COEP Satellite Team Induction Questionnaire

March 2022

Structure Subsystem

Important Instructions:

1. Logical justification to answers is expected.

2. Answers should be submitted through online submission using the link https://forms.gle/G7vhkzpcbhYscPSD8.Submit your soft copy only in single PDF file. You may use adobe scanner to create a soft copy of your answers.

3. Deadline for submission is **Monday 14/03/2022 11:59 pm**.

4. Attempt as many questions as you can.

5. The open-ended (no accurate answer) questions will be judged on the efforts put in answering them and the creativity and practicality of the solution.

6. Assume suitable data wherever necessary and state your assumptions in the beginning.

7. Write down your thought process for the answer. You will be judged on the basis of your thinking and approach.

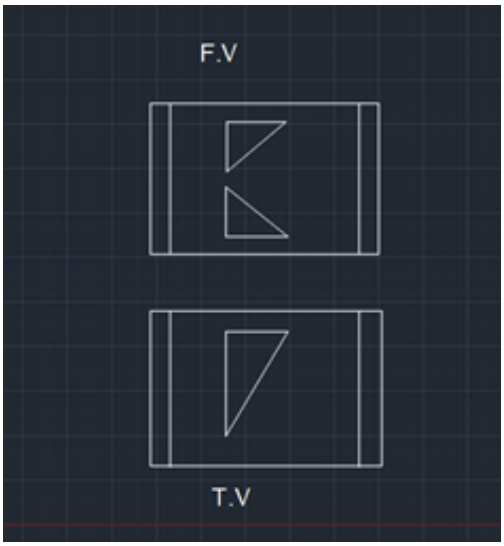
8. You may use any source of information, but provide a reference at the end of the solution. Please make sure that this source is not “the answer sheet of another candidate”. No copy-pastes, please. It is very easy to catch and leads to both the people being eliminated.

9. Preferred branches are Mechanical, Production, Metallurgy and Material Science, and Civil.

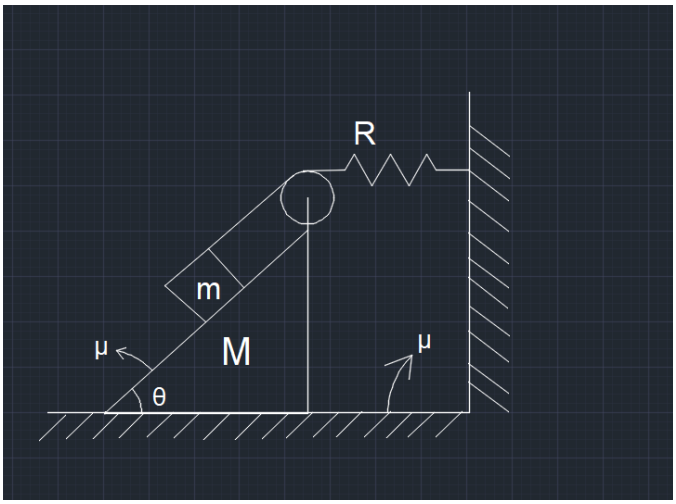
10. For any kind of queries, feel free to contact Vaishnavi Butte (7757856178), Amey Landge (9850039330).

Q1) A sphere is held at the bottom of a 10m deep water tank. The specific gravity of the cylinder is 0.5. The radius of the sphere is 20mm. The sphere is released from the bottom. The sphere escapes the tank after release. Find the maximum height (above the water surface) that the sphere reaches after releasing from the bottom. Also, find the velocity at the instance when the sphere completely goes into the air. Neglect surface tension and viscosity.

