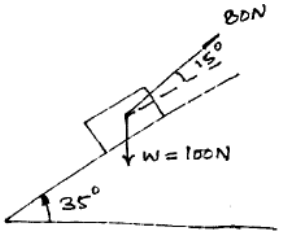
Problems Based on Kinetics of Rigid Body

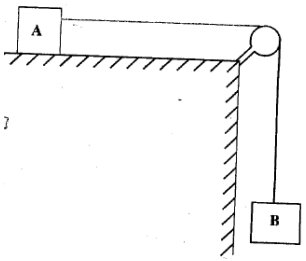
2006–2007 (Sem. II) (ME202)

1. State the D'Alembert's principle. A lift has an upward acceleration of 2.5 m/s^2. What pressure will a man of weight 800 N exert on the floor of the lift? Determine the pressure by him if the acceleration of lift is 2.5 m/s^2 downwards. Assume g = 9.8 m/s^2.
2. With suitable examples explain the difference between conservative and non-conservative forces.
3. An object weighing 100 N is pulled up by a 80 N force up an inclined smooth plane as shown in Fig. Determine the velocity of the object after it has moved 4 m.



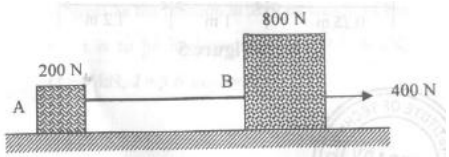
2008–2009 (Sem. I) (EME102)

1. A vehicle weighing 50 kN moves with a velocity of 60 km/hr along x-direction. Another vehicle weighing 25 kN moving along y-direction with a velocity of 90 km/hr, collides with it. If two vehicles get entangled after collision, determine their common velocity.
2. A sphere, a cylinder and a hoop, each having the same mass an4 radius are released from rest on an incline. Determine the velocity of each body after it has rolled through a distance corresponding to a change in elevation h.
3. A body of mass 25 kg resting on a horizontal table is connected by a string passing over a smooth pulley at the edge of the table to another body of mass 3.75 kg and hanging vertically as shown in fig. Initially, the friction between 25 kg mass and the table is just sufficient to prevent the motion. If an additional 1.25 kg is added to the 3.75 kg mass, find the acceleration of the masses.



2008–2009 (Sem. II) (EME202)

1. Two bodies A and B are connected by a thread and move along a rough horizontal plane (μ = 0.3) under the action of a force 400 N applied to the body B as shown in Figure. Determine the acceleration of the two bodies and the tension in the thread, using D'Alembert's principle.

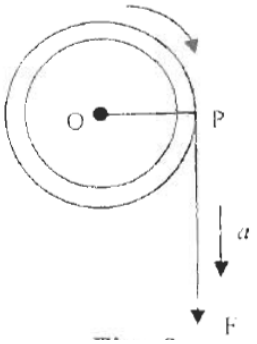


2. What is energy? Explain the various form of mechanical energies.

2009–2010 (Sem. I) (EME102)

1. A cord is wrapped around a wheel of radius 0.2 m, which is initially at rest as shown in Fig. If a force is applied to the cord and gives it an acceleration a = (4t) m/sec^2,

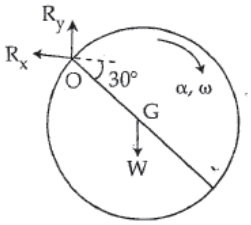
where t is in second. Determine the angular velocity of the wheel and the angular position of line OP both as a function of time.



2. A road roller has a total mass of 12000 kg. The front roller has a mass of 2000 kg, a radius of gyration of 0.4 m and a diameter of 1.2 m. The real axle, together with its wheels, has a mass of 2500 kg, a radius of gyration of 0.6 m and a diameter of 1.5 m. Calculate kinetic energy of rotation of the wheels and axles at a speed of 9 km/h and total kinetic energy of road roller.

