SOMAIYA
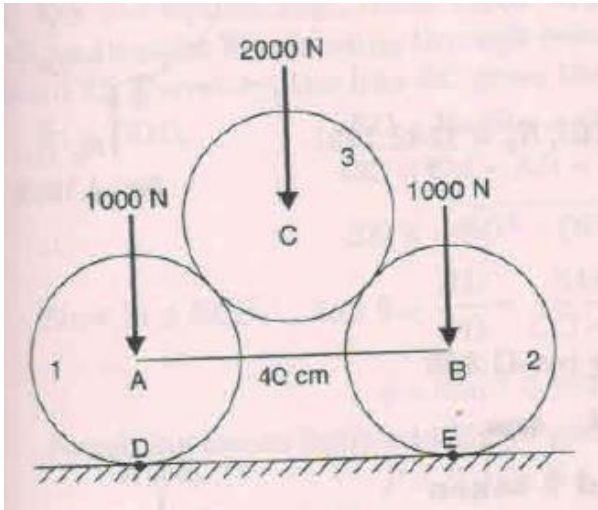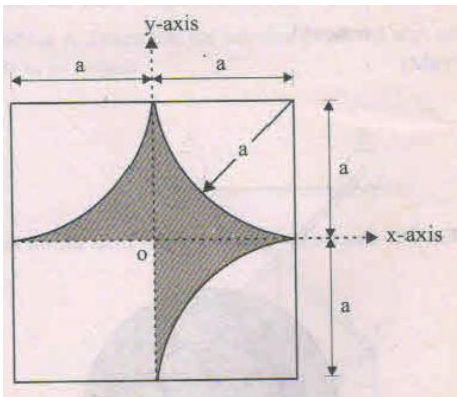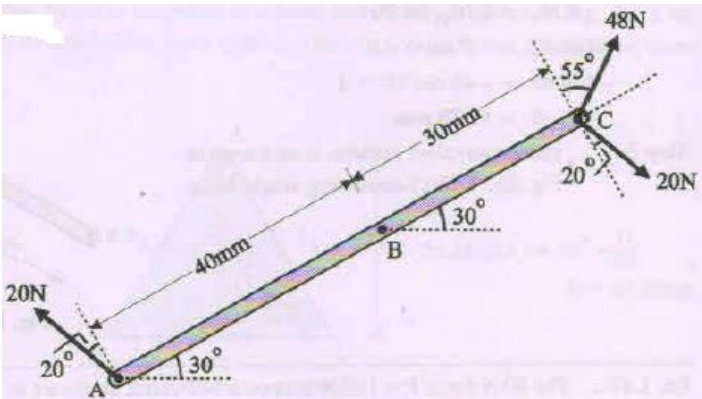VIDYAVIHAR UNIVERSITY

Semester: September 2020 – January 2021 Examination: ESE Examination			
Programme code: 01 Programme: B.TECH		Class: FY	Semester: I (SVU 2020)
Name of the Constituent College: K. J. Somaiya College of Engineering		Name of the Department ETRX/EXTC/MECH	
Course Code: 116U06C104	Name of the Course: Engineering Mechanics		
Duration : 1 Hour 45 Minutes	Maximum Marks : 50		
Instructions: 1)Draw neat diagrams 2) Assume suitable data if necessary			

Question No.			Max Marks
Q1 (A)	1.	Determine the magnitude of resultant of the two forces of magnitude 12 N and 9 N acting at a point, if angle between these two forces is 30°. a) 18.3 N b) 19.3 N c) 20.3 N d) 21.3 N	1
	2.	Choose the appropriate statement for law of polygon of forces a) If number of forces acting at a point can be represented in direction and magnitude by sides of polygon taken in to order, then the forces are in equilibrium b) If number of forces acting at a point can be represented by sides of polygon taken in to order, then the forces are in equilibrium c) If number of forces acting at a point can be represented in magnitude and direction by sides of polygon, then the forces are in equilibrium d) If polygon is representing forces acting at a point is closed, then forces are in equilibrium	1
	3.	Application of D'Alembert's principle is a) Reducing the problem of kinetics to equivalent static problem b) Determining the forces in truss c) Stability of floating bodies d) Designing safe structures	1
	4.	A cantilever beam subjected to uniformly distributed load on entire span length, then at fixed end there will be a) Vertical reaction only b) Vertical reaction and moment c) Vertical reaction and horizontal reaction d) Horizontal reaction, vertical reaction and moment	1

	5.	Select not appropriate statement from the following a) Tangent of angle of friction is equal to coefficient of friction b) Angle of repose is equal to angle of friction c) Tangent of angle of repose is equal to coefficient of friction d) Sine of angle of repose is equal to coefficient of friction	1
	6.	The maximum frictional force which comes in to play when body just begins to slide over another surface is called as a) Limiting friction b) Sliding friction c) Rolling friction d) Kinematic friction	1
	7.	A body moves from rest with constant acceleration of $5m/sec^2$.the distance covered in 5 seconds is a) 38 m b) 62.5 m c) 96 m d) 124 m	1
	8.	When velocities of two bodies are equal in magnitude and opposite in direction, then relative velocity of one w. r. t. other is a) Zero b) Double the velocity of each body c) Half the velocity of each body d) Not able to predict	1
	9.	In work energy principle the gravity force does no work when a) Body movers along vertical plane b) Body moves along inclined plane c) Body moves along horizontal plane d) Body moves along vertical or horizontal plane	1
	10.	Movement of a block resulted in to compression of spring by 50 mm. What will be work done by spring. Figure 1A.10 a) 0.875 N.m b) 1.875 N.m c) 2.875 N.m d) 3.875 N.m	1

