in figure. All contact surfaces are smooth. Determine the reactions at all the contact surfaces. Sizes of spheres are same but with different weight. 	Evaluate	Learner to **find** the magnitude and direction of the reactions by **identifying** the required formulae to be used.	CO 2
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	Learner to **find** the magnitude and direction of the forces in the strings by **identifying** the required formulae to be used.	CO 2
16	Two weights are suspended as shown in figure. Determine the tension in String PQ. Pulley is assumed smooth. 	Understand	Learner to **find** the magnitude and direction of the forces in the strings by **identifying** the required formulae to be used.	CO 2
17	In the arrangement shown in figure, all pulleys are assumed to be smooth	Understand	Learner to **find** the magnitude and direction of the forces in	CO 2

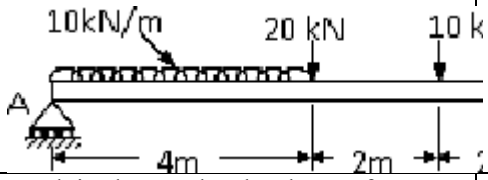
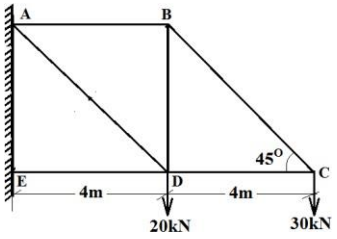
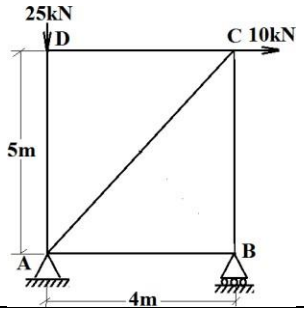
	and frictionless. Determine the angle 'α' and the reactive force on the ball from the floor. 		the strings and the required angle by **identifying** the required formulae to be used.	
18	A ladder of weight 30kg is supported at wall and floor as shown in figure. A man of weight 72kg rides on a rung 8m above the floor level. Considering all contact surfaces smooth, determine the reactions at P and Q. 	Understand	Learner to **find** the magnitude and direction of the reactions by **identifying** the required formulae to be used.	CO 2
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	Learner to **find** the magnitude and direction of the reactions and tensions in string by **identifying** the required formulae to be used.	CO 2
20	Neglecting the thickness and mass of the beam, determine the support reactions for the beam loaded as shown in figure. 	Understand	Learner to **find** the magnitude and direction of the reactions by **identifying** the required formulae to be used.	CO 2

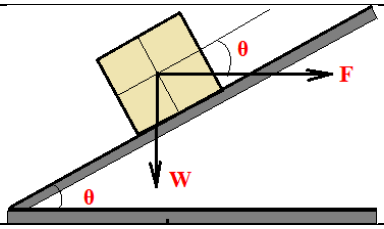
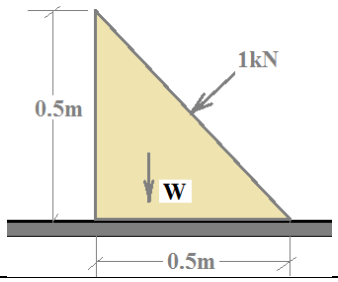
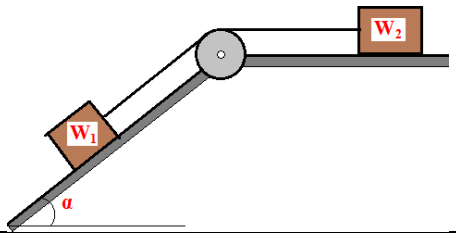
Part - C (Problem Solving and Critical Thinking Questions)				
1	A force P is applied at 'O' to the string AOB as shown in figure. If the tension in each part of string is 50N, Find the direction and magnitude of force P for equilibrium conditions. 	Remember	Learner to **find** the magnitude and direction of the reactions by **identifying** the required formulae to be used.	CO 2
2	Determine the resultant of system of forces acting as shown in figure. 	Remember	Learner to **find** the magnitude and direction of the resultant by **identifying** the required formulae to be used.	CO 2
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	Learner to **find** the magnitude of the pull by **identifying** the required formulae to be used.	CO 2
4	Two forces are applied to an eye bolt fastened to a beam. Determine the magnitude and direction of their resultant. 	Remember	Learner to **find** the magnitude and direction of the resultant by **identifying** the required formulae to be used.	CO 2