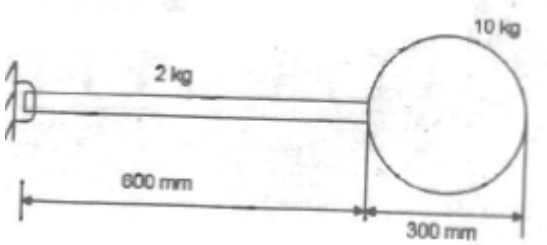
2009–2010 (Sem. II) (EME202)

1. The cylinder shown in figure is 70 cm in diameter and weighs 500 N. It is rotating about the fixed axis O and has an angular velocity of 7 rad/s at the given instant. Using D'Alembert's principle, find the horizontal and vertical components of the reaction at O.

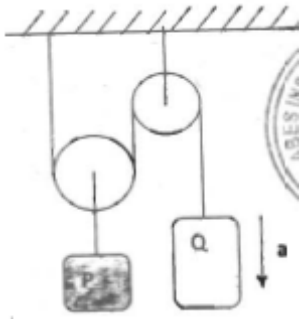


2010–2011 (Sem. I) (EME102)

1. A homogeneous sphere weighing 10 kg is attached to a slender rod of mass 2 kg. If the system is released from horizontal position in rest condition, find the magnitude of angular acceleration. Also find angular velocity of system when it passes through vertical position.

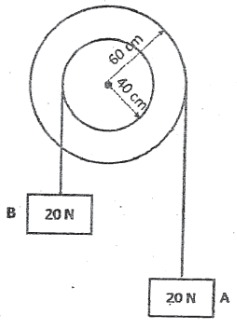


2. Two weights P and Q are connected by the arrangement shown in figure. Neglecting friction and the inertia of the pulleys and cord, find the acceleration a of the weight Q. Assume that P = 178 N and Q = 133.5 N.

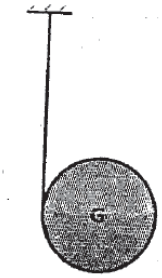


2010–2011 (Sem. II) (EME202)

1. Two weights, each of 20 N, are suspended from a two step pulley as shown in figure. Find the acceleration of the weight *A*. The weight of the pulley is 200 N and its radius of gyration is 200 mm.

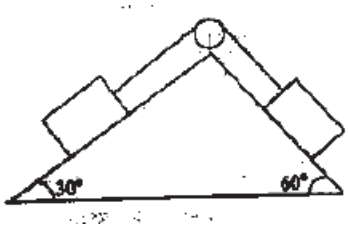


2. A cylinder of mass 5 kg and radius 50 mm is suspended from a cord that is wound around its circumference. If the cylinder is allowed to fall freely, find acceleration of its mass centre *G* and tension in the cord.



2010–2011 (Sem. II) (EME202) (MTU)

1. Two equal weights of 1000 N each are lying on two inclined planes connected by a string passing over a frictionless pulley as shown in Fig, Using D'Alembert's principle, find the acceleration of weights and tension in the string. The coefficient of friction between the plane and weights is 0.2.



2. What is energy? Explain the various form of mechanical energies.

3. A bullet of mass 20 g is fired horizontally with a velocity of 300 m/sec., from a gun carried in a carriage which together with the gun has a mass of 100 kg. The resistance to sliding of the carriage over the ice on which it rests is 20 N. Find:

(i) velocity, with which the gun will recoil,

(ii) distance, in which it comes to rest, and

(iii) time taken to do so.

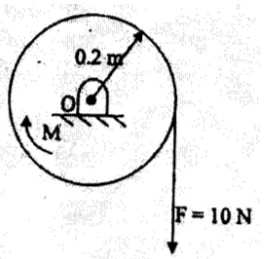
2011–2012 (Sem. I) (EME102)

1. Describe the law of dynamic equilibrium for a body of mass *m* moving with acceleration *a*.

2. A rod of length 4 m and mass 20 kg is pivoted at one end and is rotated with an angular speed 10 rad/s in horizontal plane. Find the force on pivot due to rod and the tension in the rod at a distance of 2 m from the pivot.

