Roll No.

B.E./B.Tech. (Full Time) Degree End Semester Examinations, April/May 2013

Common to

Mechanical/civil/Production/Aeronautical/Industrial/Manufacturing/Automobile/Rubber and Plastics/Agricultural and Irrigation/geo Informatics/Electrical and Electronics/Material Science/Mining/Printing/ceramic/Chemical/Food/Industrial Biotechnology/Leather/Textile / Apparel

Second Semester

GE 8251 ENGINEERING MECHANICS
(Regulation 2012)

Time: 3 Hours **Answer ALL questions** **Max. marks: 100**

PART-A (10 x 2 = 20 marks)

1. State Lami's theorem.

2. The cable exerts a force, F = 100 N as shown in Figure 1. Find the components of force along X, Y and Z directions.

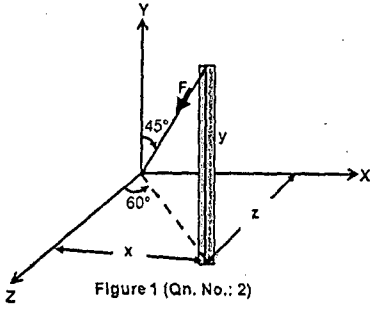


Figure 1 (Qn. No.: 2)

3. The weighted cylinders in Figure 2 are smooth. Draw free body diagrams of cylinders A and B separately.

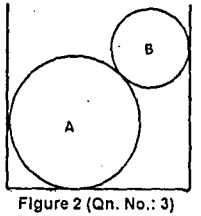


Figure 2 (Qn. No.: 3)

4. Find the moment of forces about point O shown in Figure 3. It is enough to use scalar approach to find the moment.

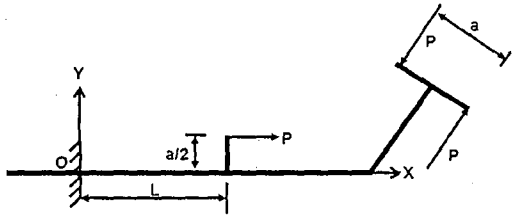


Figure 3 (Qn. No.: 4)

5. Calculate the surface area formed by the given inclined line shown in Figure 4 using Pappus and Guldinus theorem. Note: Given inclined line is revolved by 2π about X axis.

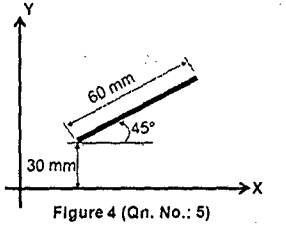


Figure 4 (Qn. No.: 5)

6. Calculate the second mass moment of inertia about X- axis. Second mass moment of inertia about Centroidal axis X_c is 200 kgcm^2 and mass of the given component shown in Figure 5 is 15 kg.

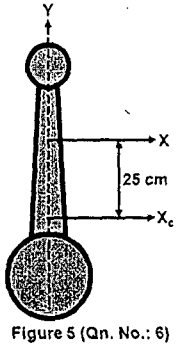


Figure 5 (Qn. No.: 6)

7. Acceleration of a Particle is defined by $-k/x^2$. The Particle starts with no initial velocity at X = 800 mm. It is observed that velocity is 6 m/s at X = 500 mm. Find the value of 'k'.

8. Define coefficient of restitution and D' Alembert's principle.

9. Whether the body shown in Figure 6 slide or not. Give suitable reason. Static coefficient of friction between surfaces is assumed to be $1/\sqrt{3}$.

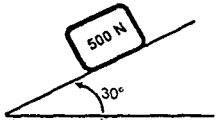


Figure 6 (Qn. No.: 9)

10. Draw free body diagrams of Wedges shown in Figure 7. Static Coefficient of friction between all surfaces of contact is 0.1.

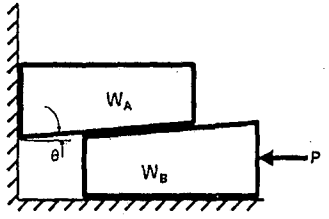


Figure 7 (Qn. No.: 10)

PART B (5 x 16 = 80)

11. (i) If the wall is smooth, calculate the minimum coefficient of static friction, μ_s, between the ladder and the floor such that the ladder is in equilibrium with self weight (W) of 10 kg and length of 2 m. (Figure 8) **[6]**

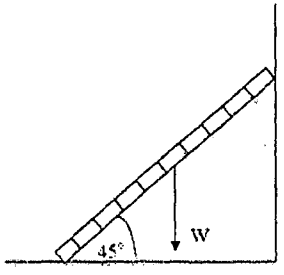


Figure 8 (Qn. No.: 11 (i))

(ii) Find the range of force P for which equilibrium of given system (refer Fig.9) is maintained. The coefficient of friction between incline and body is 0.15. There is no friction between pulley and rope. **[10]**

