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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B,Tech.

SEM: III - THEORY EXAMINATION (2022 - 2023)

Subject: Engineering Mechanics

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of three Sections -A, B, & C. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.
2. Maximum marks for each question are indicated on right -hand side of each question.
3. Illustrate your answers with neat sketches wherever necessary.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.
6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION A

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1. Attempt all parts:-

- 1-a. What is the direction of the resultant vector if two vectors having equal magnitude are placed in the Cartesian plane at the origin as, one being parallel to and heading towards positive x-axis and the other making 165° with it and heading in the opposite direction to that of the first one? (CO1) 1
- (a) It is either in the 1st quadrant or in the 2nd quadrant
 - (b) It is either in the 1st quadrant or in the 3rd quadrant
 - (c) It is either in the 1st quadrant or in the 4th quadrant
 - (d) Only in the 1st quadrant
- 1-b. For a hinged support..... (CO1) 1
- (a) The beam is free to move and rotate, so only normal reaction will develop.
 - (b) The beam can not move but can rotate about the support, so there are two reactions.
 - (c) There is no movement or rotation, so there are three reactions
 - (d) None of the above
- 1-c. The free body diagram used to explain the theory of dry friction is having _____ 1

distribution of both the normal forces and frictional surface. (CO2)

- (a) Uneven
- (b) Even
- (c) Uniform
- (d) Equal

1-d. A machine raised a load of 360 N through a distance of 200 mm. The effort, a force of 60 N moved 1.8 m during the process. Calculate mechanical advantage. (CO2) 1

- (a) 6
- (b) 7
- (c) 8
- (d) 9

1-e. In a simply supported beam carrying a uniformly distributed load over the left half span, the point of contra flexure will occur in (CO3) 1

- (a) Left half span of the beam
- (b) Right half span of the beam.
- (c) Quarter points of the beam
- (d) Does not exist

1-f. Trusses are subjected to stress. (CO3) 1

- (a) Compressive
- (b) Tensile
- (c) Lateral
- (d) Direct

1-g. The point at which the total area of a plane figure is assumed to be concentrated is called (CO4) 1

- (a) Centroid
- (b) Centre of gravity
- (c) Central point
- (d) Inertial point

1-h. What will be the the radius of gyration of a circular plate of diameter 10cm? (CO4) 1

- (a) 1.5cm
- (b) 2.0cm
- (c) 2.5cm

- (d) 5cm
- 1-i. When a body of mass moment of inertia I (about a given axis) is rotated about that axis with an angular velocity, then the kinetic energy of rotation is (CO5) 1
- (a) $0.5 I.\omega$
- (b) $I.\omega$
- (c) $0.5 I.\omega^2$
- (d) $I.\omega^2$
- 1-j. The wheels of a moving car possess (CO5) 1
- (a) potential energy only
- (b) kinetic energy of translation only
- (c) kinetic energy of rotation only
- (d) kinetic energy of translation and rotation both.

2. Attempt all parts:-

- 2.a. Solve the following: A force vector $F = 700i + 1500j$ is applied to a bolt. Determine the magnitude of the force and angle it forms with the horizontal. (CO1) 2
- 2.b. A bullet of mass 80 gm moving with a velocity of 250 m/s is fired into a block of wood and gets embedded in it to a depth of 20 cm. What will be the resistance offered by the wood ? (CO2) 2
- 2.c. What is the Shear Force and Shear Force Diagram? (CO3) 2
- 2.d. State the relationship between the second moment of area and mass moment of inertia of a uniform plate. (CO4) 2
- 2.e. Define Co-efficient of restitution. (CO5) 2