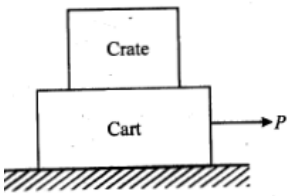
3. The 30 kg disk, shown in Fig., is pin supported at its center. Disc is at rest. *A* constant couple moment *M* of 5 Nm is applied on the disc and a constant force *F* of 10 N

is applied at the end of a rope wrapped on the disk. Determine the number of revolutions made by the disc when its angular velocity becomes 20 rad/s.

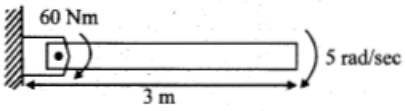


2011–2012 (Sem. I) (EME102) (MTU)

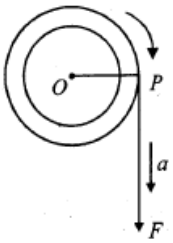
1. Explain the various forms of mechanical energies.
2. A 750 N crate rests on a 500 N cart as shown in Fig. The coefficient of friction between crate and cart is 0.3 and between the cart and the road is 0.2. If the cart is pulled by a force P such that the crate does not slip, determine: (i) the maximum allowable magnitude of force P, and (ii) the acceleration of cart.



3. A 20 kg slender rod shown in fig is rotating in a vertical plane and at the instant shown, it has an angular velocity of 5 rad/sec. Determine the rod's angular acceleration and the horizontal and vertical components of reactions at the pin at this instant.

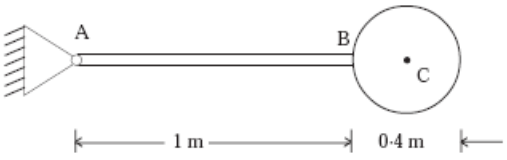


4. A cord is wrapped around a wheel of radius 0.2 m, which is initially at rest as shown in Fig. If a force is applied to the cord and gives it an acceleration $a = (4t)$ m/sec^2, where t is in second. Determine the angular velocity of the wheel and the angular position of line OP both as a function of time.

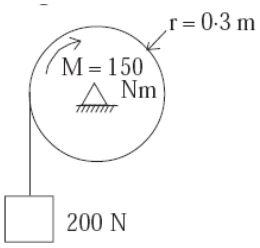


2011–2012 (Sem. II) (EME202)

1. D'Alembert's principle is basically otherwise explanation of Newton's second law of motion. Comment.
2. A cylinder weighing 500 N is welded to a 1 m long uniform bar of 200 N as shown in Fig. Determine the acceleration with which the assembly will rotate about point A, if released from rest in horizontal position. Determine the reaction at A at this instant.



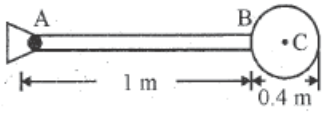
3. A motor provides a constant torque of M = 150 Nm to a hoisting pulley of mass 25 kg and mass moment of Inertia 0.9 kg m^2. The pulley lifts 200 N block starting from rest. Determine speed of block after it rises by 2 m.



2011–2012 (Sem. II) (EME202) (MTU)

1. State the principle of conservation of momentum and give some of its particle applications.

2. A cylinder weighing 500 N is welded to a 1.0 m long uniform bar of 200 N as shown in Fig. Determine the acceleration with which the assembly will rotate about point *A*, if released from rest in horizontal position determine the section at *A* at this instant.

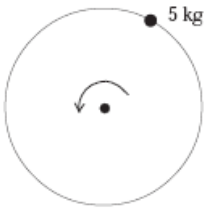


2012–2013 (Sem. I) (EME102)

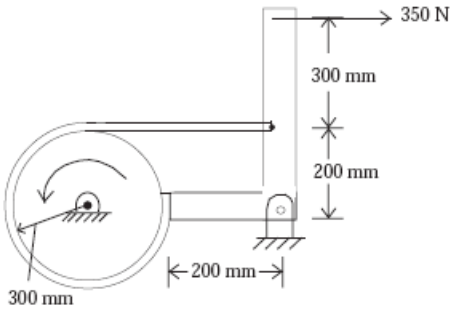
1. A uniform rod of length 3 m and mass 15 kg is rotating about a vertical axis and one end of the rod is on the axis. Rod is rotating in horizontal plane. Determine the force at the fixed end of rod due to axis.