Q1 (B)	Attempt any FIVE questions out of the following (any 5 out of 7)	10
	1. A lamp weighing 5 N is suspended from the ceiling by a chain. It is pulled aside by a horizontal chord until the chain makes and angle of 60° with ceiling. Find the tension in the chain.	2
	2. Describe different types of supports used for beams.	2
	3. Explain D'Alembert's principle.	2
	4. The position of particle which moves along a straight line is defined by the relation $x = t^3 - 6t^2 - 15t + 40$. Where x is in meters and t is in seconds. Determine the time at which the velocity will be zero.	2
	5. A particle is traversing a curved path of radius 300 m with a speed of 108 kmph and a tangential acceleration 4 m/s^2. Determine magnitude of total acceleration of particle.	2
	6. A train moving at speed of 12.5m/s is hit by a stone thrown at right angles to it with a velocity of 6.25 m/s. Find the velocity of stone appears to hit the train.	2
	7. Explain the work energy principle for a particle.	2
Q. 2	Two smooth cylinders, each of 1000 N weight and radius of 15 cm, are connected by string AB of 40 cm length and supporting above them a third cylinder of weight 2000 N and radius of 15 cm as shown in Figure 2. Find the force S in the string AB and reaction produced on the floor at point D and E.	10

Figure 2

Q. 3	a) Find the x coordinate of centroid of shaded area shown in Figure 3a.1. (Assume a = 50 mm)	5
Figure 3a.1	
	OR	
	a) There are three forces acting on lever as shown in Figure 3a.2. Replace the three forces with an equivalent force-couple system at point B.	5
Figure 3a.2	
	b) The acceleration of an oscillating particle is defined by the relation as a = - kx. Determine, the value of k such that v = 15 m/sec when x = 0 and v = 0 when x = 3 m.	5
	OR	
	b) At the position shown in Figure 3b.1, the crank AB has velocity of 3 rad/sec clockwise. Find the velocity of slider C using ICR method.

Figure 3b.1 | 5 |

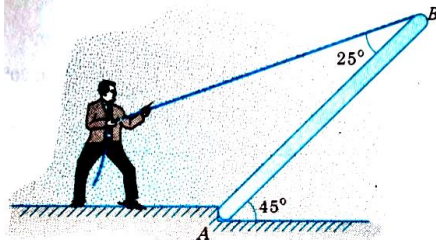| Q. 4	The velocities of trains A and B are as shown in Figure 4. Knowing that speed of each train is constant and that B reaches the crossing 10 minutes after A passed the same crossing, determine
	   a. Relative velocity of B w.r.t. A
	   b. Distance of train B from crossing when train A reaches crossing.
	
	Figure 4.1
		10

	OR	
	A 4 kg collar M is attached to a spring slides on smooth bent rod ABCD as shown in Figure 4.2. The spring has constant k = 500 N/m and is undeformed when the collar is at C. If the collar is released from rest at A. Determine the velocity of collar when it passes through B and C. Also determine the distance moved by collar beyond point C before to rest again. Figure 4.2	10

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Semester: February 2021 –May 2021 Examination: ESE Examination		
Programme code: 01 Programme: B.TECH	Class: FY	Semester: I/ II (SVU 2020)
Name of the Constituent College: K. J. Somaiya College of Engineering		Name of the Department: All
Course Code: 116U06C104	Name of the Course: Engineering Mechanics	
Duration : 1 Hour 45 Minutes	Maximum Marks : 50	

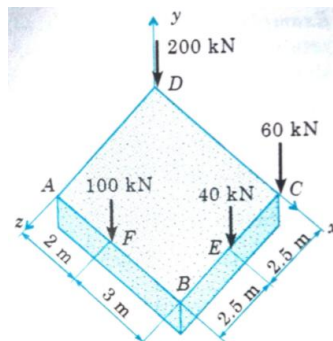**Instructions:**
1) Draw neat diagrams
2) Assume suitable data if necessary

Question No.		Max Marks
Q1 (A)	Answer the following	10
	1. Lami's theorem can be applied to	
	a) two concurrent forces	
	b) three concurrent forces	
	c) three parallel forces	
	d) any number of forces	
	2. If the resultant of five forces acting at point O (Refer following figure) is zero, then angle θ will be	
	a) 15.15°	
	b) 12.26°	
	c) 90°	
	d) 13.74°	
	3. The Y coordinate of centroid for the figure given below is,	
	a) $4r/3\Pi$	
	b) $\Pi r^2/4$	
	c) 0	
	d) r	
	4. The coefficient of friction represents the ratio of	
	a) frictional force to the normal reaction	
	b) normal reaction to the frictional force	
	c) mass to the normal reaction	
	d) mass to the frictional force	