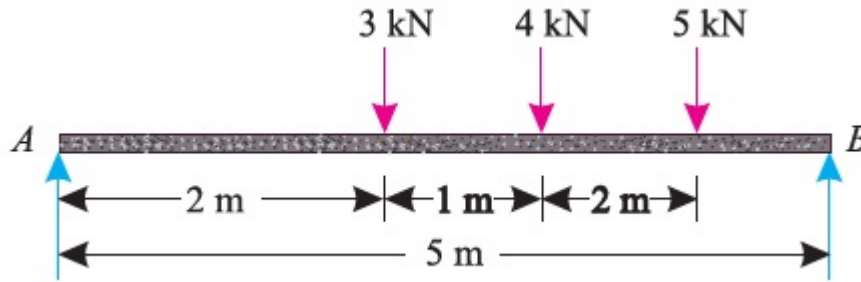
SECTION B 30

3. Answer any five of the following:-

- 3-a. A couple of moment 60Nm acts in the plane of a paper. Indicate this couple with 30N forces. (CO1) 6
- 3-b. Given $A = 2i - 3j - 1k$ and $B = 1i + 4j - 2k$. Find $A.B$ and $A \times B$. (CO1) 6
- 3-c. Explain the following with examples : (CO2) 6
- (i) Simple machines
- (ii) Compound machines.
- 3-d. A body which weights 1000 N rests on a horizontal plane, the co-efficient of friction between the body and the plane being 0.1. Find the force, which acting at 30° to the 6

horizontal will just move the body. (CO2)

- 3.e. A simply supported beam AB of span 5 m is loaded as shown in Figure below. Find the reactions at A and B. (CO3) 6



- 3.f. Find the center of gravity of a semi-circular section having the outer and inner radii of 20 cm and 16 cm respectively. (CO4) 6
- 3.g. A ball is projected vertically upwards with a velocity of 20 m/sec. Three seconds later a second ball is projected vertically upward with a velocity of 30 m/sec. At what height will they meet above the earth's surface ? (CO5) 6

SECTION C

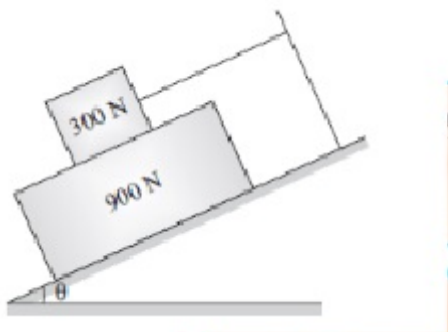
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4. Answer any one of the following:-

- 4-a. The following forces (all pull) act at a point : (i) 25 N due North ; (ii) 10 N North-East ; (iii) 15 N due East ; (iv) 20 N 30° East of South ; (v) 30 N 60° South of West. Find the resultant force. What angle does it make with East ? (CO1) 10
- 4-b. A machine weighing 1500 N is supported by two chains attached to some point on the machine. One of these chains goes to the eye bolts in the wall and is inclined 30° to the horizontal and other goes to the hook in ceiling and is inclined at 45° to the horizontal. Find the tensions in the two chains. (CO1) 10

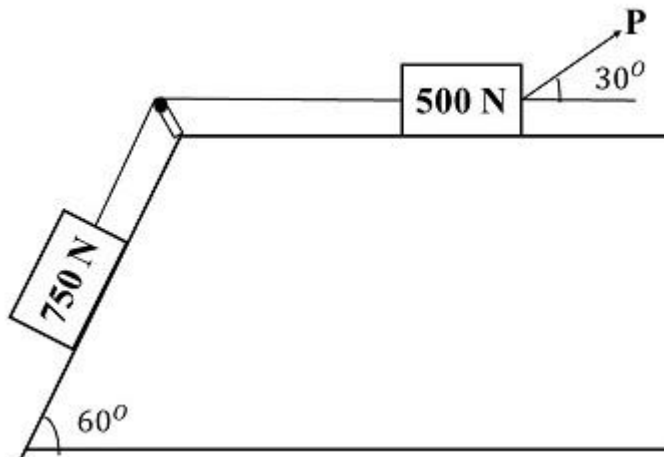
5. Answer any one of the following:-

- 5-a. What should be the value of θ in Figure below which will make the motion of 900 N block down the plane to impend? The coefficient of friction for all contact surfaces is $1/3$. (CO2) 10