2. A uniform disc of mass 10 kg and radius 40 cm is rolling on horizontal plane. The speed of the centre of mass is 50 cm/s. Determine the kinetic energy of the disc.

3. A particle of mass 5 kg is fixed at the periphery of a solid disc of radius 20 cm as shown in Fig. The disc is rotating about an axis passing through its centre. Mass of the disc is 3 kg. At certain instant the angular velocity and acceleration of the disc are 10 rad/s and 5 rad/s^2 respectively. Calculate the torque on the axis of rotation and Kinetic energy of the system at the said instant.

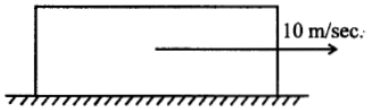


4. A cylinder is rotating at a speed of 1800 rpm when a hand brake system applies a force of 350 N as shown in Fig. The radius of gyration of the cylinder is 200 mm and mass is 500 kg. The dynamic coefficient of friction between the belt and cylinder is 0.4. How much time is required for cylinder to stop?



2012–2013 (Sem. I) (ME101) (MTU)

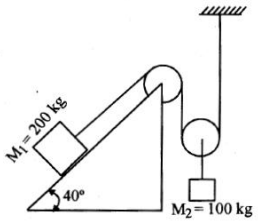
1. Define mechanical advantage.
2. A 30 kg block shown in Fig., is imparted a velocity of 10 m/sec. The coefficient of kinetic friction between the block and the floor is 0.28. Determine the distance covered by the block before it comes to rest and also time required for the box to come to rest.



3. Explain D'Alembert's principle and dynamic equilibrium.
4. In a lifting machine an effort of 98.2 N raised a load of 1000 N and an effort of 498.2 N raised a load of 6000 N. By using law of machine, find what effort is required to lift a load of 10000 N. Find also the maximum mechanical advantage.

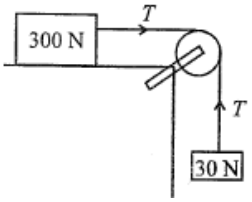
2012–2013 (Sem. I) (EME102) (MTU) [COP]

1. State D'Alembert's principle and its use.
2. Determine the acceleration of the blocks and tension in the string for system given shown in Fig., below, consider the pulley as mass less and $\mu = 0.2$.

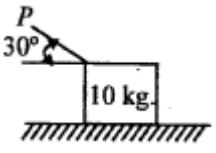


2012–2013 (Sem. II) (ME201) (MTU)

1. State D'Alemberts principle.
2. Fig., shows a body of weight 300 N on a smooth horizontal plane is attached by a string to a 30 N weight, which hangs vertically. Find the acceleration of the system and the tension in the string.



3. A block of mass 10 kg rests on a horizontal plane as shown in Fig. Find the magnitude of the force P, required to move the block at an acceleration of 2 m/s^2 towards right. Take the coefficient of friction between the block and the plane is 0.25.

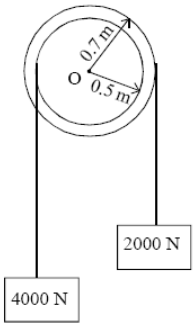


2013–14 (Sem. I) (NME102)

1. A mass of 3 kg is dropped from a height from rest. Find the distance travelled in 5 sees.
2. Two weights of 8 kN and 5 kN are attached at the ends of a flexible cable. The cable passes over a pulley of diameter 1 m. The weight of the pulley is 500 N and radius of gyration is 0.5 m about its axis of rotation. Find the torque which must be applied to the pulley to raise the 8 kN weight with an acceleration of 1.2 m/s^2. Neglect the friction in the pulley.