	5. A goods train travels at v = 20[1 - e^{-t}] m/s, where t is time in seconds. The acceleration of train at time 3 sec will be a) 1.27 m/s^2 b) 0.996 m/s^2 c) 0.867 m/s^2 d) 0.776 m/s^2 6. A car is travelling along a circular curve that has a radius of curvature of 50 m. If the speed of the car is 16 m/s and is increasing uniformly the rate of 8 m/s^2. The normal component of acceleration is a) 8 m/s^2 b) 2 m/s^2 c) 5.12 m/s^2 d) 9.5 m/s^2 7. The motion of the particle with respective to moving reference is called as a) absolute motion b) projectile motion c) uniform motion d) relative motion 8. If we add _____ to the system of forces then the state of equilibrium is created which is called dynamic equilibrium. a) weight force b) resultant force c) parallel force d) D'Alembert's force 9. The work done by external force is positive if the displacement is a) opposite to the direction of applied force b) in the direction of applied force c) zero d) against gravity 10. The energy is conserved and there will be no loss of kinetic energy in case of a) plastic impact b) semi-elastic impact c) elastic impact d) always	
Q1 (B)	Attempt **any FIVE** questions out of the following (any 5 out of 7) 1. A man raises a 10 kg joist of length 4 m by pulling on a rope. Find the tension T in the rope as shown in figure below. 2. List the different types of system of forces and explain any one of them. 3. Derive an equation for law of conservation of momentum.	10

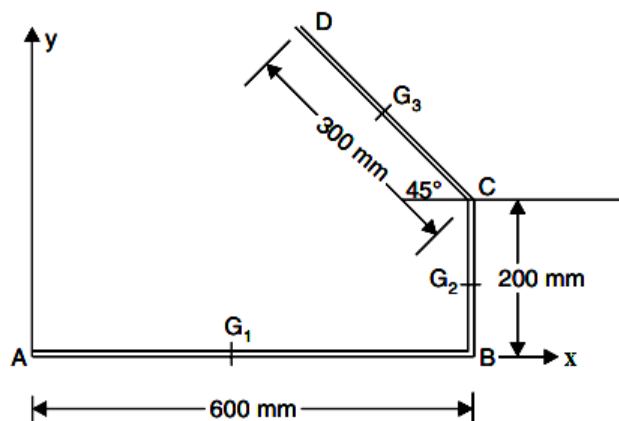|		
	4. A car starts from rest on a curved road of radius 250 m and accelerates at a constant tangential acceleration of 0.6 m/s^2. Determine the velocity of car before the magnitude of the total acceleration attained by it becomes 0.75 m/s^2. 5. Explain the concept of work of spring. Also explain when it will be positive and when it will be negative. 6. Determine the components of the force exerted at C as shown in the figure if the tension in the cable BC is 500 N. 7. A square foundation mat supports the four columns as shown in figure. Determine the magnitude of resultant of four loads. 	
Q. 2	20 N block A and 30 N block B are supported by an incline plane which is held in position as shown in figure. Knowing that the coefficient of friction is 0.15, between the two blocks and zero between block B and incline, determine the value of θ for which motion is impending. 	10
Q. 3	Solve **any two** of following (5 marks each) a. Determine the centroid of the wire as shown in the figure. 	10
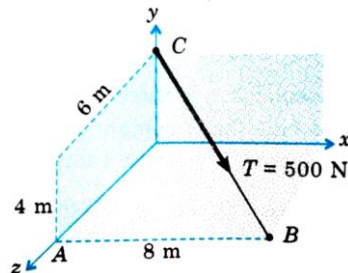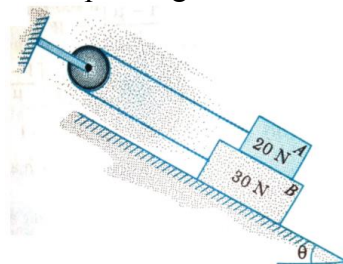
b. The beam AB supports two concentrated loads and rests on the soil which exerts a linearly distributed reaction as shown in the figure. If W_A = 18 kN/m, determine the distance a and the corresponding value of W_B in kN/m.

24 kN
a

30 kN
0.3 m

A
B

$W_A =$
18 kN/m

W_B kN/m

1.8 m
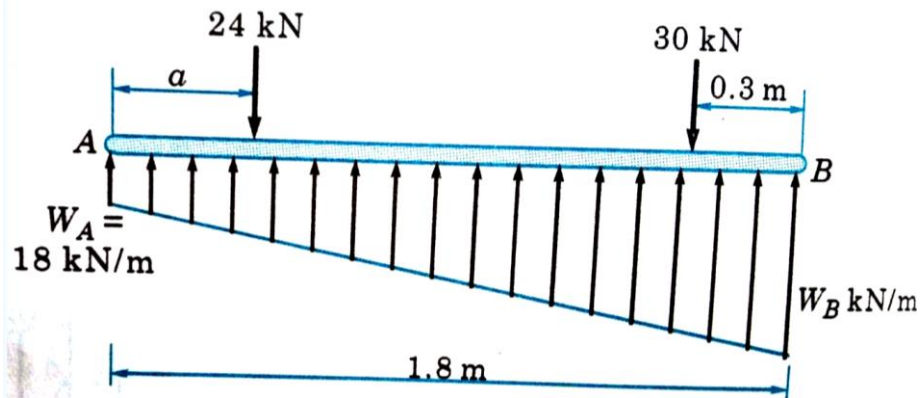
c. Figure shows a-t diagram for a particle moving along x-axis. Draw v-t diagram and find the speed of particle at time t=50 seconds.

