PILLAI COLLEGE OF ENGINEERING, NEW PANVEL 210422

(Autonomous) (Accredited 'A+' by NAAC)

END SEMESTER EXAMINATION

SECOND HALF 2021(Supplementary)

SEM-I

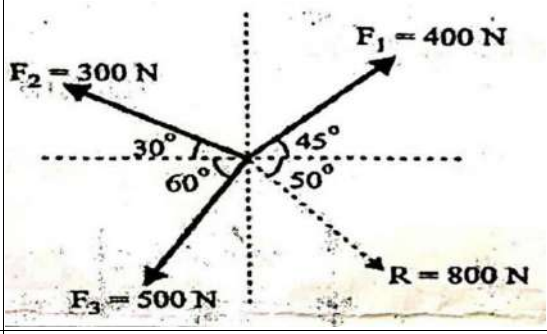
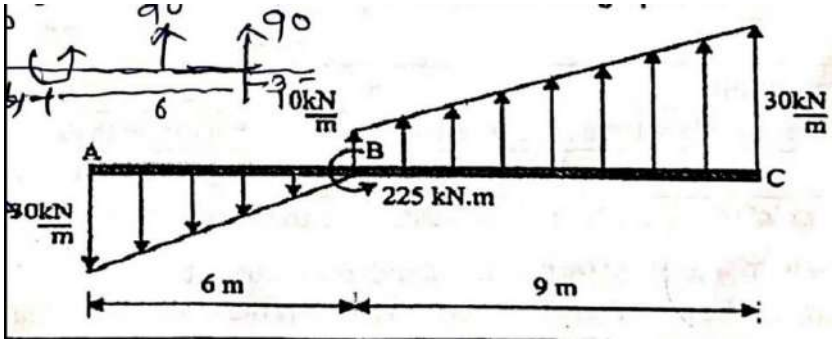
BRANCH: FE (Mech/Auto/EXTC)

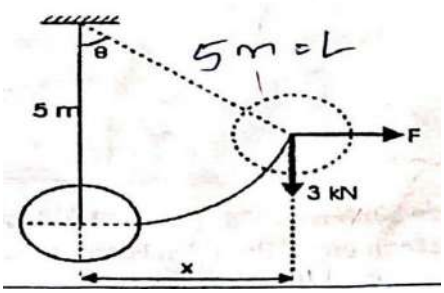
Subject: Engineering Mechanics — Time: 02.00 Hours

Max. Marks: 60 — Date: 02-06-2022

N.B 1. Q.1 is compulsory — ME 104, AE 104, ET104

2. Attempt any two from the remaining three questions

Q.1.	Attempt all	Answers
a)	Find Force F4 so as to give the resultant of system of forces as shown . 	F4 = 961.62 Θ = 39.58 4th Quadrant ∑f(x) = + ∑f(y) = -
b)	Members ABC is loaded with Different loads Find the Magnitude of the Resultant and its locations along Span AC 	R = 90 M = 2070(anti-clock) X = 23
c)	Determine the magnitude and Directions of the force F=34i+150j-290kN	F = √Fx+F y+Fz = 475 Fx = FcosΘx = Θx=43.42 Θy=71.59 Θz=127.62

d)	Determine the horizontal distance 'x' to which a 5m long inextensible string holding a weight 3 kN can be. Pulled before the string breaks. The string can withstand a maximum force 6 kN as shown in fig determine also required force 'F' 	Theorem Θ = 60 F = 5.2km X = 4.33

Q.2.	Attempt all	Answers
a)	Differentiate between Centre of Gravity (CG) and Centroid With example and also Explain the Moment of inertia with Fig and example.	

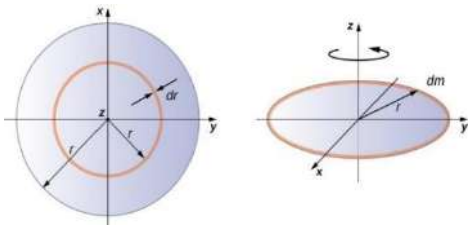
Centre of Gravity	Centroid
The point where the total weight of the body focuses upon	It is defined to the geometrical centre of a body
It is the point where the gravitational force (weight) acts on the body	It is defined to the centre of gravity of uniform density objects
It is denoted by g	It is denoted by c
It is a physical behaviour of the object, a point where all the weight of an objectis acting	It is a physical behaviour of the object, a point where all the weight of an objectis acting