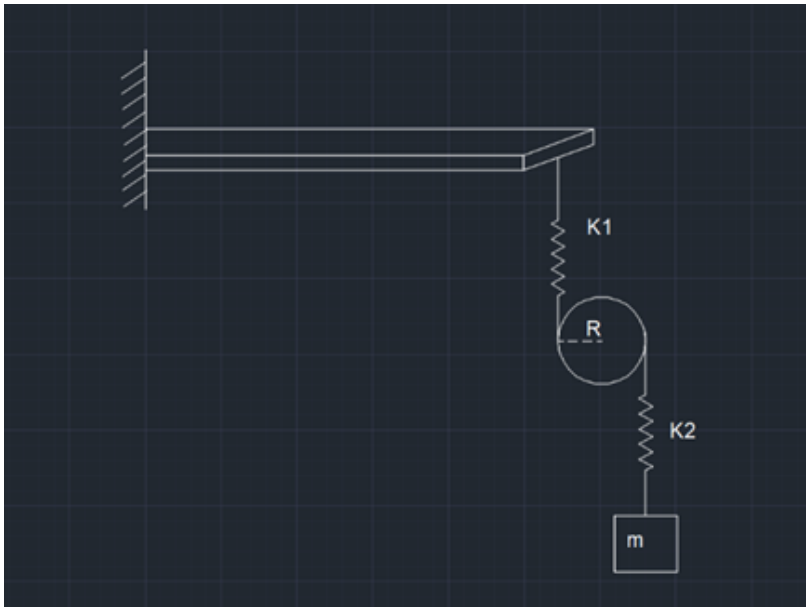
Q2) Draw all possible isometric views for the following orthographic view.



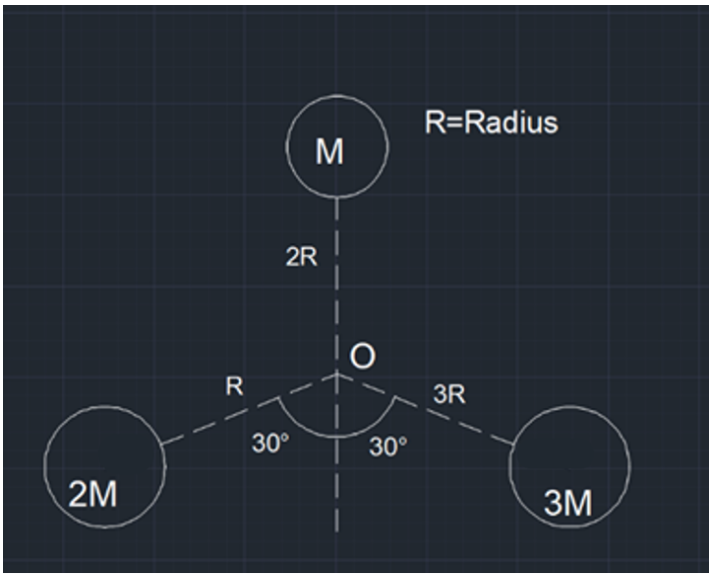
Q3) At t = 0 , spring is at natural length and block with mass m is released. If the block again reaches at rest when elongation in the spring is 8cm, find relation between m, M and R(spring constant) given that elongation in the spring is only due to the block.(θ = 45°, μ = 0.4).



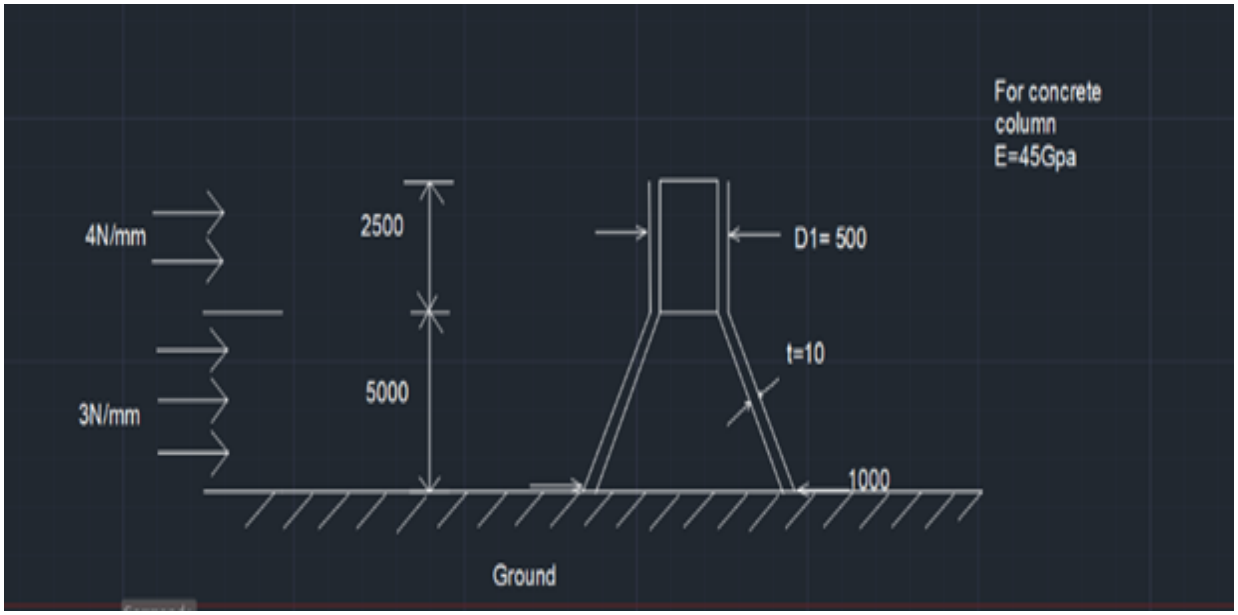
Q4) The dimensions of the cantilever are width 0.2m, length 1m, height 0.06m. The modulus of rigidity is 1GPa. Spring Constant K1 is 10N/m and K2 is 20N/m. The radius of the disc is 0.25m and mass 1kg. Mass of the block M is 0.5Kg. The disc is pivoted at the center. Find the time period of the SHM of block M when the tip of the cantilever beam is displaced by a small amount.