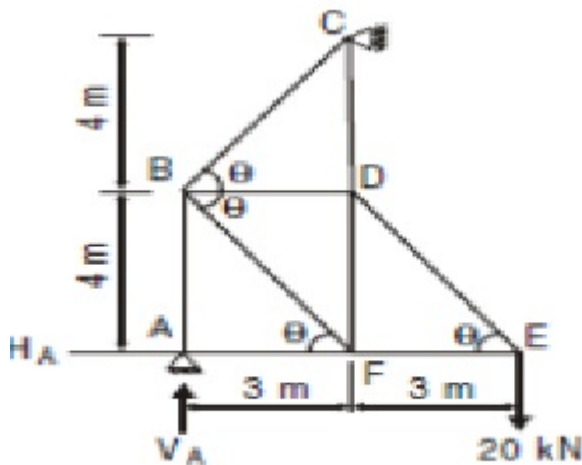
- 5-b. What will be the value of P in the system shown in Figure below to cause the motion to impend? Assume the pulley is smooth and the coefficient of friction between the other 10

contact surfaces is 0.2. (CO2)

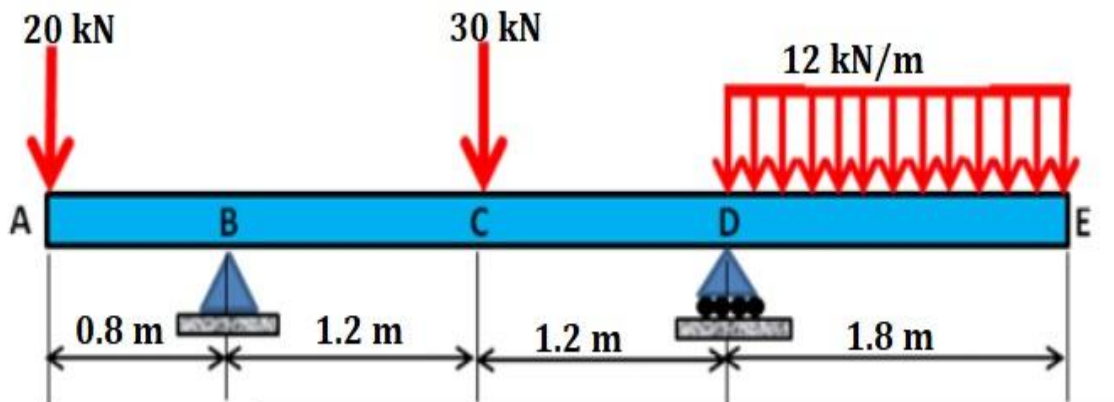


6. Answer any one of the following:-

- 6-a. Determine the forces in all the members of the trusses shown in Figure below. Indicate the nature of forces using the convention tension as +ve and compression as -ve. (CO3) 10



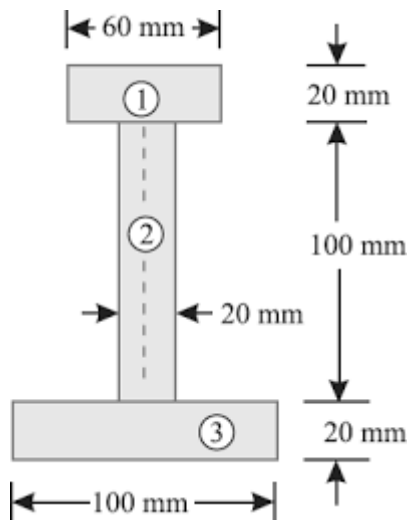
- 6-b. Draw the shear force and bending moment diagram of the following:- (CO3) 10



7. Answer any one of the following:-

- 7-a. Determine the mass moment of inertia of a rectangular plate of size $a \times b$ and thickness 't' about its centroidal axes XX, YY and ZZ. (CO4) 10

- 7-b. Determine the moment of inertia of the symmetric I-section shown in Figure below. about its centroidal axis x-x and y-y. (CO4) 10



8. Answer any one of the following:-

- 8-a. The rotor of an electric motor uniformly accelerates to a speed of 1800 rpm from rest in 5 seconds and then it decelerates uniformly to stop. If the total time elapsed from start to stop is 12.3 seconds, determine the number of revolutions made while acceleration and deceleration. What would be the reason for the longer time taken during stopping? (CO5) 10
- 8-b. A cylinder of diameter 0.4 meter, weighing 500N is welded to a 1m long uniform bar of 200N weight as shown in figure below. 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. (CO5) 10