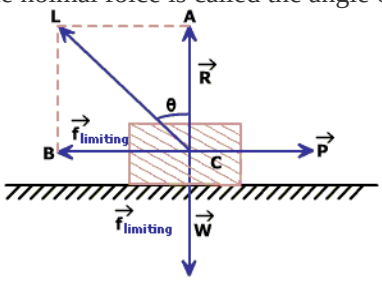
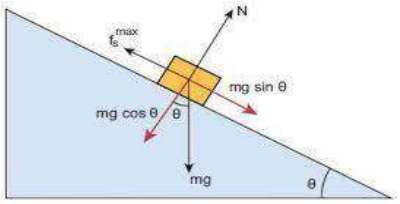
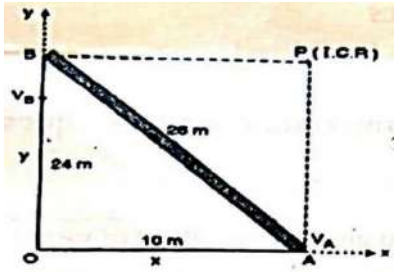
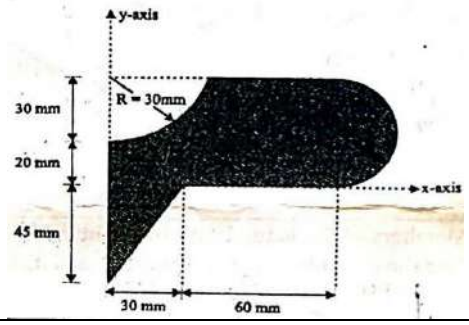
Moment of Inertia is the sum of the product of each point mass and square of its distance from the axis of rotation.

Example:Imagine you are on a bus right now. You find a seat and sit down. The bus starts moving forward. After a few minutes, you arrive at a bus stop and the bus stops. What did

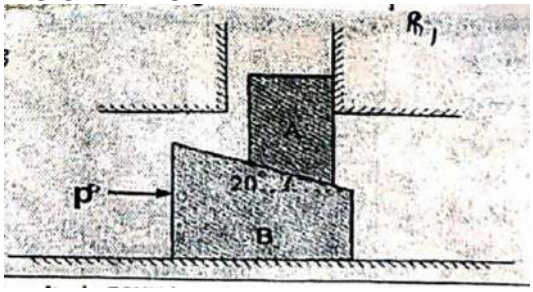
upper body moved forward whereas your lower body did not move.Why is that? It is because of Inertia. Your lower body is in contact with the bus but your upper body is not in contact

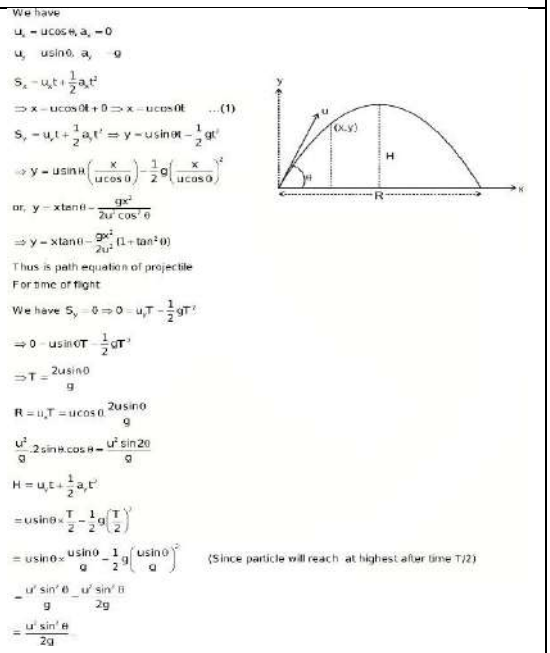
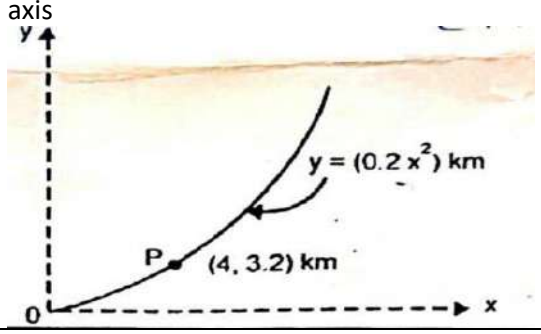
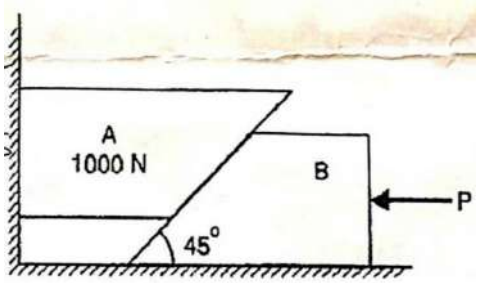
r body stopped with the bus but your upper body kept moving forward, that is, it resisted change in its state.



b)	Define and explain the terms, Angle of Friction and Angle of Repose with Fig and example	Angle of Friction : Definition : The angle between the resultant of frictional force and the normal reaction makeswith the normal force is called the angle of friction.  Angle of friction Angle of Repose: Definition : Angle of repose is defined as the angle that an inclined plane makes with the horizontal when a body placed on it just starts sliding.  Figure 3.29 Angle of repose
c)	A rod 'AB' 26m long leans against a vertical wall. The end 'A' of the rod is 10mtrs from the wall. Determine the velocity of the end 'B' sliding down vertically and the angular velocity of the rod AB  	X = 10 y = 24 L = 26 VA=24 mt/sec $X^2 + Y^2 = C^2$ VB = -10 w = 1 rod/sec counter clockwise
d)	Locate Centroid of the given Lamina  	X = 54.87 Y = 18.45