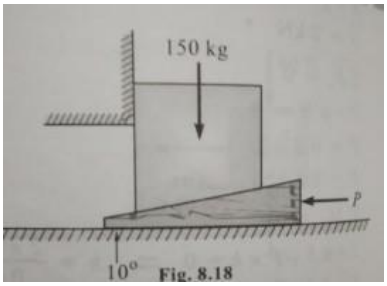
5	Find the magnitude of two forces such that if they act at right angle, their resultant is $\sqrt{10}$, but they act at 60^0 their resultant is $\sqrt{13}$	Remember	Learner to **find** the magnitude and direction of the resultant by **identifying** the required formulae to be used.	CO 2
6	The five forces 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	Learner to **find** the magnitude and direction of the resultant by **identifying** the required formulae to be used.	CO 2
7	The following forces act at a point 30kN inclined at 35^0 towards North to East. a. 22kN towards North b. 30kN inclined at 30^0 towards North to West c. 35kN inclined at 25^0 towards South to West. Find the magnitude and direction of the resultant force.	Understand	Learner to **find** the magnitude and direction of the resultant by **identifying** the required formulae to be used.	CO 2
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	Learner to **find** the magnitude and direction of the resultant by **identifying** the required formulae to be used.	CO 2
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	Learner to **find** the weight of the plank by **identifying** the required formulae to be used.	CO 2
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	Learner to **find** the magnitude and direction of the resultant by **identifying** the required formulae to be used.	CO 2
MODULE-II				
FRICTION AND BASIC STRUCTURAL ANALYSIS				
Part – A (Short Answer Questions)				
1	Explain the types of friction with examples?	Understand	--	CO 4
2	Define Friction	Understand	--	CO 4
3	Define the following (i)Angle of Repose (ii)Coefficient of frictions	Understand	--	CO 4
4	Differentiate between static and dynamic friction?	Understand	--	CO 4
5	State laws of solid friction.	Understand	--	CO 4

6	What do you understand by the limiting friction?.	Remember	--	CO 4
7	What is the principle of a screw jack?	Remember	--	CO 5
8	Define a beam? And explain different types of beams with neat sketches.	Remember	--	CO 6
9	Explain the classification of friction.	Understand	--	CO 4
10	Differentiate between beam and column.	Remember	--	CO 6
11	Explain types of friction.	Understand	--	CO 4
12	Explain rolling friction.	Understand	--	CO 4
13	Under what conditions can a cylinder roll down and under what conditions can it slide down an inclined plane.	Understand	Learner to **recall** conditions of an inclined plane and then explain how a cylinder may roll down and slide down.	CO 4
14	Differentiate between angle of repose and angle of friction.	Understand	--	CO 4
15	Explain the difference between coefficient of friction and angle of friction	Remember	--	CO 4
	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 4
2	Solve reactions at points A & B 	Understand	Learner to **find** the magnitude and direction of the resultant by **identifying** the required formulae to be used.	CO 6
3	Explain the difference between coefficient of friction and angle of friction	Remember	--	CO 4
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 4
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.	Remember	Learner to **find** the minimum force required to push the block by **identifying** the required formulae to be used.	CO 5

