# University of Mumbai

## Examination 2020 under cluster 3 (Lead College: FCRIT)

**Examinations Commencing from 23rd December 2020 to 6th January 2021 and from 7th January 2021 to 20th January 2021**

Program: F.E. (All branches) (Choice Based)

Curriculum Scheme: Rev2019

Examination: FE Semester I

Course Code: FEC104 and Course Name: Engineering Mechanics

Time: 2 hours Max. Marks: 80

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| **Q1.** | **Choose the correct option for following questions. All the Questions are compulsory and carry equal marks** |
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| | |
| 1. | The forces, which do meet at a point but lie in a single plane, are known as |
| Option A: | Coplanar concurrent forces |
| Option B: | Coplanar non-concurrent forces |
| Option C: | Non-coplanar concurrent forces |
| Option D: | Non-coplanar non-concurrent forces |
| | |
| 2. | A force P acts from point 'A' and passes through point 'B'. The moment of force 'P' about point 'O' is 2000 N-m clockwise and zero at 'A' and 'B'. What is the magnitude of force 'P' if coordinate of A, B and O are (0, 0,5) m, (0.4, 0) m and (0,0,0) respectively. |
| Option A: | P = 641.03 N |
| Option B: | P = 540.65 N |
| Option C: | P = 680.24 N |
| Option D: | P = 560.65 N |
| | |
| 3. | Which of the following is not a projectile |
| Option A: | a bullet fired from a rifle |
| Option B: | a bomb dropped from an aeroplane |
| Option C: | hydrogen balloon floating in air |
| Option D: | a boy throw a ball oblique with vertical. |
| | |
| 4. | A train enters curve of radius 800 m with a speed of 20 m/s, what will be the magnitude of tangential and normal acceleration at the instant the brakes are applied so that the train stops by covering a distance of 500 m along the curve. |
| Option A: | tangential acceleration = 0.4 $m/s^2$, normal acceleration = 0.5 $m/s^2$ |
| Option B: | tangential acceleration = 0.4 $m/s^2$, normal acceleration = - 0.5 $m/s^2$ |
| Option C: | tangential acceleration = - 0.4 $m/s^2$, normal acceleration = - 0.5 $m/s^2$ |
| Option D: | tangential acceleration = - 0.4 $m/s^2$, normal acceleration = 0.5 $m/s^2$ |
| | |
| 5. | The point at which the total area of a plane figure is assumed to be concentrated is called |
| Option A: | Centre of gravity |
| Option B: | Central point |
| Option C: | Centroid |
| Option D: | Inertial point |

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| 6. | Find the centroid of the semicircle of radius 10 cm with center at the origin lying in the first and second quadrants. |
| Option A: | (0, - 4.246 cm) |
| Option B: | (0, 4.246 cm) |
| Option C: | ( - 4.246 cm, 0) |
| Option D: | (4.246 cm, 0) |
| | |
| 7. | Kinematics of the rigid body is |
| Option A: | Study of geometry of motion considering the cause of motion |
| Option B: | Study of external forces acting on it without considering the geometry of motion |
| Option C: | Study of geometry of motion without considering the cause of motion |
| Option D: | Finding the reaction forces and moments at the supports |
| | |
| 8. | A rod AB 26 m long leans against a vertical wall. The end A on the floor is drawn away from the wall at a rate of 24 m/s, when the end A of the rod is 10 m from the wall. What is the velocity of end B sliding down vertically. |
| Option A: | velocity of end B = 57 m/s |
| Option B: | velocity of end B = 10 m/s |
| Option C: | velocity of end B = 24 m/s |
| Option D: | velocity of end B = 12 m/s |
| | |
| 9. | If three non parallel forces are in equilibrium then it should be |
| Option A: | collinear force system |
| Option B: | general force system |
| Option C: | non-concurrent force system |
| Option D: | concurrent force system |
| | |
| 10. | A beam ABCD of 20 m long supported on two intermediate supports at B and C, 12 m apart, carries two concentrated load of 30 kN at left end A and 50 kN at right end D. How far away should the first support B be located from end A so that the reactions at both the supports are equal. |
| Option A: | support B be located from end A = 5.5 m |
| Option B: | support B be located from end A = 6.5 m |
| Option C: | support B be located from end A = 7.5 m |
| Option D: | support B be located from end A = 8.5 m |
| | |
| 11. | According to _____ the algebraic sum of external force and inertia force is equal to zero. |
| Option A: | D'alembert's principle |
| Option B: | Law of Conservation of Momentum |
| Option C: | Work Energy Principle |
| Option D: | Principle of Transmissibility of Forces |
| | |
| 12. | A motorist travelling at a speed of 70 km/hr suddenly applied brakes and halts after skidding 50 m. What is the acceleration of the motorist? |
| Option A: | Accerleration = - 2.78 $m/s^2$ |
| Option B: | Accerleration = 2.78 $m/s^2$ |
| Option C: | Accerleration = - 3.78 $m/s^2$ |
| Option D: | Accerleration = 3.78 $m/s^2$ |

