2.1 Equilibrium of System of Coplanar Forces (SCF-E)

2.1.1 SCF-EQUILIBRIUM - Class work Questions

1. A circular roller of weight 1000N and Radius 200mm hangs by a tie rod AB=400mm and rests against a smooth vertical wall at C as shown in the Figure 2.1-1. Determine the tension in the rod and reaction at point C.

(T=1154.7N, Rc= 577.35N)

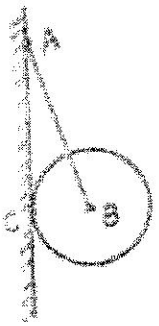

Figure 2.1-1

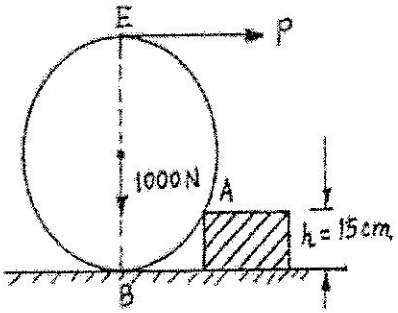

Figure 2.1-2

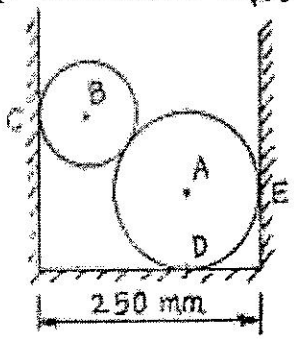

Figure 2.1-3

2. A uniform wheel of 600mm dia. And weighing 1000N rest against rectangular block 15cm high lying on a horizontal plane as shown in Figure 2.1-2. It is to be pulled over the block by a horizontal force P applied to the end of a string wound round the circumference of the wheel. Find the force P when the wheel is just about to roll over the block.

(P=577.33N)

3. Two smooth spheres A and B weigh 200N and 100N respectively are resting against two smooth vertical walls and a smooth horizontal floor as shown in Figure 2.1-3. The radius of sphere A is 100 mm and Radius of sphere B is 50 mm. Find the reactions from the vertical walls and horizontal floor. Also find the reaction exerted by each sphere on the other.

(R_C=89.44N, R_d=300N,R_e=89.44N,R=134.164N)

4. Find force transmitted by cable BC shown in Figure 2.1-4. E is frictionless pulley where B and D are weightless rings.

(T_{BC}=565.7N)

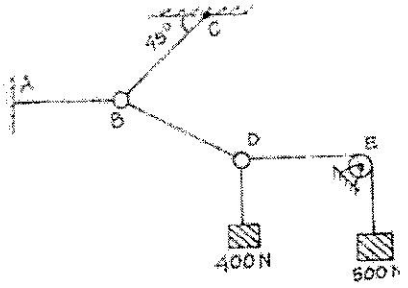

Figure 2.1-4

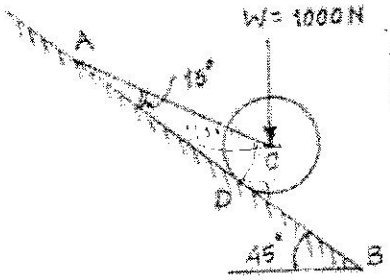

Figure 2.1-5

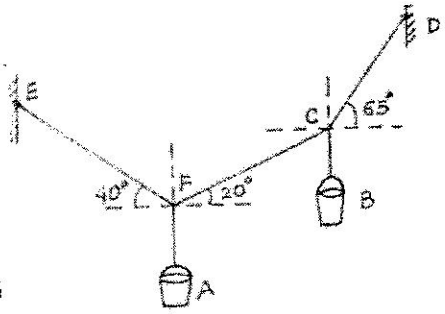

Figure 2.1-6

5. If the cords suspend the two buckets in equilibrium position shown in Figure 2.1-5. Determine weight of bucket B if Bucket A has a weight of 60N.

(W_B=88.8N)

6. A roller of weight W=1000N rest on a smooth inclined plane. It is kept from rolling down the plane by string AC. Find the tension in the spring and reaction at the point of contact D. Refer Figure 2.1-6

(T=732N, R_D=896.6N at 45^0)

7. Determine the uniform reaction from the surface on cylindrical log as shown in Figure 2.1-7. The self-weight of log is 1300N/m.