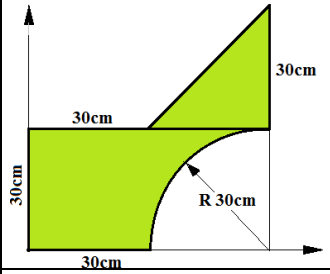
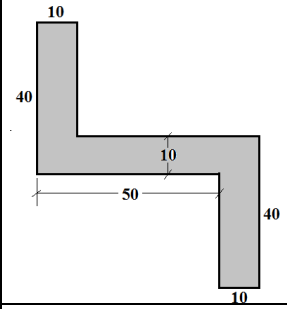
	Take coefficient of friction as 0.25 for all contact surfaces. 			
6	A body of weight 300N is lying on a rough horizontal surface having coefficient of friction as 0.3. Find the magnitude of force, which can move the body, while acting at an angle $25^0$with the horizontal.	Remember	Learner to **find** the minimum force required to push the block by **identifying** the required formulae to be used.	CO 4
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	Learner to **find** the weight of the body and co-efficient of friction by **identifying** the required formulae to be used.	CO 4
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	Learner to **find** the minimum force required to push the block by **identifying** the required formulae to be used.	CO 4
9	Find the force and its nature in member AD and BC for given cantilever truss loaded by 40KN as shown figure. 	Remember	Learner to **find** the minimum force required by **identifying** the required formulae to be used.	CO 6
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. 	Understand	Learner to **find** the forces by **identifying** the required formulae to be used.	CO 6

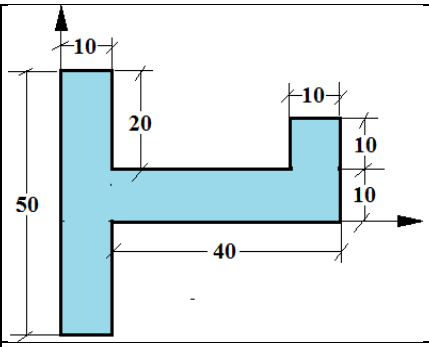
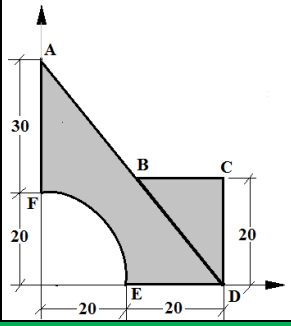
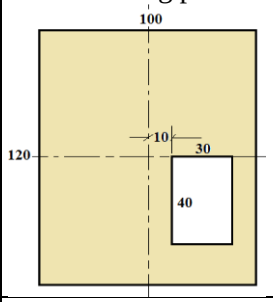
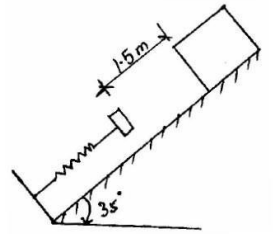
11	A beam AB is supported and loaded as shown in fig.1. Find the reactions at the supports. 	Understand	Learner to **find** the reactions by **identifying** the required formulae to be used.	CO 6
12	Explain the Coulomb's laws of friction.	Remember	--	CO 4
13	Explain Cone of friction.	Remember	--	CO 4
14	Explain wedge friction.	Remember	--	CO 5
15	Find the forces in the members AB and BD by method of sections. 	Understand	Learner to **find** the forces by **identifying** the required formulae to be used.	CO 6
16	Find the forces in the members AB and BD by method of sections. 	Understand	Learner to **find** the forces by **identifying** the required formulae to be used.	CO 6
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	Learner to **find** the force that is to be applied and also determine the efficeincy by **identifying** the required formulae to be used.	CO 5
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	Learner to **find** the forces required by **identifying** the required formulae to be used.	CO 4

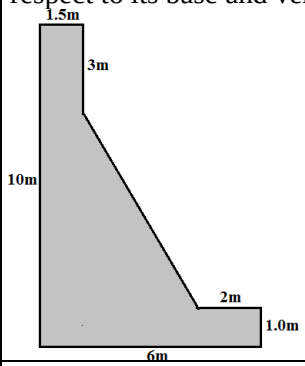
				
19	Find the minimum weight W of the triangular block such that it remains in equilibrium under the action of the force 1kN applied to it as shown in figure. Take μ = 0.25. 	Understand	Learner to **find** the weight of the body by **identifying** the required formulae to be used.	CO 5
20	Two rectangular 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	Learner to **find** the angle of inclination by **identifying** the required formulae to be used.	CO 4
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	Learner to **find** the position of ladder by **identifying** the required formulae to be used.	CO 4
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	Understand	Learner to **find** the frictional force by **identifying** the required formulae to be used.	CO 4