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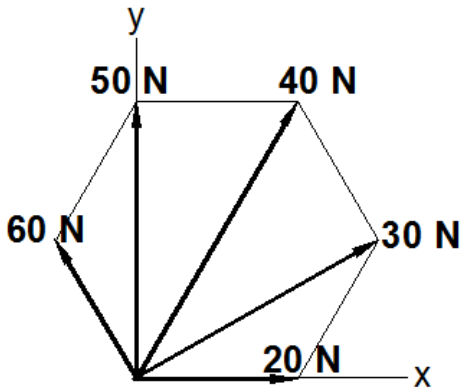
| 13. | Reaction of a roller support is always |
| Option A: | parallel to the roller base |
| Option B: | perpendicular to the roller base |
| Option C: | depends on the direction of loading |
| Option D: | Independent of the position of roller |
| | |
| 14. | A beam AB, 8 m long is hinged at A and has a roller support at B. The roller support is inclined at an angle 30° to the horizontal. What is the reactions at A and B if the beam carries point load of 64 kN is at the centre of the beam. |
| Option A: | $H_A$ = 18.47 kN, $V_A$ = 32 kN, $R_B$ = 36.95 kN |
| Option B: | $H_A$ = 32 kN, $V_A$ = 32 kN, $R_B$ = 32 kN |
| Option C: | $H_A$ = 18.47 kN, $V_A$ = 36.95 kN, $R_B$ = 32 kN |
| Option D: | $H_A$ = 64 kN, $V_A$ = 64 kN, $R_B$ = 64 kN |
| | |
| 15. | What happens to the kinetic energy of a moving object if the net work done is positive? |
| Option A: | The kinetic energy increases |
| Option B: | The kinetic energy decreases |
| Option C: | The kinetic energy remains the same |
| Option D: | The kinetic energy becomes negative |
| | |
| 16. | A spring of stiffness 500 N/m is placed **horizontally** with the fixed wall and a ball of mass 5 kg strikes the spring with linear velocity of 3 m/s. What is the maximum compression of the spring. |
| Option A: | 0.003 m |
| Option B: | 0.03 m |
| Option C: | 0.3 m |
| Option D: | 3 m |
| | |
| 17. | Coefficient of friction is the |
| Option A: | Angle between normal reaction and the resultant of normal reaction and the limiting friction |
| Option B: | Ratio of limiting friction and normal reaction |
| Option C: | The friction force acting when the body is just about to move |
| Option D: | The friction force acting when the body is in motion |
| | |
| 18. | A body of weight 500 N is pulled up along inclined plane having a inclination of 30° with the horizontal. If the coefficient of friction between the body and the plane is 0.3 and force is applied parallel to the inclined plane. What will be the force required to maintain an equilibrium? |
| Option A: | 360 N |
| Option B: | 370 N |
| Option C: | 380 N |
| Option D: | 390 N |
| | |
| 19. | If a ball, initially at rest, is released on a flat surface from a height **h** and it rebounds to a height $\mathbf{h'}$, the coefficient of restitution is given by_____ |

| | |
|---|---|
| Option A: | $e = \sqrt{\frac{h'}{h}}$ |
| Option B: | $e = \frac{h'}{h}$ |
| Option C: | $e = \sqrt{\frac{h}{h'}}$ |
| Option D: | $e = \frac{h}{h'}$ |
| | |
| 20. | A 8 kg body moving to the right at a speed of 3 m/s strikes a 1 kg body that is moving to the left at a speed of 10 m/s. The final velocity of 8 kg body is 1.25 m/s to the left and the final velocity of 1 kg body is 4 m/s to the right respectively. What is the coefficient of restitution between two bodies. |
| Option A: | coefficient of restitution = 0.5 |
| Option B: | coefficient of restitution = 0.4 |
| Option C: | coefficient of restitution = 0.3 |
| Option D: | coefficient of restitution = 0.2 |