a (m/s^2)

12

8

4

0

20

40

50   t (s)
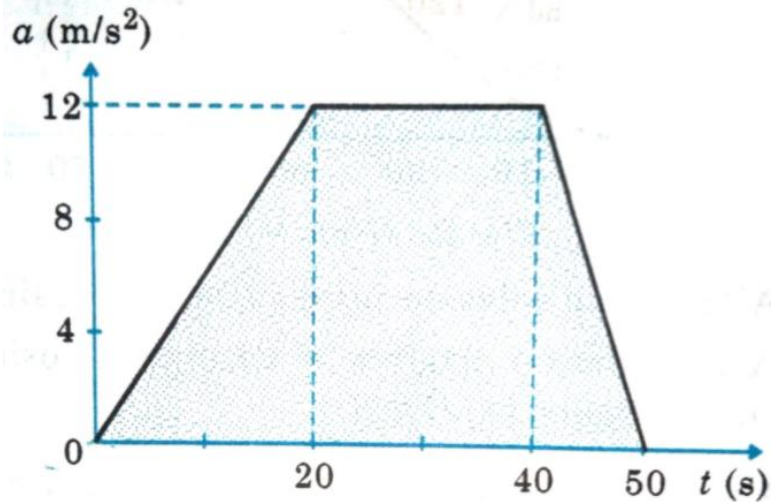
d. For the link and slider mechanism shown in figure, locate the instantaneous centre of rotation of link AB. Find also the angular velocity of link OA.

$v_B = 2500$ mm/s

B

30°

400 mm

A

200 mm

O
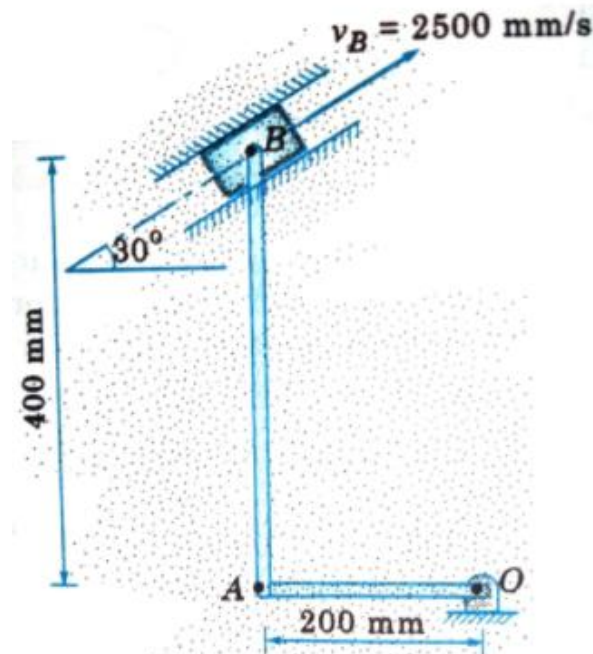
| Q. 4 | Two smooth balls of mass A 3kg and ball B of mass 4kg are moving with velocities 25m/s and 40 m/s respectively at an angle of 30° and 60° with the vertical as shown in figure. If the coefficient of restitution between two balls is 0.8, find the magnitude and direction of velocities of these balls after impact. | 10 |
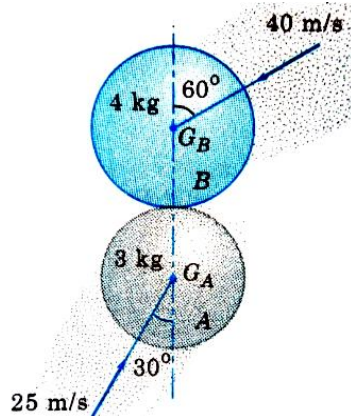
OR