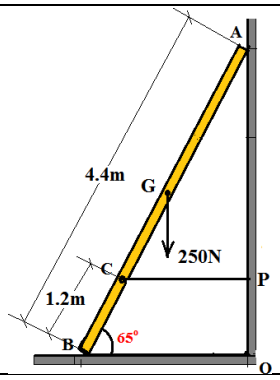
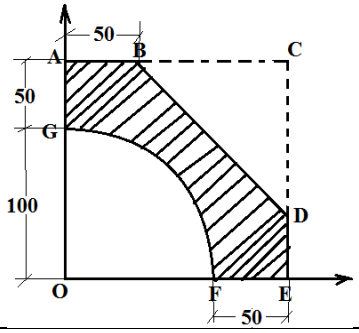
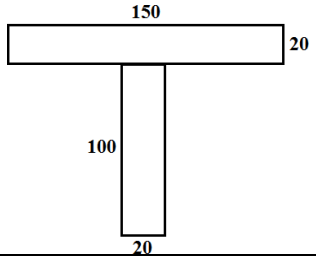
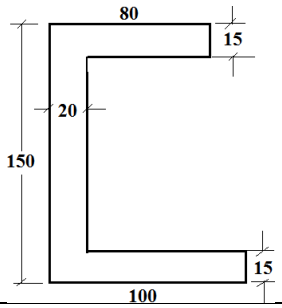
	between the ladder and the floor? Show that the ladder will remain in equilibrium in this position.			
3	A block of mass 150kg is raised by a 100wedge weight 50kg under it and by applying a horizontal force at its end. Taking coefficient of friction between all surfaces of contact as 0.3, find minimum force that should be applied to raise the block.  Fig. 8.18	Remember	Learner to **find** the force required to raise the block by **identifying** the required formulae to be used.	CO 5
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	Learner to **find** how far the man climb the ladder with the given conditions by **identifying** the required formulae to be used	CO 4
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	Learner to **find** effort required to raise a load by **identifying** the required formulae to be used	CO 5
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	Learner to **find** torque required for a given pressure by **identifying** the required formulae to be used	CO5
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	Learner to **find** effort required to raise a load by **identifying** the required formulae to be used	CO 5
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	Understand	Learner to **find** effort required to raise a load by **identifying** the required formulae to be used	CO 5

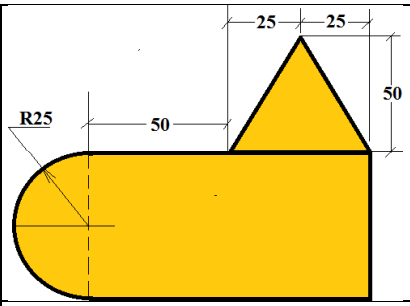
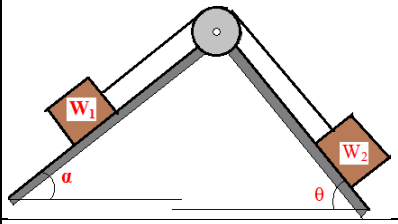
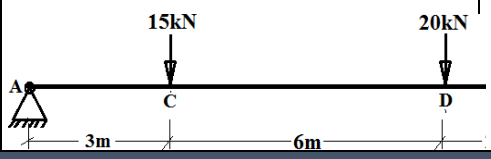
	60cm length is needed to raise a weight of 2KN			
9	A differential screw jack has a pitch of 12mm, 10mm and 300mm arm length.What will be the efficiency of the machine, if it can lift a load of 7.5KN by an effort of 30N.	Understand	Learner to **find** effort required to raise a given load by **identifying** the required formulae to be used	CO 5
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	Learner to **find** effort required to at the end of the arm to lift given load by **identifying** the required formulae to be used	CO 5
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 7
2	Define polar moment of inertia	Remember	--	CO 8
3	Define Radius of gyration	Remember	--	CO 8
4	State the parallel axis theorem	Remember	--	CO 8
5	State the perpendicular axis theorem	Remember	--	CO 8
6	State Pappus – Guildinus theorem.	Remember	--	CO 9
7	Determine the moment of inertia of rectangular lamina about base using parallel axis theorem.	Understand	--	CO 8
8	Determine the polar moment of inertia of circular lamina about centroidal axis.	Understand	--	CO 8
9	Describe the various methods of finding the center of gravity of a body	Understand	--	CO 7
10	List out the solid of revolution.	Remember	--	CO 9
CIE-II				
11	Give the location of centroids of rectangle, right angled triangle, parabola, semi-circle, quarter circle.	Remember	--	CO 7
12	Determine the volume and surface area of cylinder of height ‘h’ and radius ‘r’ using Pappus – Guildinus theorems.	Understand	--	CO 8
13	Define mass moment of inertia	Remember	--	CO 8
14	Determine the moment of inertia of a square lamina about its diagonal.	Understand	--	CO 8
15	Determine the moment of inertia of Triangular lamina, using parallel axis theorem.	Understand	--	CO 8
16	Define the term power	Remember	--	CO 9