(R=4500N/m)

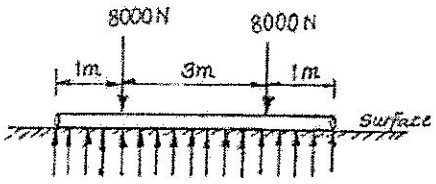

Figure 2.1-7

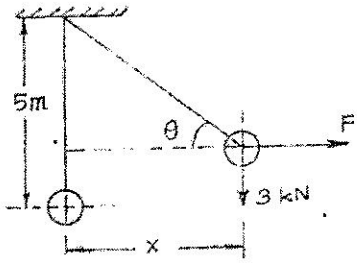

Figure 2.1-8

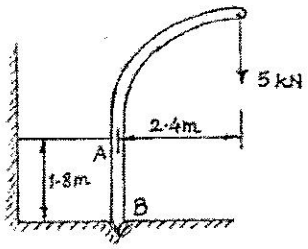

Figure 2.1-9

8. Determine the horizontal distant x to which a 5m long inextensible string holding a weight of 3kN can be pulled before the string breaks. The string can withstand a maximum force of 6kN. Determine also the required force F. Refer .Figure 2.1-8

(x=4.33m, F=5.196kN)

9. A crane pivoted at the end B is supported by a guide at A. Determine the reaction produced at A and B by a vertical load W=5kN applied at C. Ref. Figure 2.1-9

(R_B= 8.33kN & θ=36.87^0, R_A=6.67kN)

10. Forces act on a plate ABCD are shown in Figure 2.1-10. Given that the plate is in equilibrium. Find the force F, the angle α and distance from A along AD.

[F=13N, AD=8.67 m]

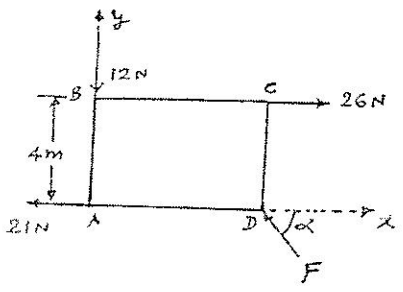

Figure 2.1-10

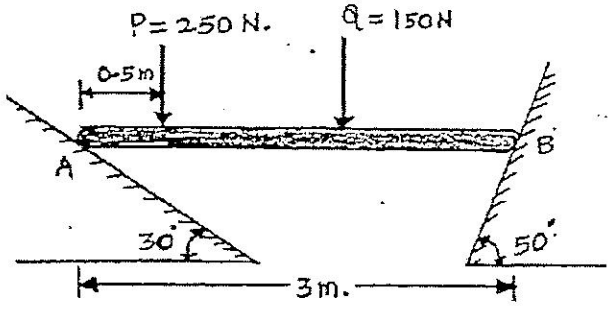

Figure 2.1-11

11. A bar of 3m length and negligible weight rests in a horizontal position on two smooth inclined planes. Determine the distance x at which the load Q=150N should be placed from point B to keep the bar horizontal. Refer Figure 2.1-11 **[x=1.22 m from B]**

2.1.2 SCF-EQUILIBRIUM - Surprise Test Questions

1. A man raises a 12Kg joist of length 4m by pulling the rope. Find the tension in the rope and reaction at A. Refer Figure 2.1-12

[T = 98.51 N, H_A = 92.57 N, V_A = 151.4 N]

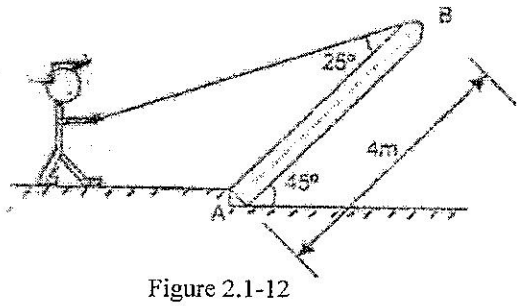

Figure 2.1-12

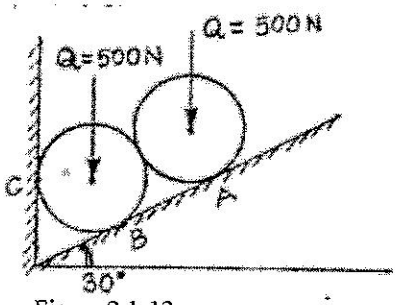

Figure 2.1-13

2. Two identical rollers each of weight Q=500N are supported by an inclined plane in the vertical wall as shown in the Figure 2.1-13. Assuming smooth surfaces find the reaction induced at the points of support A, B and C

(H_C=577.36N, R_A=433N & 60^0, R_B=721.7N & 60^0)

3. A thin ring of mass 3 kg and radius 140 mm is held against a frictionless wall by a string of length 120 mm. Find distance d and tension in the string. Ref. Figure 2.1-14

[d = 219.09mm,T = 34.925N]