Planes A and B are flying at the same altitude. If their velocities are V_A = 600 kmph and V_B = 500 kmph when the angle between their straight line course is 30° as shown. Determine the velocity of plane A with respect plane B. Also determine the distance between them in t=5 min.
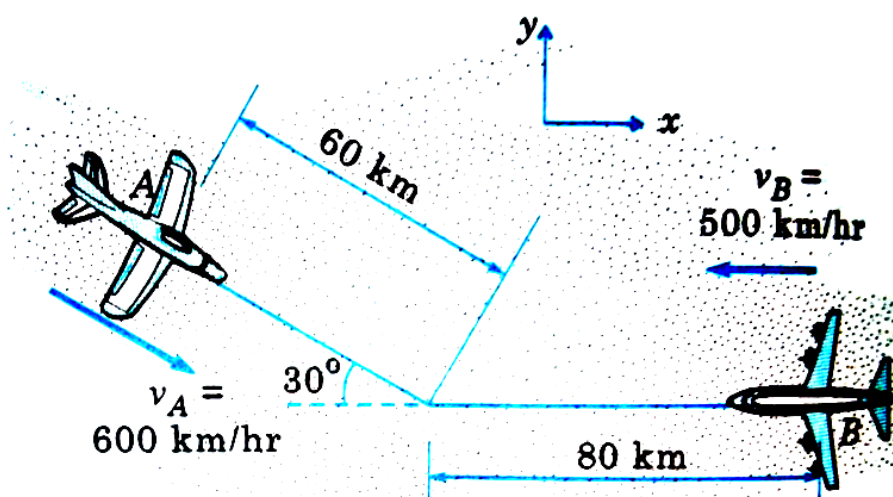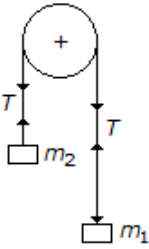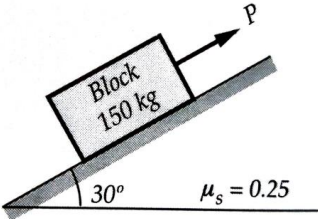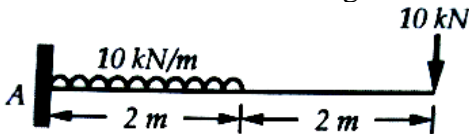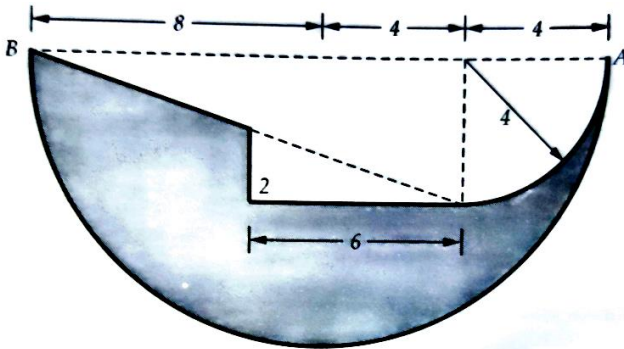
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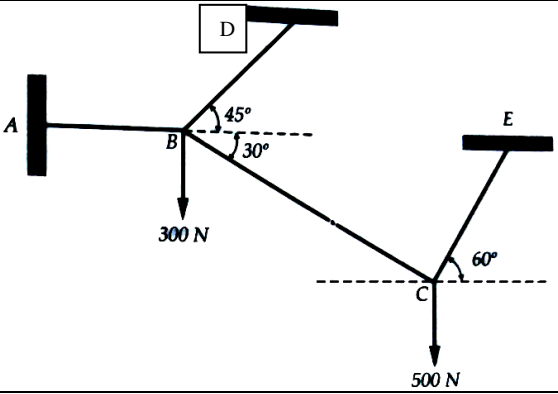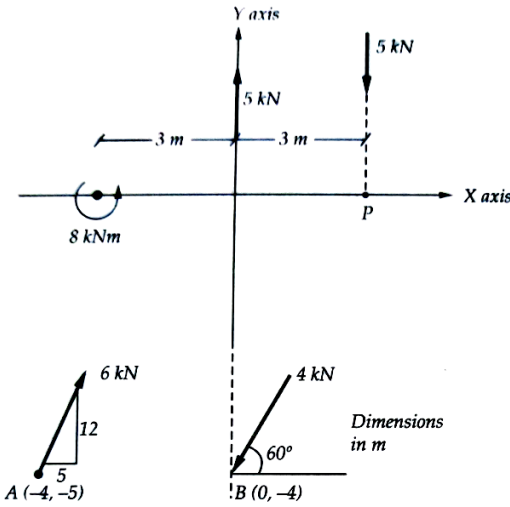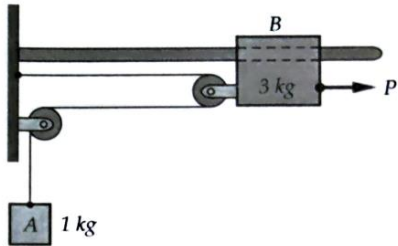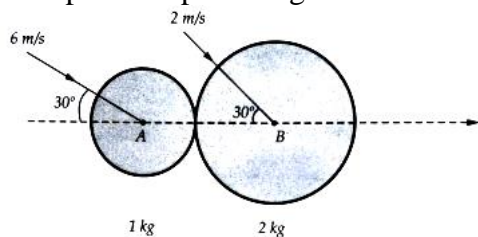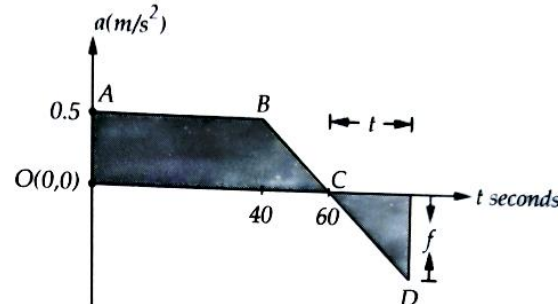
Semester: September 2021 – Feb 2022 Examination: ESE Examination			
Programme code: 01 Programme: B.TECH		Class: FY	Semester: I (SVU 2020)
Name of the Constituent College: K. J. Somaiya College of Engineering		Name of the Department ETRX/EXTC/MECH	
Course Code: 116U06C104	Name of the Course: Engineering Mechanics		
Duration : 1 Hour 45 Minutes	Maximum Marks : 50		
Instructions: 1)Draw neat diagrams 2) Assume suitable data if necessary			