2013–14 (Sem. I) (EME102) [COP]

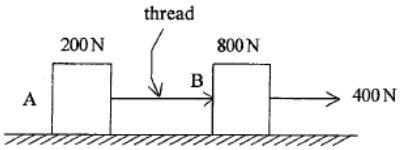
1. The composite pulley shown in Fig., weighs 800 N and has a radius of gyration of 0.6 m. The 2000 N and 4000 N blocks are attached to the pulley by inextensible strings as shown in figure. Neglecting weight of the strings, determine the tension in the strings and angular acceleration of the pulley.



2013–14 (Sem. I) (ME101) [COP]

1. State D'Alembert's principle.

2. Two bodies A and B are connected by a thread and move along a rough horizontal plane ($\mu = 0.3$) under the action of a force 400 N applied to body B as shown in figure. Find the acceleration of the two bodies and tension in the thread using D'Alembert's principle.



3. A solid cylinder is released from rest on an inclined plane at an angle θ from horizontal. The mass of the cylinder is m and radius is R. Determine the velocity of cylinder after it has rolled down the incline through a distance S.

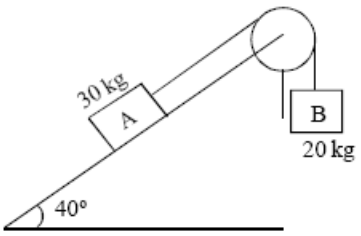
2013–14 (Sem. II) (NME202)

1. A body of mass 30 kg is projected up an incline of 30° with an initial velocity of 10 m/s. The friction coefficient between the contacting surfaces is 0.2. Determine distance travelled by the body before coming to rest.

2013–14 (Sem. II) (EME202) [COP]

1. Define impulse momentum principle.

2. Two blocks are connected by a string. The block of 30 kg lies on a rough plane of slope 40° and the block of 20 kg hangs freely. The coefficient of friction between the plane and the block is 0.2. The 30 kg block is moving down the plane. Determine the acceleration of the masses:



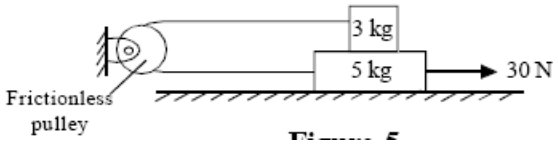
2013–14 (Sem. II) (ME201) [COP]

1. A body is moving with constant linear velocity of 18 m/s and its mass is 5 kg. What will be the value of inertia force on it?

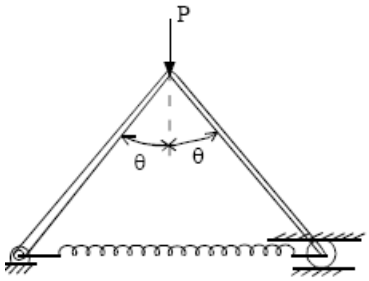
2. Show that work-energy principle and impulse-momentum principle are other forms of Newton's second law of motion.

3. A body of mass 10 kg is moving with variable acceleration $a = 10t$, where 't' is time in seconds, from rest. What will be its kinetic energy after 8 seconds? 'a' is in meter per square seconds.

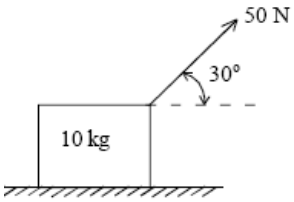
4. In Figure, a force of 30 N is applied on the lower block of mass 5 kg, over which another block of 3 kg mass rests. Determine the acceleration of the blocks and tension in the string assuming it to be inextensible. The coefficient of kinetic friction for all surfaces is 0.15 and co-efficient of static friction is 0.20 for all surfaces.



5. Two links of Equal lengths l are hinged and arranged vertically as shown in Figure. They are connected at their lower ends by a spring of unstreched length s. When a vertical force P is applied, determine the spring constant k to maintain equilibrium at the position shown:



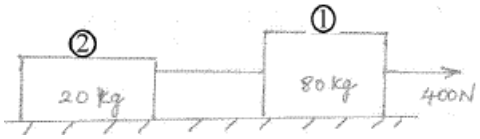
6. A block of 10 kg mass rests on a rough horizontal surface, whose co-efficient of kinetic friction is 0.2. It is being pulled by a constant force of 50 N as shown in Figure. Determine the velocity and distance travelled by the block after 5 seconds.