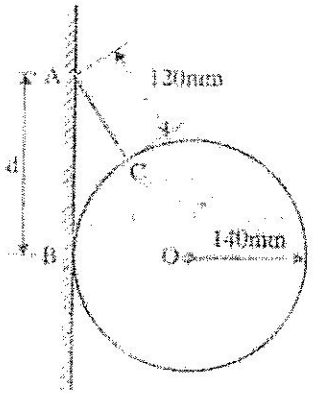

Figure 2.1-14

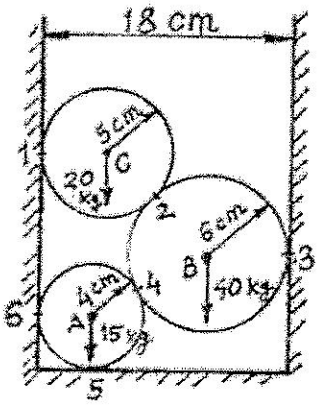

Figure 2.1-15

4. Three cylinders are piled up in a rectangular channel as shown in the Figure 2.1-15. Determine all reactions between contact surfaces. All surfaces are smooth. Assume g=10m/sec^2.

(R_1 =165N, R_2=259.27N,R_3=965N,R_4 = 1000N,R_5 =750N,R_6 =800N)

2.1.3 SCF-EQUILIBRIUM - Assignment / Tutorial Questions

1. State Lami's theorem. State the necessary conditions for application of Lami's theorem.

{MU, May 2017, 4 Marks}

2. Two spheres A and B of weight 1000N and 750N respectively are kept as shown in the Figure 2.1-16. Determine the reactions at all contact points 1, 2, 3 and 4. Rad of A = 400 mm and B = 300 mm.

{MU, Dec 2016, 8 Marks} [R_1 = 496.65N, R_2 = 1463.26N, R_3 = 869.14N, R_4 = 573.48N]

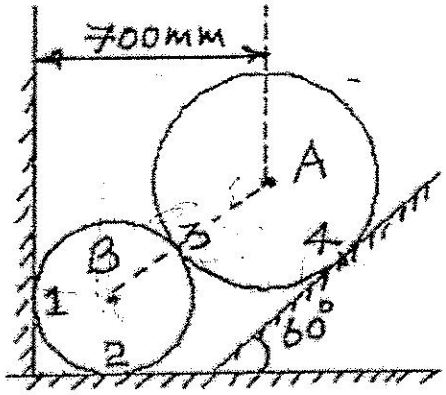

Figure 2.1-16

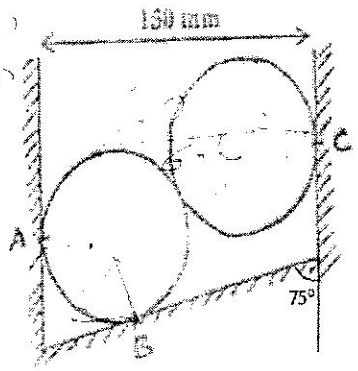

Figure 2.1-17

3. Two cylinders each of diameter 100 mm and each weighing 200N are placed as shown in Figure 2.1-17. Assuming that all contact surfaces are smooth find the reactions at A, B and C. **[R_A=22.65 N, R_B=414.11 N, R_C=115 N, R_D=230.94 N]**

4. A 40 kg cylinder is held in position on an inclined plane by means of a wire AB as shown in Figure 2.1-18. Determine reactions at surface of inclined plane and tension in the wire.

[T = 319.544N, R = 436.086N]

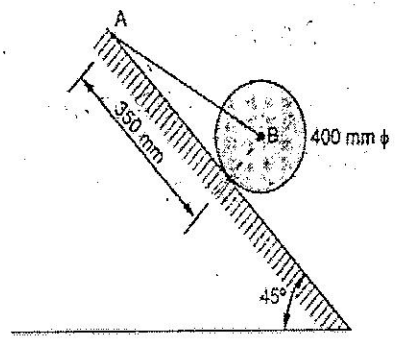

Figure 2.1-18

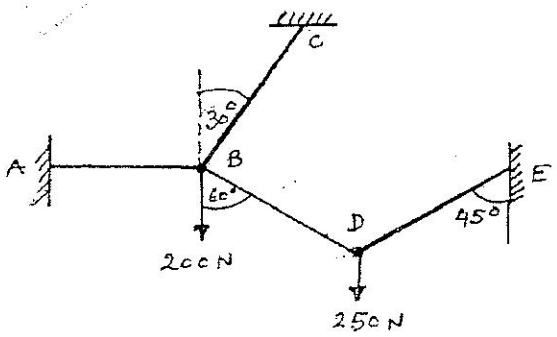

Figure 2.1-19

5. Determine the forces in various segments of the cable. Vertical forces 200N and 250N acts at point B and D. Ref. Figure 2.1-19

[T_{DB} = 183N, T_{DE} = 224.125N, T_{BC} = 336.60, T_{BA} + 326.79N]