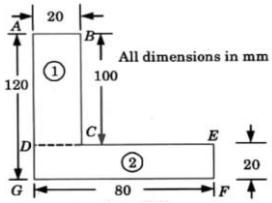
JHARKHAND Rai University
RANCHI

End Semester/Reappear (Semester III) Examination December, 2024

Programme:B.Tech (MiE)
Course:Engineering Mechanics **Full Marks: 70**
Course Code: 8ESC201 **Time: 3 Hrs.**
Enrolment no. _____

Q.No.	Questions	CO	Bloom Taxonomy Category	Marks
	Section I			
1	**Short Answer type questions.**			**4 x 5 = 20**
a	State triangle law of forces and polygon law of forces.	CO1	Understand	
	or			
	State the characteristics of force. Distinguish between concurrent force system & non-current force system.	CO1	Understand	
b	Define Limiting friction, angle of friction, angle of repose and co-efficient of friction.	CO2	Understand	
	or			
	A body of weight 450 N is pulled up an inclined plane, by a force of 300 N. The inclination of the plane is 30° to the horizontal and the force is applied parallel to the plane. Find the coefficient of friction.	CO2	Apply	
c	Explain parallel axis theorem and perpendicular axis theorem with diagram.	CO3	Understand	
	or			
	What is moment of inertia and radius of gyration?	CO3	Remember	
d	A bullet of mass 0.1 kg and travelling at a speed of 180 m/s penetrated 10 cm when fired into a wooden log. Determine the velocity with which this bullet would emerge when fired the same velocity into a similar 5 cm thick wooden plank. Also determine the force of resistance assuming it to be uniform.	CO4	Apply	
	or			
	A particle, starting from rest, moves in a straight line, whose equation of motion is given by: $s = t^3 - 2t^2 + 3$. Find the velocity and acceleration of the particle after 5 seconds.	CO4	Apply	
	Section II			
Long Answer type questions. Answer any three.				**3 x 10 = 30**
2	State and prove parallelogram law of forces. A triangle ABC has its side AB = 40 mm along positive x-axis and side BC = 30 mm along positive y-axis. Three forces of 40 N, 50 N and 30 N act along the sides AB, BC and CA respectively. Determine magnitude of the resultant of such a system of forces.	CO1	Evaluate	
	or			
	Determine the magnitude and direction of the resultant of the following set of forces acting on a body (i) 200 N inclined 30° with east towards north. (ii) 250 N towards the north, (iii) 300 N towards north west, and (iv) 350 N inclined at 40°.	CO1	Apply	
3	Derive moment of inertia of a rectangular section of width 'b' and depth 'd'. Find the moment of inertia of a hollow rectangular section about its Centre of gravity if the external dimensions are breadth 60 mm, depth 80 mm and internal dimensions are breadth 30 mm and depth 40 mm respectively.	CO3	Evaluate	
	or			

	The moment of inertia of rectangular section beam about x-x and y-y axes passing through the centroid are 250 x and 40 x respectively. Calculate the size of the section.	CO3	Apply	
4	A train weighing 2 x N starts from rest with an acceleration of 0.8 m/ and acquires a speed of 90 km/hr. Determine the kinetic energy corresponding to final speed and the average power required.Subsequently the power is shut off and the train is subjected to a retarding force equal to 8 % of the weight of train. Calculate the distance the train will travel before coming to rest.	CO5	Apply	
	or			
	A block of weight 2000 N rests on a rough horizontal surface ($\mu = 0.2$) and is pulled by a force of 800 N applied at an angle of 30˚to the horizontal. Determine the velocity attained by the block after it has moved 20 m starting from rest. Proceed to calculate the further distance moved by the body if the pull is removed. Use work-energy relation.	CO5	Evaluate	
	Section III			
	Application based questions.			
5	a. A screw jack has mean diameter of 60 mm and pitch of 12 mm. If the co-efficient of friction between its screw and nut is 0.15. Find the effort required at the end of 800 mm long handle to raise a load of 15 kN. Also find the effort to lower the same load.	CO2	Evaluate	**1 x 20 = 20**
	b. Locate the centroid of L- section as shown in figure. 			
	or			
	a. Derive the equation for equilibrium of a body on a rough inclined plane subjected to a force acting at an angle θ with the inclined plane.	CO2	Apply	
	b.Elaborate the laws of friction. A body of weight 300 N is lying on a rough horizontal plane having a coefficient of friction as 0.3. Find the magnitude of the force, which can move the body, while acting at an angle of 25° with the horizontal.		Analyze	

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Course Outcome:

On the completion of the Course, the students will be able to:

CO1 To understand the basic concepts of force systems & its various force analysis.

CO2 Understand the static equilibrium of particles and rigid bodies both in two dimensions and three dimensions.

CO3 Analyze the properties of surfaces & solids in relation to moment of inertia.

CO4 Illustrate the laws of motion, kinematics of motion and their interrelationship.

CO5 Understand Kinetics of Rigid Bodies & Free and forced vibrations.