2014–15 (Sem. I) (NME102)

1. Principle of work and energy.

2. Two bodies of masses 80 kg and 20 kg are connected by a thread along a rough horizontal surface under the action of a force 400 N applied to the first body of mass 80 kg as shown in Fig. The coefficient of friction between the sliding surfaces of the bodies and plane is 0.3. Determine the acceleration of two bodies and tension in the thread using D'Alembert's principle.



2014–15 (Sem. I) (EME102) [COP]

1. For which point on the rigid body, is the Newton's second law applicable?

2. Define impulse.

2014–15 (Sem. I) (ME101) [COP]

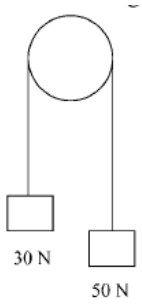
1. What do you understand by moment of momentum?

2. State and prove Law of conservation of energy.

3. Two bodies of weight 50 N and 30 N are connected to the two ends of a light inextensible string. The string is passing over a smooth pulley as shown in figure. Determine:

(i) The acceleration of the system, and

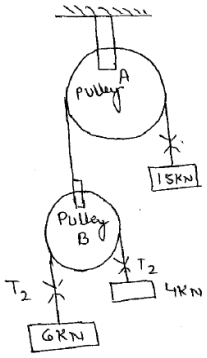
(ii) Tension in the string. Take $g = 9.8$ m/sec^2.



2014–15 (Sem. II) (NME202)

1. State and explain D'Alemberts Principles.

2. A system of weight connected by string passing over pulleys A and B shown in fig. Find the acceleration of three weights. Assuming string is weightless and ideal condition for pulleys.



3. Write short notes on:

(i) Principle of work and energy.

(ii) Law of conservation of energy.

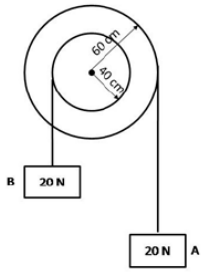
(iii) Law of conservation of linear momentum.

(iv) Plane motion of rigid bodies.

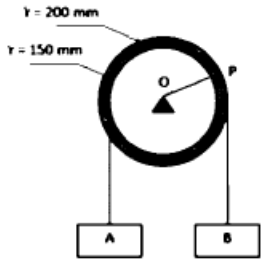
2014–15 (Sem. II) (EME202) [COP]

1. Explain the concept of dynamic equilibrium?

2. Two weights, each of 20 N, are suspended from a two-step pulley as shown in figure. Find the acceleration of the weight A and B using D'Alembert's principle. The weight of the pulley is 200 N and its radius of gyration is 200 mm.

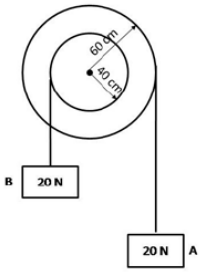


3. A double pulley supports two blocks A and B as shown in figure. The block A is moving downwards and has an acceleration of $0.3t$ m/s^2 and an initial velocity of 0.5 m/s. At time $t = 5$ s, determine acceleration of point P.



2014–15 (Sem. II) (ME201) [COP]

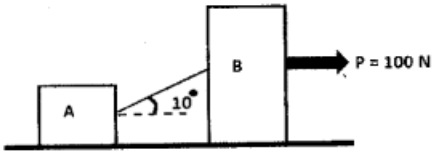
1. Explain the concept of dynamic equilibrium?
2. Two weights, each of 20 N, are suspended from a two step pulley as shown in figure. Find the acceleration of the weight A and B using D'Alembert's principle. The weight of the pulley is 200 N and its radius of gyration is 200 mm.



3. A 50 kg block kept on top of a 15° slopping surface is pushed down the plane with an initial velocity of 20 m/s. if coefficient of kinetic friction is 0.4, determine the distance travelled by the block and the time it will take as it comes to rest.