| **Q2. A** | **Solve any Two** **5 marks each** |
|---|---|
| i. | Five forces 20 N, 30 N, 40 N, 50 N and 60 N respectively at one of the angular point of regular hexagon toward the other five points as shown in figure 1.<br>Find their resultant in magnitude and direction.<br>  <br><br>Figure 1 |
| ii. | A heavy roller with radius 14 cm and weighing 2000 N is pulled to the right by a pulling force T acting at an angle 30° with respect to horizontal as shown in figure 2. A 6 cm step stops the rolling motion of the roller.<br>Find the magnitude of force T, to just start the motion of the roller. Also find the reaction at A. |

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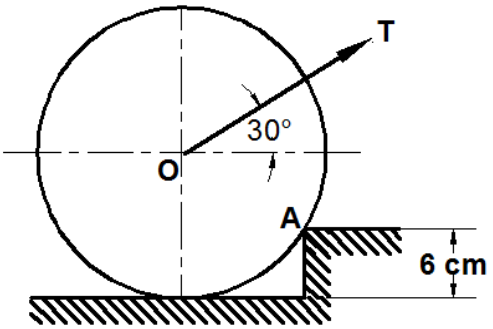
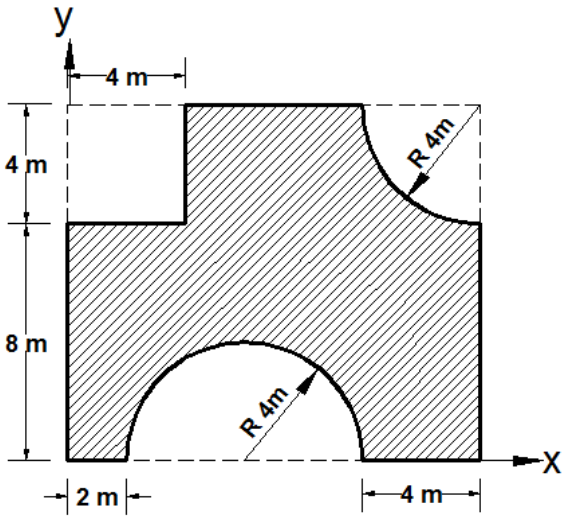
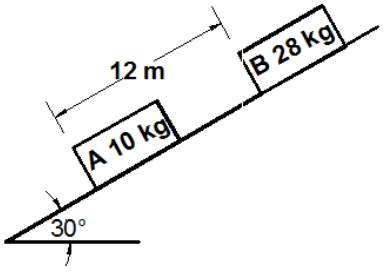
| |  <br>Figure 2 |
| iii. | A particle starts from rest from origin and its acceleration is given by<br>$a = \frac{k}{(x+4)^2}$<br>Knowing that v = 4 m/s when x = 8 m. Find value of k |
| **Q2. B** | **Solve any One** **10 marks each** |
| i. | Determine the co-ordinates of the centroid of the plane area as shown in figure 3 with reference to the axes as shown.<br>  <br>Figure 3 |
| ii. | Two blocks A(10 kg) and B(28 kg) released from rest on 30° incline, when they are 12 m apart. The coefficient of friction between the inclined plane and block A is 0.25 and the inclined plane and block B is 0.1 as shown in figure 4.<br>In what time block A reaches the block B?<br>  <br>Figure 4 |