17	State the principle of conservation of energy	Understand	--	CO 9
18	Explain the term work done by friction force	Understand	--	CO 9
19	Explain the term work done by spring force	Understand	--	CO 9
20	State the principle of virtual work.	Remember	--	CO 9
Part – B (Long Answer Questions)				
1	State and prove the parallel axis theorem.	Remember	--	CO 7
2	State and prove the perpendicular axis theorem	Remember	--	CO 7
3	State and prove the Pappus guildlinus theorem for area and volume	Remember	--	CO 7
4	Determine the coordinates of centroid of the shaded area shown in figure. 	Remember	Learner to **find** the co-ordinates of centroid by **identifying** the required formulae to be used.	CO7
5	Determine the Moment of Inertia about the centroidal coordinate axes of plane area shown in fig. Also find Polar Moment of Inertia. 	Remember	Learner to **find** the Moment of Inertia and polar moment of inertia by **identifying** the required formulae to be used.	CO 7
6	Derive an expression for centroid of semi-circle.	Remember	--	CO 7
7	Derive an expression for MI for a rectangle section.	Remember	--	CO 8
8	State and explain Pappus-Guldinus theorems for surface of revolution and Volume of revolution.	Understand	--	CO 8
9	Locate the centroid of the composite area shown in figure.	Understand	Learner to **find** the co-ordinates of centroid by **identifying** the required formulae to be used.	CO 7

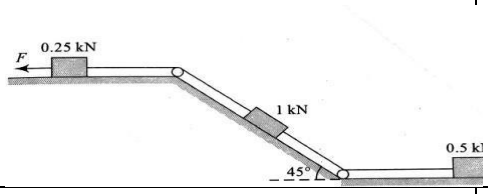
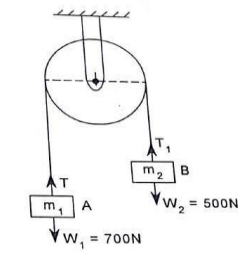
				
10	Locate the centroid of the composite area shown in figure. 	Understand	Learner to **find** the co-ordinates of centroid by **identifying** the required formulae to be used.	CO 7
	CIE-II			
11	In a rectangular plate of 100 x 120 mm and of negligible thickness, a rectangular cut of dimensions 30 x 40mm is made as shown in figure. Determine the position of centroid of the remaining part of the plate. 	Understand	Learner to **find** the co-ordinates of centroid by **identifying** the required formulae to be used.	CO 8
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	Learner to **find** the Co-efficient of kinetic friction between the block and the plane by **identifying** the required formulae to be used	CO 7