2014–15 (Sem. I) (NME202/NME102/EME202/EME102) [SCOP]

1. Explain D'Alembert's principle with suitable example.
2. Two bodies *A* and *B* of masses 5 kg and 20 kg. are connected by an inclined string. A horizontal force *P* of 100 N is applied to block *B*. Calculate the tension in the string and acceleration of the system. Take coefficient of friction for all surfaces as 0.25. Refer figure.



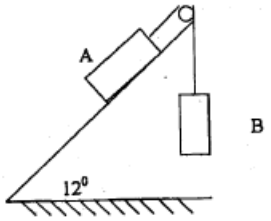
2015–16 (Sem. I) (NME102)

1. What do you understand by Work-Energy principle?
2. State D-Alembert's principle.

2015–16 (Sem. I) (EME102) [COP]

1. State D, Alembert's principle.
2. State work-energy principle. Also describe rotational motion of body.
3. A car weighing 11 kN and running at 10 m/sec holds three men each weighing 700 N. the men jump off from the back end gaining a relative velocity of 5 m/sec with the car. Find the speed of car if three men jump off (i) all together (ii) in succession.

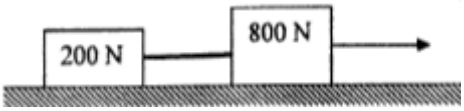
4. A body weighing 1200 N rests on a rough plane inclined at 12° to horizontal. It is pulled by a flexible rope running parallel to the plane and passing over a frictionless pulley. The portion of rope hangs vertically down and carries weight 800 N Fig. If the coefficient of friction is 0.2 find tension in rope and acceleration with which body moves up.



5. A step pulley starts from rest and accelerates by 2 rad/s^2. Inner radius is 0.6 m and outer radius is 1 m. Two blocks *A* and *B* are attached to inner and outer pulley respectively. Find out time required for block *A* to move 20 m. also find out velocities of both blocks.

2015–16 (Sem. I) (ME101) [COP]

1. State the D'Alembert's principle.
2. A bullet of 10 gm is fired into a body mass of 1 kg which is suspended by a string 1 m long. The bullet is embedded in the body & due to impact, the body swings through an angle of 18.2°. Find the velocity of the bullet.
3. Two blocks weighing 800 N and 200 N and connected by a thread, are pulled by 400 N forces on a rough horizontal surface as shown in figure given below. If coefficient of friction between blocks and plane is 0.3. Using D'Alemberts principle and also by using work energy principle determine acceleration of the blocks and tension in thread.



2015–16 (Sem. II) (NME202)

1. Write, down the conservation of energy principle.
2. A right circular cylinder of mass *m* and radius *r* is suspended from a cord that is wound round its circumference. If the cylinder is allowed to fell freely, find acceleration of its mass centre *G* and tension in the cord.

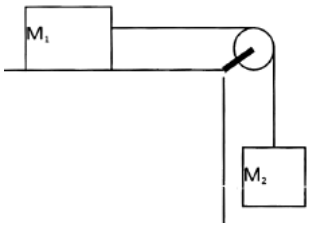
2015–16 (Sem. II) (EME202) [COP]

1. Explain the principle of work and Energy.
2. Explain D' Alembert principle with example.
3. Write down the principle of conservation of momentum.
4. A bullet weighing 4 N is fired horizontally in to a wooden block weighing 300 N, which is hanging from the ceiling by a wire, 3 m long. The bullet gets embedded in the block and causes the block to swing forward such that the wire makes an angle

of 30° with the vertical. Determine the velocity of the bullet before striking the block and the loss of energy in the process.