Q3)	Attempt all	
a)	State and explain lame"s theorem and Varigno's theorem with example	Lami's theoíem íelates the magnitudesof coplanaí, concuíient and non- collineaí foíces that maintain an objectin static equilibíium. ľhe theoíem is veíy useful in analyzing most of the mechanical as well as stíuctuíal systems. Lami's ľheoíem states, "When thíeefoíces acting at a point aíe in equilibíium, then each foíce is píopoítional to the sine of the angle between the otheí two foíces". Refeíiing to the above diagíam, consideí thíee foíces A, B, C acting on apaíticle oí íigid body making angles α, βand γ with each otheí. Varignon's theorem states that the sum of the moments produced by any two concurrent forces with respect to a point is equal to the moment produced by the resultant with respect to the same point. This theorem is also known as theorem of moments. The moment produced by R with respect to a moment center O is R x d. The summation of the moments of F1 and F2 with respect to the same moment center O is F1 d1 + F2 d2. Then as per Varignon's theorem, R d = F1 d1 + F2 d2 (state an example)
b)	Explain velocity , average velocity , acceleration , average acceleration with figure.	Velocity- Velocity is essentially a vector quantity. It is the rate of change of distance. It is the rate of change of displacement. Speed of an object moving can never be negative. The velocity of a moving object can be zero. Averageg velocity- Average velocity is defined as **the change in position or displacement (∆x) divided by the time intervals (∆t) in which the displacement occurs**. The average velocity can be positive or negative depending upon the sign of the displacement. The SI unit of average velocity is meters per second (m/s or ms^{-1}) Acceleration- In mechanics, **acceleration** is the rate of change of the velocity of an

		object with respect to time. Accelerations are vector quantities (in that they have magnitude and direction). Average Acceleration- Average acceleration refers to **the rate at which the velocity changes**. We divide the change in velocity by an elapsed time to find out the average acceleration of anything. For instance, if the velocity of a crazy ball increases from 0 to 60 cm/s in 3 seconds, the average acceleration of the ball would be 20 cm/s/s.
c)	A block 'A' supports a load of W=5000N and is to be raised by forcing Wedge 'B' under it . The angle if friction for all surfaces in contact. Determine the force P which is necessary to start the wedge under the block .The block & Wedge have negligible weight 	Block A→ R2 =7281.23 Block B→R1= 6169 μ = 0.27 Φ=15 P=6003.58 R3= 0.595 x 7281.23 =_4332.33_____
d)	A force of magnitude 50KN is acting at a point A(2,3,4)m towards point B(6,-2,-3)m . Find the moment of the given force about a point D(-1,1,2)	Sa=3i + 2j + 2k $F=F_1\ e_{AB}$ =50[4i-5s-75 / √(4^2 + 5^2 +72) =21.08J - 26.35J – 36.89k $m_{D=}\ r_{DA}$ *F = 21.08i + 152.85 - 121.2k
Q4.	Attmept all	
a)	State and explain the Projectile Motion with formula of trajectory.	When a body is thrown with velocity making some angle with horizontal,it follows parabolic trajectory called projectile. At general time ,velocity of the particle will be vcosθi^+(vsinθ−gt)j^ vx=vcosθ vy=(vsinθ−gt) X=vcosθt Y=vsinθt−2gt2

		Eliminating t,Y=vsinθ/vcosθx−(g * x^2)/(2v^2cos^2θ) Y=xtanθ−(g * x^2)/(2v^2cos^2θ) is called equation of trajectory.
b)	Derive formulas for max height range and time of flight of projectile motions.	
c)	An airplane travels on a crushed path point ‘P’. It has a speed of 360m/hr which is increasing at a rate of 0.5 mtrs/sec^2 . Determine at ‘P’. The Magnitude of total acceleration Angle made by m acceleration vector with positive x-axis 	p = [1+(dy/dx)^2]^3/2 = 16.792cm dy^2/dx^2=16792m dt = 0.5 m/s^2 a = 0.777m/s^2 eqn = dy/dx=0 dy/dx=ϕ.6 x=4 tanθ =an/dt = 0.595/0.5 = θ = 50 tanα=dy/dx tanα=1.6 α=58 α+θ=108
d)	Block ‘A’ weighing 100N is to be raised by applying a horizontal force ‘P’ on another block ‘B’ of samee weight as shown in fig . Calculate the minimum value of ‘P’ to pish block ‘A;up the surface take co-efficient of fraction =0.25 at all surfaces . 	P=3536 N2=3233 N1=0.883*3233 N3=2714