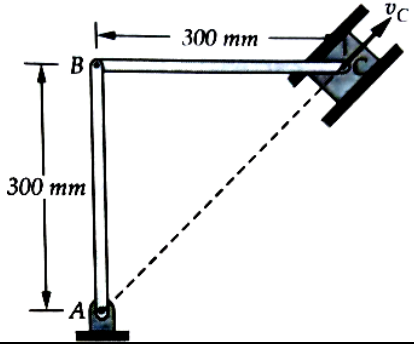| Q. No		Marks
Q.1A	Multiple choice questions (1 mark each)	10
	1. What is the position of a particle A, if it moves along a path $y = 2x^3 / 3$ with uniform velocity of 15 m/s? (Assume $v_x = v_y$) a. (0.33, 0.5) b. (0.235, 0.707) c. (0.577, 20.33) d. (0.707, 0.235)	1
	2. A car moves along a circular arc at a speed of 30 m/s, if speed of the car is increased at the rate of 50 m/s^2, what is the resultant acceleration of the car? (Radius of arc =15 m) a. 78.10 m/s^2 b. 58.10 m/s^2 c. 60.23 m/s^2 d. 33.16 m/s^2	1
	3. Two cars X and Y move on adjacent roads in opposite directions. If velocity of car X and Y is 80 km/hr and 60 km/hr respectively, then what will be the relative velocity of car X w.r.t. Y? a. 70 km/hr b. 100 km/hr c. 140 km/hr d. 120 km/hr	1
	4. During elastic impact, the relative velocity of the two bodies after impact is _____ the relative velocity of the two bodies before impact. a. equal to b equal and opposite to c. less than d. greater than	1
	5. If the masses of both the bodies, as shown in the below figure, are reduced to 50 percent, then tension in the string will be	1

a. same
b. half
c. double
d. none of above

	6. If two concurrent forces A and B acting on a point are 200 N and 300 N. What is the magnitude of resultant force, if it makes an angle of 50^0 with each force? a. 471.08 N b. 455.12 N c. 400.56 N d. 300 N	1
	7. Which of the following laminas do not have centroid at its geometrical centre? a. Circle b. Equilateral triangle c. Right angled triangle d. None of the above	1
	8. A block is displaced by 3 m when a force of 200 N is applied on it on an inclined surface which is at an angle of 50^0 with the horizontal. What is the work done? a. 385.67 Nm b. 459.62 Nm c. 933.00 Nm d. 600 Nm	1
	9. The radial component of velocity for a particle moving in circular path is _____ a. constant b. radius itself c. variable d. zero	1
	10. What is the maximum distance traveled by a block moving upwards on an inclined plane of 30^0 with velocity of 20 m/s, if coefficient of friction is 0.23 between the block and inclined plane? a. 29.19 m b. 22.56 m c. 17.32 m d. 17.00 m	1
Q.1B	Attempt any **FIVE** questions out of the following (**Any 5**)	10
	1. A block of mass 150kg is resting on plane inclined at 30^0 with horizontal as shown in figure. Determine minimum value of P required to maintain equilibrium. Take $\mu_s = 0.25$.	2

	2.	State and explain varignon's theorem with suitable example.	2
	3.	A force F=9i + 6j – 15k acts through the origin. What is the magnitude of the force and the angle it makes with X, Y and Z axis.	2
	4.	The motion of particle moving in a straight line is given by the expression s = $t^3 - 3t^2 + 2t + 5$. Where s is in meters and t is in seconds. Determine a) velocity and acceleration after 4 seconds b)maximum or minimum velocity.	2
	5.	A motorist travelling at a speed of 72km/h suddenly applies brakes and come to stop after skidding 30m. Determine a) Time required by car to stop and b)The coefficient of friction between tires and road surface.	2
	6.	Find reactions for cantilever beam shown in fig. fixed at A.	2
	7.	A 40kg block A connected to a 60kg block by a spring of constant k=180N/m. The blocks are placed on a smooth horizontal surface and are at rest when spring is stretched 2m. If they are released from rest determine speeds of block at the instant spring become unstretched.	2
Q.2	A thin lamina with uniform thickness is shown in fig. Locate the centroid with respect to point A.		10
Q.3	(A) Figure shows system of cables in equilibrium condition under two vertical loads of 300N and 500N. Determine forces developed in the different segments.		5

		OR	
	(A)Replace the force and couple system shown in fig by and equivalent single force and moment at point 'P'		5

Q.3	(B)The slider block C is moving at 1.2m/s up the incline as shown in fig. Determine angular velocity of links AB and BC and velocity of point B at the instant shown.	5