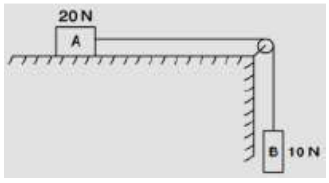
2015–16 (Sem. II) (ME201) [COP]

1. Write down the work energy principle.
2. Explain the principle of virtual work.
3. Write down the principle of conservation of Linear momentum.
4. A string is wound several time around a solid cylinder of 2 kg mass the free end of the string is fixed to ceiling and the cylinder is released from rest. Determine the velocity after it has fallen through a height of 2 m. In addition, determine tension in the string.
5. A block mass M_1 resting on a rough horizontal plane is pulled by an inextensible string, whose other end is attached to a block of mass M_2 and passing over a pulley as shown in fig. Assume the pulley to be frictionless and mass less. If the coefficient of kinetic friction between the plane and the block is μ, derive the expression for the acceleration of the system and tension in the string. If M_1 = 3 kg, M_2 = 2kg and μ = 0.2 them determine the acceleration of the system and tension in the string.



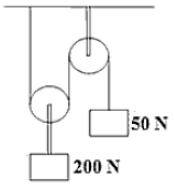
2016–17 (Sem. II) (NME202/EME202/ME201) [COP]

1. Two blocks shown in Fig have weight A = 20 N and B = 10 N and the coefficient of friction between the block A and the horizontal plane is 0.25. If the system is released from rest, and the B falls through a vertical distance 2 m, what is the velocity attained by the block B. Neglect the friction in the pulley and the extension of the string.

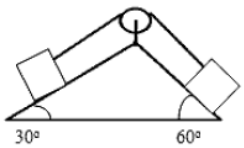


2017–18 (Sem. I) (NME102/EME102) [COP]

1. Find the tension in the string and acceleration of blocks A and B weighing 200 N and 50 N respectively, connected by a string and frictionless and weightless pulley as shown in figure.

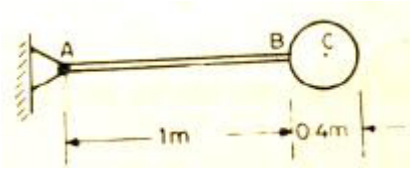


2. Two equal weight of 3000 N are lying on two inclined planes connected by a string passing over a frictionless pulley as shown. Using D'Alembarts principle, find the acceleration of the weights and tension in the string. μ = 0.2 for wedge.



2017–18 (Sem. II) (NME202) [COP]

1. Define the D'Alembert's principle.
2. State the Work-Energy principle and Impulse momentum principle.
3. What is Instantaneous centre and discuss; how to locate it.
4. A cylinder weighing 500 N is welded to a 1m long uniform bar of 200 N weight as shown in figure. Determine the acceleration with which the assembly will rotate about point *A*, if released from horizontal position. Determine the reaction at *A* at this instant.



2017–18 (Sem. II) (EME202) [COP]

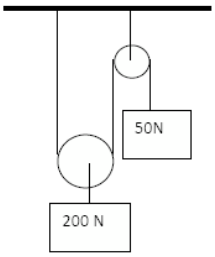
1. An elevator cage of a mineshaft, weighing 5 kN, is lifted or lowered by means of a wire rope. Starting from rest, it moves upwards with constant acceleration and acquires a velocity of 3 m/s within a distance of 3 m. Calculate the tensile force in the cable during the accelerated motion.
2. A flywheel is rotating freely clockwise at a speed of 2000 rpm. An anticlockwise torque is applied on the flywheel producing an angular acceleration defined by $\alpha = 6t$ rad/s^2. Determine the (a) time required to reduce clockwise angular speed to 1000 rpm, (b) time required to reverse direction of rotation, and (c) total number of revolutions during the first 12 sec. of the movement.

2018–19 (Sem. I) (NME102/EME102) [COP]

1. State D'Alembert's principle.
2. State and derive Impulse-Momentum equation.
3. A pulley of weight 400 N has a rod of 0.6 m. A block of 600 N is suspended by a tight rope wound round the pulley. Other end being attached to the pulley. Determine acceleration of weight and tension in the rope.

2018–19 (Sem. II) (NME202/EME202) [COP]

1. Write D'Alembert's principle.
2. State the law of conservation of momentum.
3. Determine the tension in the string and accelerations of blocks *A* and *B* weighing 200 N and 50 N connected by an inextensible string as shown in fig. Assume pulleys as frictionless and weightless.



2019–20 (Sem. I) (NME102/EME102) [COP]

1. State and prove work energy principle.