03-06-2026 FE (SEM-I) (ALL BRANCHES) C SCHEME EM-I QP CODE: 20009228

(Time: 3 hours) **Max.Marks:80**

N.B (1) Question No.1 is compulsory
(2) Answer any three questions from Q.2 to Q.6
(3) Figures to the right indicate full marks

1	a)	Express A=$\begin{bmatrix} 1+i & i \\ -i & 2-i \end{bmatrix}$ as sum of Hermitian and skew Hermitian matrices.	5
	b)	If $z=tan^{-1}\left(\frac{y}{x}\right), find\ \frac{\partial^2 z}{\partial x^2}+\frac{\partial^2 z}{\partial y^2}$	5
	c)	Find the value of $\left(\frac{-1+i\sqrt{3}}{2}\right)^{15}+\left(\frac{-1-i\sqrt{3}}{2}\right)^{15}$	5
	d)	Find the value of log(3+4i) +log(3-4i)	5
2	a)	Find all the values of $(1+i)^{\frac{1}{3}}$,and show their continued product is 1+i.	6
	b)	Find real and imaginary parts of $cos^{-1}\left(\frac{3i}{4}\right)$	6
	c)	If u=f(x-y,y-z,z-x),then show that $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}=0$	8
3	a)	Check if A=$\begin{bmatrix} cos\alpha & 0 & sin\alpha \\ 0 & 1 & 0 \\ -sin\alpha & 0 & cos\alpha \end{bmatrix}$ is orthogonal,if yes find A^{-1}.	6
	b)	If y=$\frac{x}{(x+1)^4}, find\ y_n$	6
	c)	Using Newton-Raphson method,find approximate value of $\sqrt[3]{150}$.	8
4	a)	Find the extreme values of f(x,y)=$y^2+4xy+3x^2+x^3$	6
	b)	Using De-Moivre's theorem,prove that $\frac{sin5\theta}{sin\theta}=16cos^4\theta-12cos^2\theta+1$	6
	c)	If y=acos(logx)+bsin(logx),then prove that x^2y_{n+2}+(2n+1)$xy_{n+1}+(n^2+1)y_n=0$	8
5	a)	Test the consistency of the equations and solve if consistent $2x+y+z=4, x-y+3z=3, 4x-y-z=2$	6
	b)	Solve the following equations by Gauss-Seidel Method $28x+4y-z=32, 2x+17y+4z=35, x+3y+10z=24$	6
	c)	If u=log$(x^3+y^3-x^2y-xy^2)$, then find the value of $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}+x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}$	8
6	a)	Reduce the matrix to normal form,hence find its rank. A=$\begin{bmatrix} 2 & 3 & 4 & 5 \\ 3 & 4 & 5 & 6 \\ 4 & 5 & 6 & 7 \end{bmatrix}$	6
	b)	Prove that $\log(secx)=\frac{x^2}{2}+\frac{1}{3}\frac{x^4}{4}+\frac{2}{15}\frac{x^6}{6}+\ldots$.	6
	c)	If $\sin(\theta+i\varphi)=e^{i\alpha}$, then prove that $cos^4\theta=sin^2\alpha=sinh^4\varphi$	8

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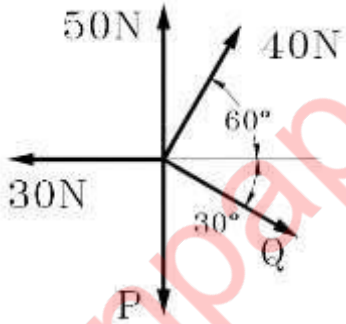
08-06-2026 FE (SEM-I) (ALL BRANCHES) C SCHEME EM QP CODE: 20012424

Time: 3 Hours **Total Marks: 80**

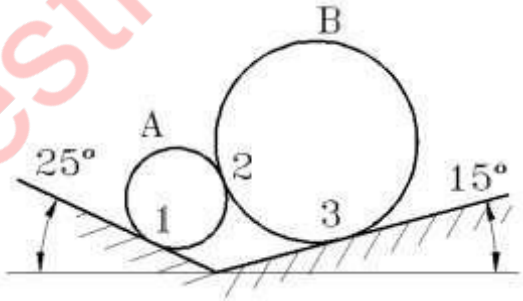
- Question-1 is compulsory.
- Answer any three from remaining five questions.
- Assume any suitable data wherever required, but justify the same. Assumptions made should be clearly stated.
- Illustrate answers with sketches, wherever required.