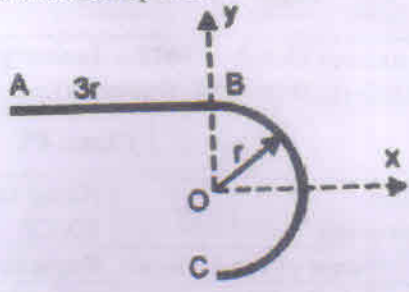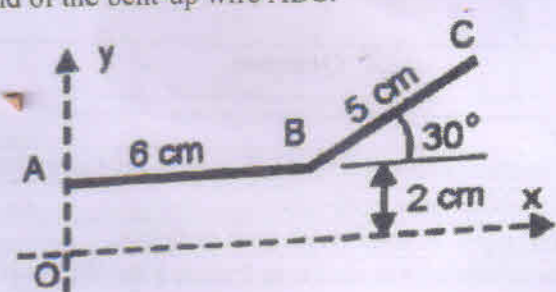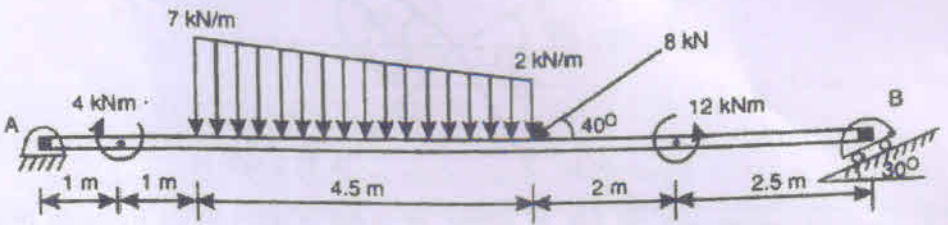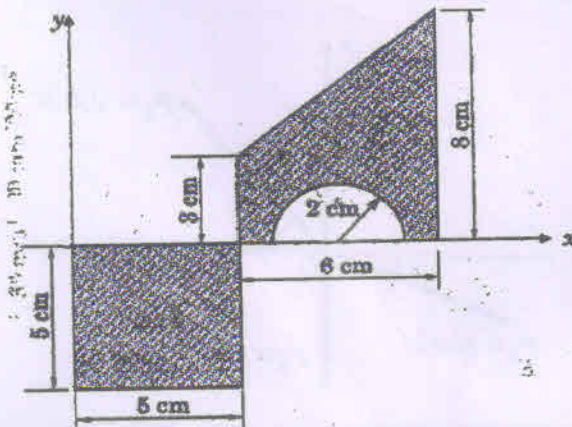|	OR	
	(B)The system shown in fig. is initially at rest. Neglecting friction determine a) The force P required if the velocity of collar B is to be 5m/s after 2 seconds. b) The corresponding tension in the cable.	5

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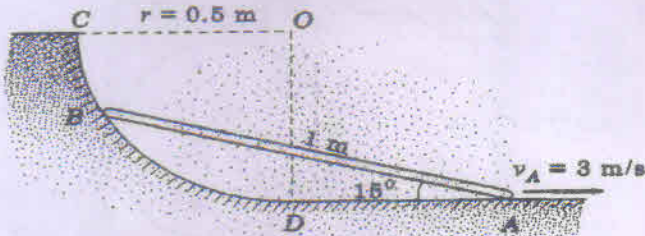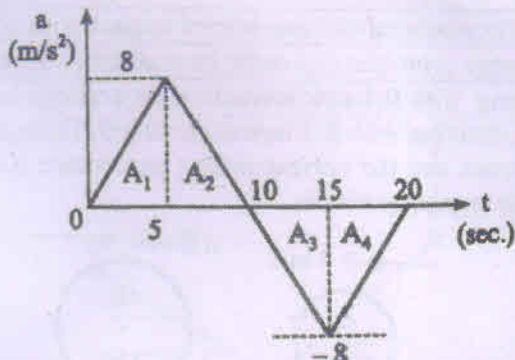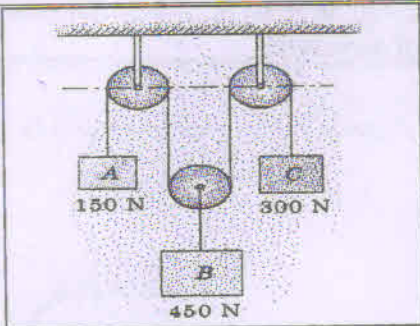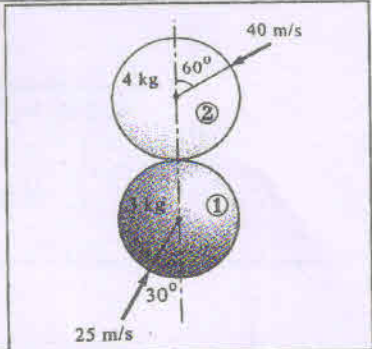|		
Q.4	A ball of mass 1kg moving with a velocity of 6m/s strikes another ball of mass 2kg moving with velocity of 2m/s. At the instant of impact the velocities of two balls are inclined at 30^0 to the line joining their centers as shown in fig. If the coefficient of restitution is 0.5 find the velocity and direction of two balls after impact. Also calculate loss in KE due to impact and percentage of loss. 	10
	OR	
	The fig. shows a-t diagram for a car which starts from rest and comes to halt after time (60+t) seconds. Find the value of 't' and 'f' shown in diagram. Find velocity and distance travelled at all time and plot v-t and s-t curve. 	10