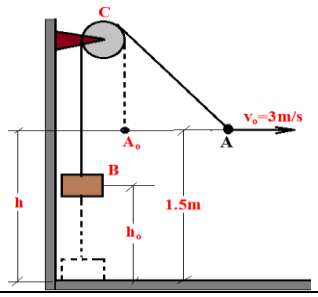
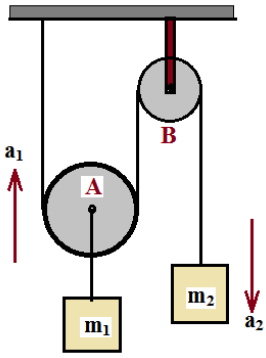
13	State and prove work energy principle	Remember	--	CO 9
14	Explain the following terms 1. Work done by weight force 2. Work done by friction force and 3. Work done by spring force	Remember	--	CO 9
15	A force of 500N is acting at 30^0 to the horizontal on a block of mass 50kg resting on a horizontal surface. Determine the velocity after the block has travelled a distance of 10m. Coefficient of kinetic friction is 0.5.	Understand	Learner to **find** the velocity after the block has travelled the given distance upon the application of given force by **identifying** the required formulae to be used	CO 7
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	Learner to **find** the input power of the pump with a given efficiency by identifying the required formulae to be used	CO 9
17	Locate the centroid of the dam cross section shown in figure with respect to its base and vertical face.  	Understand	Learner to **find** the co-ordinates of centroid by **identifying** the required formulae to be used.	CO 7
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	Learner to **find** the Co-efficient of kinetic friction between the block and the plane by **identifying** the required formulae to be used	CO 7
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	Learner to **find** the tension of the rope by using the virtual work method	CO 7

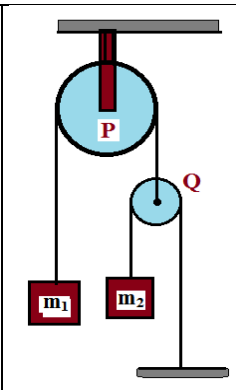
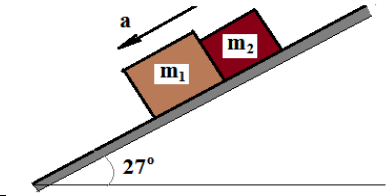
				
20	Determine the centroid of the shaded area ABDEFG shown in figure. 	Understand	Learner to **find** the co-ordinates of centroid by **identifying** the required formulae to be used.	CO 7
	Part – C (Problem Solving and Critical Thinking)			
1	Find the centre of gravity of the "T "lamina as shown in figure. All dimensions are in mm. 	Remember	Learner to **find** the co-ordinates of centre of gravity by **identifying** the required formulae to be used.	CO 7
2	Find the centroid of the plane lamina shown in Figure 	Remember	Learner to **find** the co-ordinates of centroid by **identifying** the required formulae to be used.	CO 7
3	Uniform lamina shown in fig consists of rectangle, a semi-circle and a triangle. Find the centre of gravity.	Remember	Learner to **find** the co-ordinates of centre of gravity by **identifying** the required formulae to be used.	CO 7

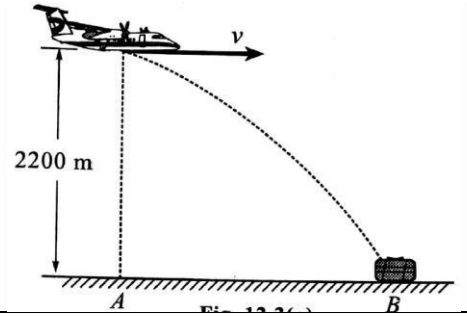
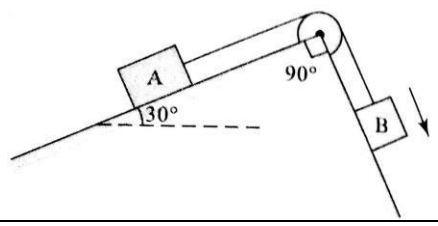
				