1. Answer any four

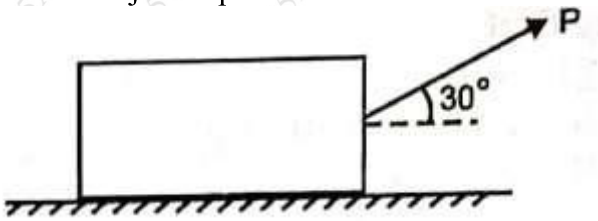
a. Two concurrent forces **P** and **Q** acts at **O** such that their resultant acts along x-axis. Determine the magnitude of **Q** and the Resultant **[05]**



b. Determine the reactions at the point of contacts 1, 2 and 3. Assume smooth surface. m_A= 1 kg, m_B= 4 kg, r_A= 1 cm, r_B= 4 cm **[05]**



c. A 1000 N block is kept on a rough horizontal surface having μs = 0.35 . Force P is applied as shown. Determine P for motion to just impend. **[05]**



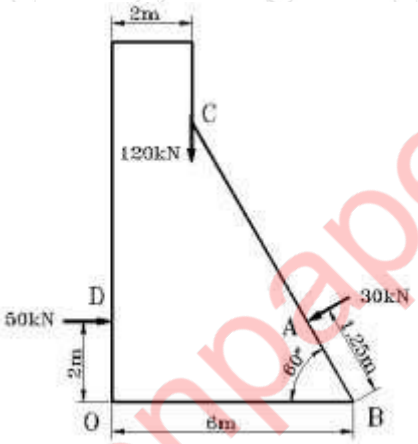
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d. A car covers a distance of 100 m in 6 s and it takes another 5 s to cover next 120 m. Find the initial velocity and uniform acceleration of the car. **[05]**

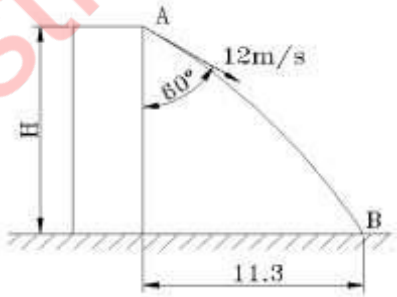
e. i)Define the Instantaneous Centre of Rotation and explain the properties of Instantaneous Centre of Rotation.(3marks) **[05]**
ii) State Impulse -Momentum principle. .(1 mark)
iii)Define Coefficient of Restitution.(1 mark)

g. Rectilinear motion of a particle is defined by equation $V^3 = x^2$. Determine velocity and acceleration at x= 8 m **[05]**

2a. The forces acting on 1 m length of a dam are shown in figure. Determine the resultant force acting on the dam. Calculate the point of intersection of the resultant with the base. **[06]**



b. A ball thrown with speed of 12 m/s at an angle of 60° with a building strikes the ground 11.3 m horizontally from the foot of the building as shown. Determine the height of the building. **[08]**

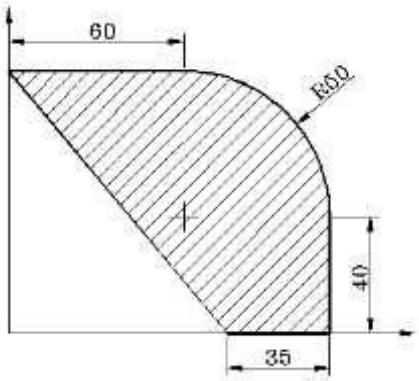


c. Three perfectly elastic balls A, B and C of masses 2 kg, 4 kg and 8 kg move along a line with velocities 4 m/s, 1 m/s and 0.75 m/s, respectively. If the ball-A strikes the ball-B, which in turn strikes the ball-C, determine the velocities of the three balls after the impacts. **[06]**

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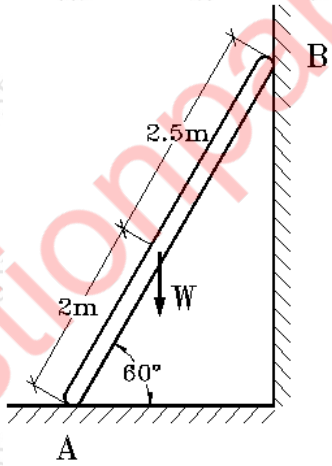
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3a. Determine the centroid of the shaded area with respect to the given x and y axes. All dimensions are in mm. **[06]**

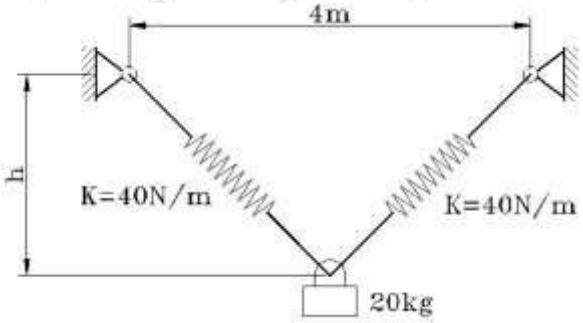


b. . **[06]**

A homogeneous ladder shown in figure rests against a smooth wall at A and a rough horizontal floor at B. The mass of the ladder is 30 kg and is concentrated at a location 2 m from bottom as shown in the figure. The coefficient of static friction between the ladder and the floor is 0.35. Will the ladder stand in 60^0 position?