13.2.2023 (M)
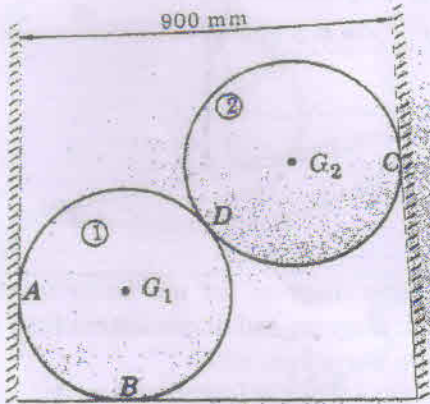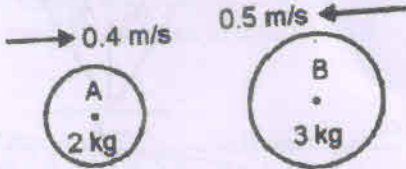
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VIDYAVIHAR UNIVERSITY

Semester: October 2022 – January 2023		
Maximum Marks: 100	Examination: ESE Examination	Duration:3 Hrs.
Programme code: 01 Programme: B.Tech	Class: FY	Semester:I (SVU 2020)
Name of the Constituent College: K. J. Somaiya College of Engineering	Name of the department:COMP / IT / EXCP	
Course Code: 116U06C104	Name of the Course: Engineering Mechanics	
Instructions: 1)Draw neat diagrams 2) All questions are compulsory 3) Assume suitable data wherever necessary		

Que. No.	Question	Max. Marks
Q1	Attempt any **Four**	20
i)	Describe angle of friction and cone of friction with neat sketches.	5
ii)	Discuss on elastic and inelastic collision.	5
iii)	Discuss on different types of loads with neat sketches.	5
iv)	$R = 800$ N is the resultant of 4 concurrent forces. Find the fourth force F_4?	5

| v) | A force of magnitude 50 kN is acting at point A $(2,3,4)$ m towards point B $(6,-2,-3)$ m. Find the moment of the given force about a point D $(-1,1,2)$ m. | 5 |
| vi) | If the resultant of five forces acting at point O is zero, determine the force P_1 and angle θ as shown in figure. | 5 |

1/4

Q2 A	Solve the following	**10**
i)	Determine the centroid of the bent-up wire in terms of r.	5

ii)	Locate the centroid of the bent-up wire ABC.	5

OR

Q2 A	The beam AB is loaded by forces and couples as shown. Find the reaction force offered by the supports to keep the system in equilibrium.	10

Q 2 B	Solve any **One**	**10**
i)	Find the coordinates of centroid for the shaded area shown in figure.	10

ii)	State and prove Varignon's Theorem.	10

Q3	Solve any **Two**	**20**
i)	Bar AB is 1 m long. End A of the bar moves with a velocity of 3 m/s on the horizontal plane. End B travels along circular path CD of radius 0.5 m. Find the velocity of B for the given position. 	10
ii)	For the acceleration time diagram for the linear motion is shown in figure. Construct velocity time diagram and displacement time diagram for the motion. Assume that the motion starts from rest. Solve the problem by motion curve (graphical) method. Also show type (nature) of each curve on all the diagrams. 	10
iii)	A particle moves along a hyperbolic path $\frac{x^2}{16} - y^2 = 28$. If the x-component of velocity is $V_x = 4$ m/s and remains constant, determine the magnitudes of particles velocity and acceleration when it is at point (32,6) m.	10
Q4	Solve any **Two**	**20**
i)	Three weights A, B and C are connected as shown in figure. Determine the acceleration of each weight and tension in the string. Given : $W_A = 150$ N, $W_B = 450$ N and $W_C = 300$ N. 	10
ii)	Two smooth balls of ball 1 of mass 3 kg and ball 2 of mass 4 kg are moving with velocities 25 m/s and 40 m/s respectively at an angle of 30^0 and 60^0 with the vertical as shown in figure. If coefficient of restitution between two balls is 0.8, find the magnitude and direction of velocities of these balls after impact. 	10

iii)	Two smooth spheres of weight 100 N and of radius 250 mm each are in equilibrium in a horizontal channel of width 900 mm as shown. Find the reaction at the surface of contact A, B, C and D , assuming all the surfaces to be smooth.	10

		20
Q5	Attempt any **four**	
i)	Discuss on Direct central and oblique central impact with neat sketches.	5
ii)	Explain Work energy principle and write its mathematical expression.	5
iii)	A 2 kg ball moving with 0.4 m/s towards right collides head on with another ball of mass 3 kg, moving with 0.5 m/s towards left. Determine the velocities of the balls after impact and the corresponding percentage loss of kinetic energy, when the impact is perfectly elastic.	5
iv)	Discuss on different types of supports with neat sketches.	5
v)	Discuss on laws of friction.	5
vi)	A particle travels on a circular path whose arc distance travelled is defined by $s = (0.5t^3 + 3t)$ m. If the total acceleration is 10 m/s^2 at t = 2 sec., find the radius of curvature?	5