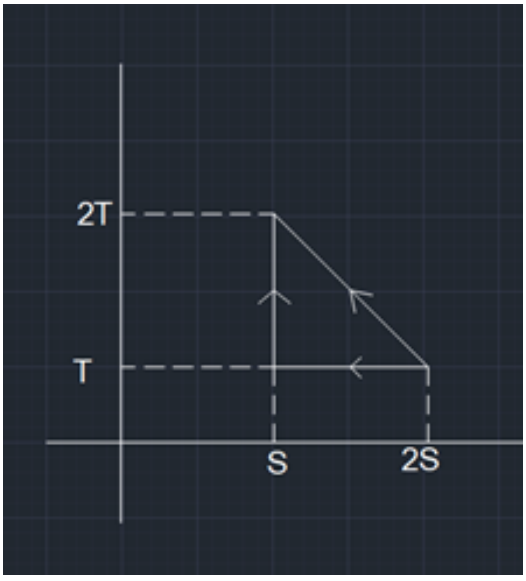
Q5) Consider a man positioned at O and is in deep space and surrounded by 3 planets as shown in figure. Find the weight of the man.Make suitable assumptions and Explain .(M =$3\times10^{24}Kg$, Radius of each planet = R = $4\times10^{6}m$, Mass of man = 60Kg).



Q6) A fractional distillation column has dimensions as follows. It is a vertical cantilever and is acted on by wind which acts as a UDL on each section. The material of the column is concrete and has a thickness of 10 mm throughout. Calculate the deflection of the upper tip of the column and bending stresses at the base of the column. (All dimensions in mm)