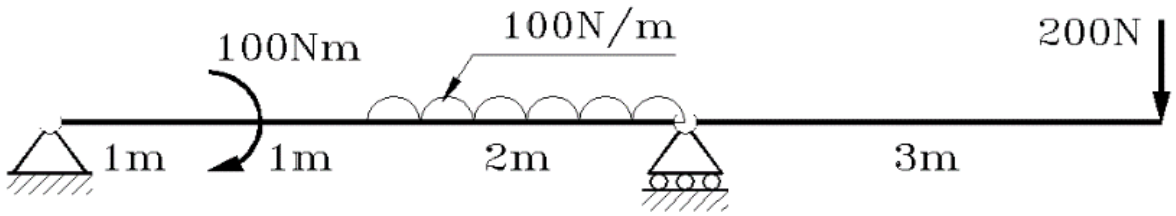


c. A cylinder has mass 20 kg and is released from rest, when h= 0. Determine the speed when h= 3 m. The springs have un-stretched lengths of 2 m. **[08]**

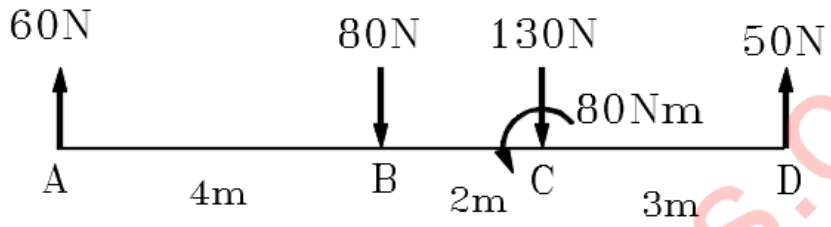


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4a. Determine the reactions of all supports of the given beam. **[07]**



b. Convert the given force system into a force and a couple at point A. **[07]**

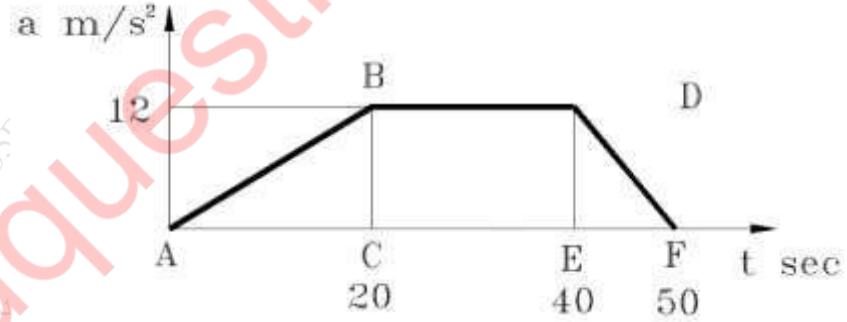


c. A truck travels along a circular road of radius 50 m at a speed of 4 m/s. For a short distance when t= 0 speed is increased by dv/dt= 0.4t m/s^2. Determine the speed and the magnitude of acceleration when t= 4 s. **6**

5a. The lines of actions of three concurrent forces at the origin 'O' passing through points A (1, 2, 4), B (3, 0, -3) and C (2, -2, 4) are having magnitudes F_A = 40 N, F_B = 10 N and F_C = 30 N, respectively. Find the magnitude and direction of their resultant. **[08]**

b. Figure below shows a plot of **a-t** curve for a particle moving along a straight line. Draw **v-t** curve. **[07]**

Determine the speed of the particle after 50 sec. Also, find the maximum speed attained by the particle.



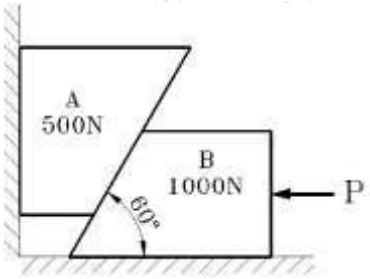
c. The motion of particle is defined by the realtion $x = 3t^3 - 18t^2 + 26t + 8$, where x is the position expressed in meters and t is the time in seconds. Determine **[05]**

(i) Time when the velocity is zero and

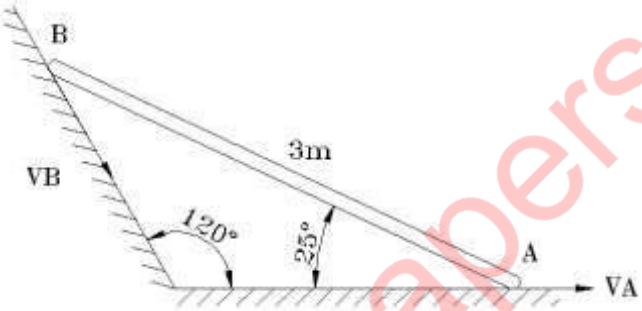
(ii) The position and the total distance travelled when the acceleration becomes zero.

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6a. Assuming the values for μ as 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks, find the minimum value of the horizontal force P applied to the lower block that will hold the system in equilibrium. **[07]**



b. A 3 m long bar AB slides down the plane. The velocity of the end A is 3.6 m/s., Determine the angular velocity of the rod AB and the velocity of the end B. **[07]**



c. A car travelling at a speed of 90 k/hr suddenly applies brakes and comes to stop after skidding 68 m. Determine, **[06]**

i) Time needs to stop the car.

(i) Coefficient of friction between the tyre and the road.

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