4	Derive an expression for centroid of triangular area	Remember	--	CO 7
5	Derive an expression for centroid of circle.	Remember	--	CO 7
CIE-II				
6	Derive an expression for centroid of rectangle area.	Understand	--	CO 7
7	Determine the distance in which a car moving at 90kmph can come to rest after the power switched off if coefficient of friction is 0.8 on road and tyres.	Understand	Learner to **find** the distance covered by the car moving by **identifying** the required formulae to be used.	CO 7
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 9
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	Learner to **find** the angle by **identifying** the required formulae to be used.	CO 9
10	Using the method of virtual work, determine the reaction at supports A and B of the transversely loaded beam shown in figure. 	Remember	Learner to **find** the reactions by **identifying** the required formulae to be used.	CO 9
MODULE –IV				
PARTICLE DYNAMICS AND INTRODUCTION TO KINETICS				
Part – A (Short Answer Questions)				

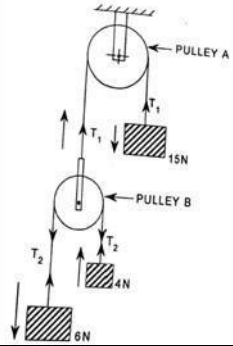
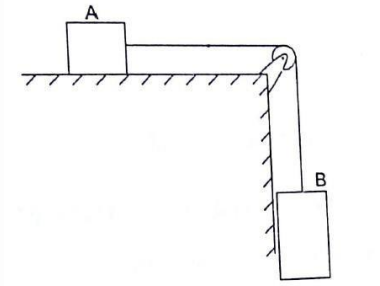
1	Define the terms velocity and acceleration	Understand	--	CO 10
2	Define angular displacement, angular velocity and angular acceleration	Understand	--	CO 10
3	Define the terms Kinetics and kinematics.	Understand	--	CO 10
4	Define the term rigid body	Remember	--	CO 10
5	State D'Alembert's principle..	Remember	--	CO 11
6	Compare Newton's second law with D'Alembert's principle	Remember	--	CO 11
7	Define the term momentum of a body with units	Remember	--	CO 11
8	Distinguish between mass and weight.	Remember	--	CO 10
9	Write governing equations of velocity and acceleration of fixed axis rotation	Remember	--	CO 11
10	Define instantaneous centre of velocity	Remember	--	CO 10
11	State the assumptions necessary for the analysis of a plane projectile motion.	Remember	--	CO 11
PART – B (LONG ANSWER QUESTIONS)				
1	Derive an expression F=ma	Understand	--	CO 11
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
5	Derive the expression for range along an inclined plane. What is the necessary condition for obtaining maximum range along an inclined plane?	Understand	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10
7	A hammer of mass 400kg falls through a height of 3m on a pile of negligible	Apply	Learner to **find** the displacement and velocity by	CO 11

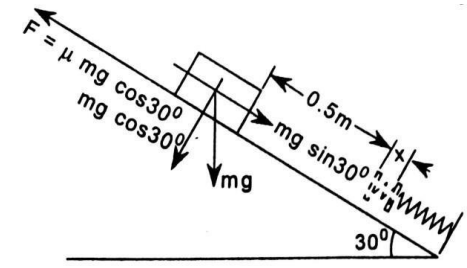
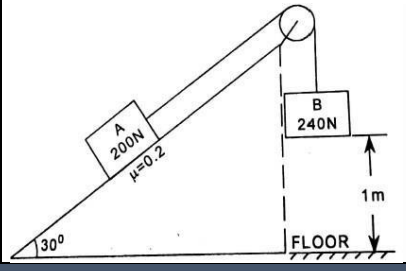
	mass. If it drives the pile 1m into the ground, find the average resistance of the ground for penetration		**identifying** the required formulae to be used.	
8	A mass of 5kg is dropped from a height of 2 metres upon a spring whose stiffness is 10N/mm. Calculate the speed of the mass when a spring is compressed through a distance of 100mm.	Understand	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11

				
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10

				
17	Two blocks , as shown in figure, slide down a 27^o 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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
PART – C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
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	Understand	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11

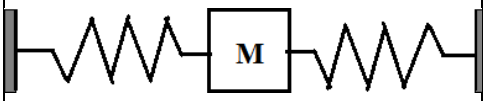
	resistance. Also find velocity at *B* and time taken to reach *B*.  			
2	A particle starts moving along a straight line with initial velocity of 25m/s, from O under a uniform acceleration of -2.5 m/s2. Determine (i) Velocity, displacement and the distance travelled at t= 5 sec (ii) How long the particle 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 Instantaneous velocity, displacement and distance covered at t=25 s	Remember	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10
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 , The height of the tower and The velocity of the stone when they reach the ground	Understand	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11