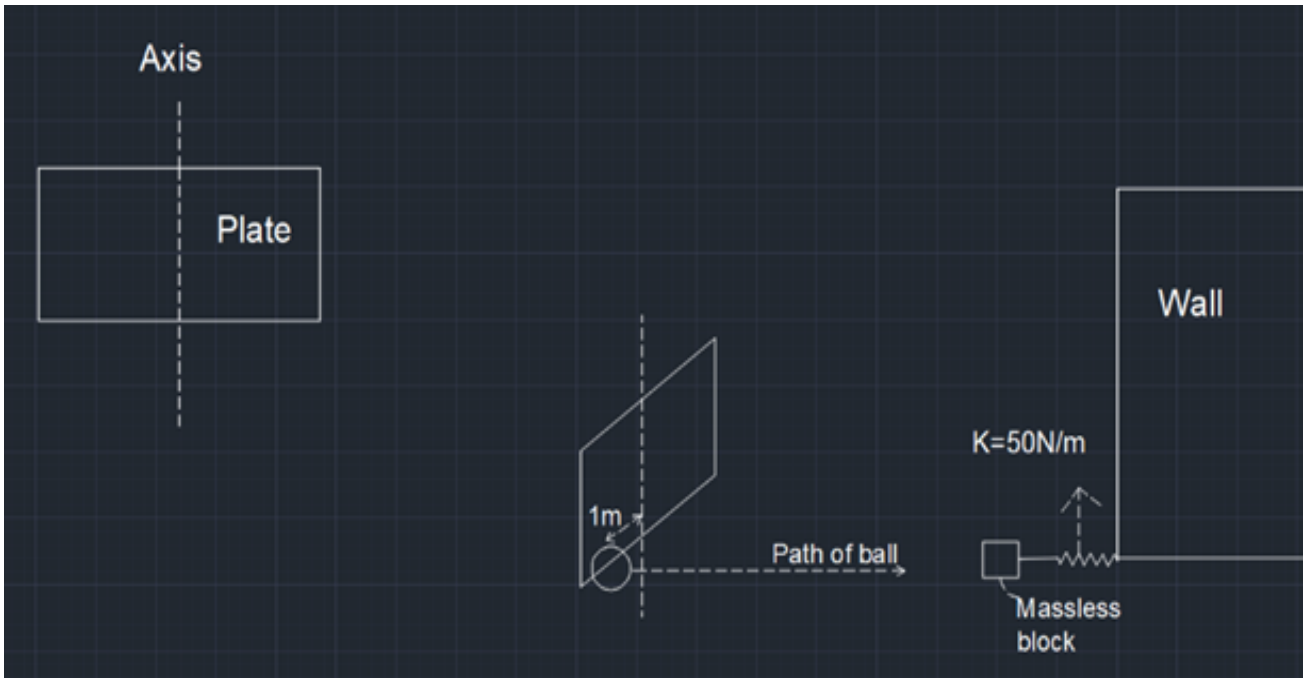


Q7) Determine the efficiency of the following cyclic process represented on the T-S diagram. The cycle is now reversed. Find the coefficient of performance and comment on whether the cycle is irreversible or reversible.

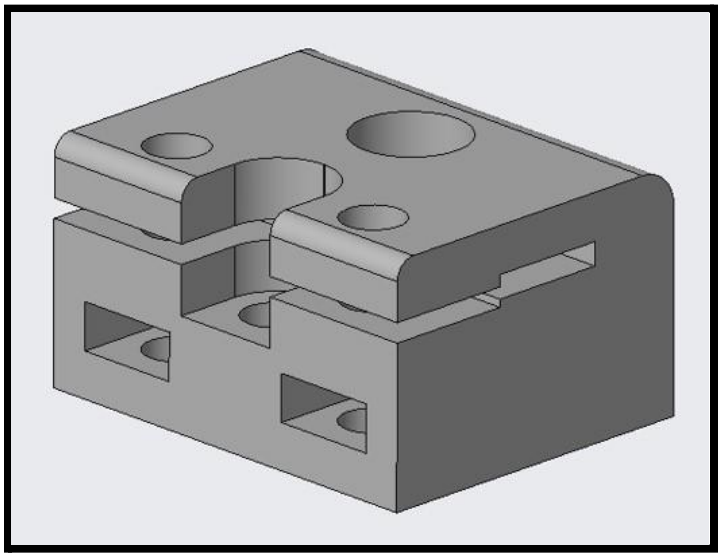


Q8) Consider a plate coated with white paint and black paint on either side. Dimensions of the plate are 100x100x1mm, with a conductivity of 205 W/mK. The thickness of both the coatings is 0.2mm, with a conductivity of 0.001W/mK. The plate is in a vacuum at an ambient temperature of 273K. The white coating side is maintained at 10°C. The emissivity of the white side is 0.84 and that of the black side is 0.94. The rate of heat transfer through the coated plate is 5W. Find the total heat radiated from the coated sides of the plate.

Q9) A Rectangular metal plate is having its axis of rotation passing through its center parallel to its breadth initially at rest is pushed at a point on the edge parallel to its axis of rotation by a force of 50kN for 2 milliseconds. A metal ball placed in the surrounding of the metal plate gets hit by the plate after force stops acting on the plate. The ball hits a spring having a spring constant of 50 N/m. Find the compression in the spring. The mass of the ball is 1 kg. The mass of the metal plate is 4Kg. The length of the metal plate is 3m the ball hits the metal plate at a distance of 1m from the axis. Neglect friction losses(find the answer up to 2 decimal places).



Q10) Define and describe the manufacturing processes involved in the production of the following component.



Q11)Design and explain a mechanism for closing the refrigerator door shut without slamming. (You can explain all possible mechanisms that you can think of)