| | |
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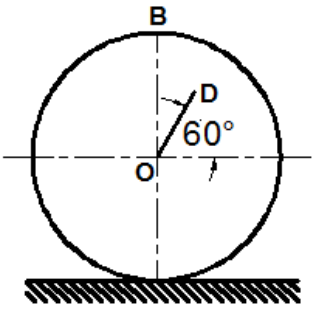
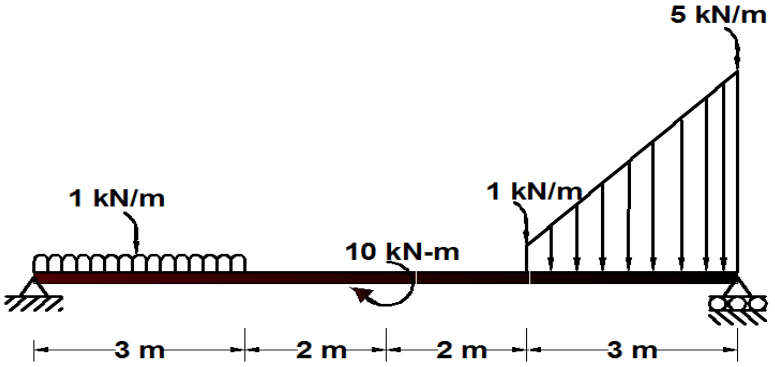
| **Q3. A** | **Solve any Two** **5 marks each** |

| | |
|---|---|
| i. | A wheel, with an angular velocity = 5 rad/sec clockwise and radius 1 m rolls without slipping on a horizontal surface. Determine the velocities of the points B and D as shown in figure 5. Also locate Instantaneous Centre of Rotation.<br>Take Distance OD = 0.6 m<br>  <br><br>Figure 5 |
| ii. | A block weighing 500 N just starts moving down a rough inclined plane at an angle 30° with respect to horizontal, when supported by a force of 200 N acting parallel to the plane in upward direction.<br>Find the coefficient of friction between the inclined plane and the block. |
| iii. | Prove that for a perfectly elastic body, two equal masses participating in collision exchange their velocities. |
| **Q3. B** | **Solve any One** **10 marks each** |
| i. | Determine the reactions at hinged support and roller support as shown in figure 6.<br>  <br><br>Figure 6 |
| ii. | A block of mass 80 kg is compressed against a spring as shown in figure 7.<br>What will be the horizontal speed of block at point B and also how far from point B (distance x) will the block strike the plane at point A.<br>Take a) Free length of spring = 0.9 m<br>b) Spring stiffness, k = 40 x $10^2$ N/m<br>c) Coefficient of friction = 0.2<br>d) Motion B-A is projectile motion. |

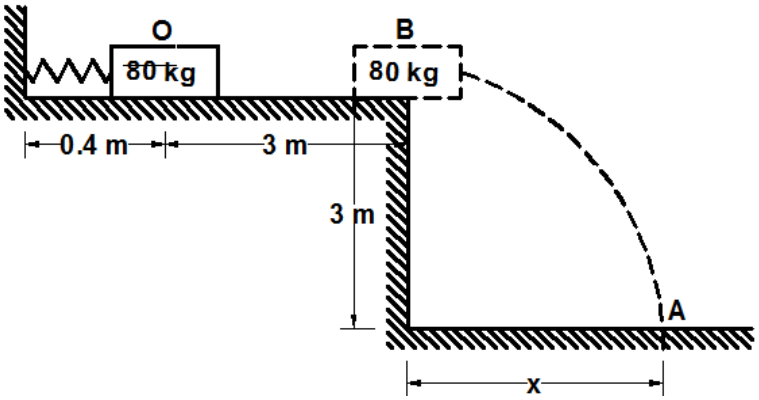


Figure 7

# University of Mumbai

## Examination 2020 under cluster 3 (Lead College: FCRIT)

**Examinations Commencing from 23rd December 2020 to 6th January 2021 and from 7th January 2021 to 20th January 2021**

Program: F.E. (All branches) (Choice Based)

Curriculum Scheme: Rev2019

Examination: FE Semester I

Course Code: FEC104 and Course Name: Engineering Mechanics

Time: 2 hours Max. Marks: 80

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| Question Number | Correct Option (Enter either 'A' or 'B' or 'C' or 'D') |
|---|---|
| Q1. | A |
| Q2. | A |
| Q3. | C |
| Q4 | D |
| Q5 | C |
| Q6 | B |
| Q7 | C |
| Q8. | B |
| Q9. | D |
| Q10. | B |
| Q11. | A |
| Q12. | C |
| Q13. | B |
| Q14. | A |
| Q15. | A |
| Q16. | C |
| Q17. | B |
| Q18. | C |
| Q19. | A |
| Q20. | B |