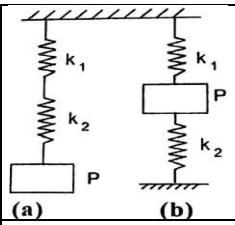
5	A body *A* is projected vertically upwards from the top of a tower with a velocity of 40m/s, the tower being 180m high. After *t* seconds, another body *B* is allowed to fall from the same point. Both the bodies reach the ground simultaneously. Calculate *t* and the velocities of *A* and *B* on reaching the ground.	Understand	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
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 The speed of each car at that time.	Understand	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
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	Understand	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 10

	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. 			
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	Learner to **find** the displacement and velocity by **identifying** the required formulae to be used.	CO 11
MODULE –V				
MECHANICAL VIBRATIONS				
Part - A (Short Answer Questions)				
1	Define simple harmonic motion. Give examples	Remember	--	CO 12
2	Define the terms Amplitude and Oscillations	Understand	--	CO 12
3	Define the terms periodic time and frequency and give their units.	Remember	--	CO 12
4	Write the equation of simple harmonic motion with notations	Understand	--	CO 12
5	Draw the graphical representation for displacement, velocity and acceleration equations of SHM	Remember	--	CO 12
6	Discuss the different types of vibrations?	Understand	--	CO 12
7	Write the expression for time period of a simple pendulum	Understand	--	CO 12

8	Write the expression for time period of a compound pendulum	Understand	--	CO 12
9	Write the expression for time period of a torsional pendulum	Understand	--	CO 12
10	Write the expression for time period of a conical pendulum	Remember	--	CO 12
11	Define the term free vibration.	Understand	--	CO 12
12	A point describes simple harmonic motion in a 0.6m long. Find the maximum velocity if the time period is 0.3s	Understand	Learner to **find** the maximum velocity by **identifying** the required formulae to be used	CO 12
13	If a displacement of a particle in simple harmonic motion is x=0.3sin(0.4t) meter.find its displacement and velocity when t= 10s.	Remember	Learner to **find** the maximum velocity by **identifying** the required formulae to be used	CO 12
14	Write the expression for equivalent stiffness of a spring system when springs are arranged in series.	Remember	Learner to **find** the maximum velocity by **identifying** the required formulae to be used	CO 12
15	Write the expression for equivalent stiffness of a spring system when springs are arranged in parallel.	Understand	Learner to **find** the maximum velocity by **identifying** the required formulae to be used	CO 12
16	Find the length of second pendulum assuming the value of gas 9.81 m/s^2	Understand	Learner to **find** the maximum velocity by **identifying** the required formulae to be used	CO 12
17	Define the term free vibration	Remember	--	CO 12
18	Calculate the length of a simple pendulum to make one complete oscillation per second	Remember	--	CO 12
Part - B (Long Answer Questions)				
1	Derive an expression for the time period of a simple pendulum.	Remember	--	CO 12
2	Derive an expression for the time period of a compound pendulum	Remember	--	CO 12
3	Derive an expression for the time period of a torsional pendulum	Remember	--	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
6	A body moving with SHM has amplitude of 30cm and the period of one complete oscillation is 2s. What	Remember	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12

	will be the speed and acceleration of the body 2/5 of a second after passing the mid position			
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
8	Derive an expression for the time period for a spring mass system subjected to free vibration.	Understand	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
13	Derive an expression for the time period for a spring mass system subjected to free vibration.	Understand	--	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12

15	A simple pendulum swings 5 oscillations in the same time as another 0.48m longer swings 3 oscillations. Determine their lengths.	Remember	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the amplitude, maximum velocity and period of vibration by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the length of the pendulum by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12

				
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the frequency by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the speed and acceleration by **identifying** the required formulae to be used.	CO 12
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	Learner to **find** the acceleration by **identifying** the required formulae to be used.	CO 12

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