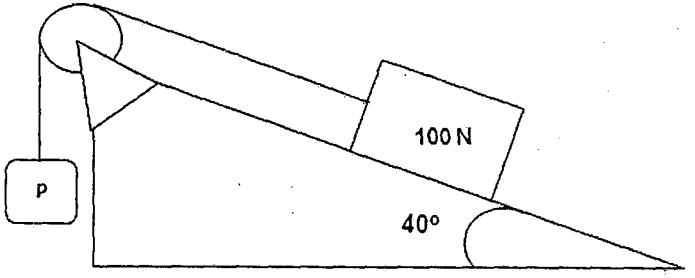


Figure 9 (Qn. No.: 11 (ii))

12. (A) Three ropes are anchored in ground to prevent the upward lift of balloon. Determine tension in ropes AB, AC and AD when the upward thrust of Balloon is 50 N.(all dimensions are in mm, figure 10) **[16]**

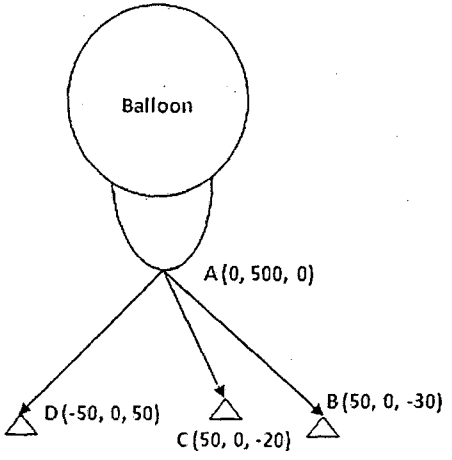
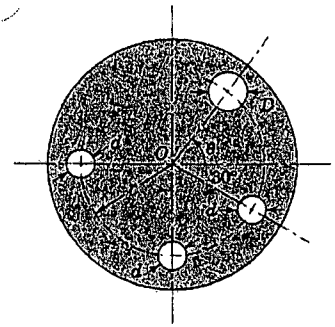


Figure 10 (Qn. No.: 12.A)

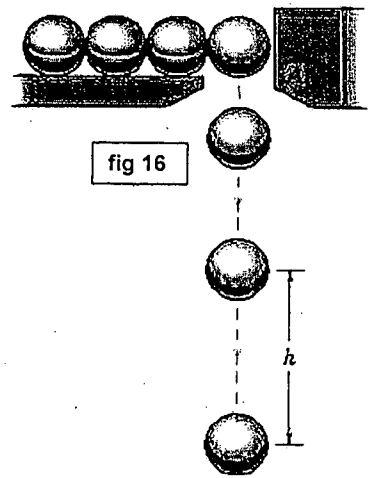
b) The circular disk shown in **Fig. 15** rotates about an axis through its center O and is three holes of diameter d positioned as shown. A fourth hole is to be drilled at the same radius r so that the disk will be in balance (center of mass at O). Determine the required diameter D of the new hole (in terms of d) and its angular position.

fig 15



14. a) (i) Small steel balls fall from rest through the opening at A at the steady rate of two per second **(fig. 16)**. Find the vertical separation *h* of two consecutive balls when the lower one has dropped 3 metres. Neglect air resistance. **(8 marks)**

fig 16



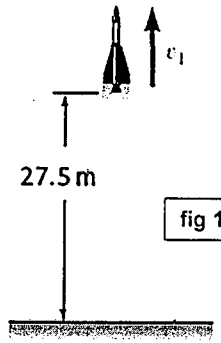


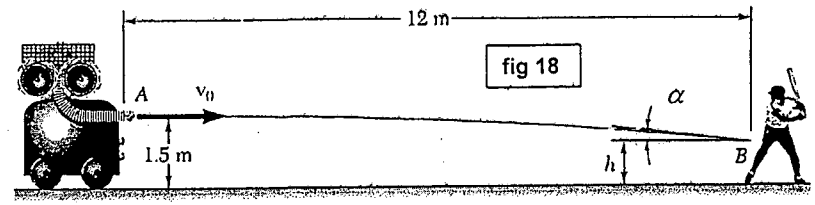
fig 17

(ii) A group of students launches a model rocket in the vertical direction **(fig. 17)**. Based on tracking data, they determine that the altitude of the rocket was 27.5 m at the end of the powered portion of the flight and that the rocket landed 16 s later. Knowing that the descent parachute failed to deploy so that the rocket fell freely to the ground after reaching its maximum altitude and assuming that $g = 9.8\ m/s^2$, determine (a) the speed v1 of the rocket at the end of powered flight, (b) the maximum altitude reached by the rocket. **(8 marks)**

[OR]

b) A baseball pitching machine **(fig. 18)** "throws" baseballs with a horizontal velocity v_0. Knowing that height *h* varies between 0.8 m and 1 m, determine (*a*) the range of values of v_0, (*b*) the values of α corresponding to $h = 0.8$ m and $h = 1$ m.

fig 18



15. a) Two blocks of weight W_1 and W_2 rest on a rough inclined plane **(fig. 19)** and are connected by a short piece of string as shown in Fig. If the coefficients of friction are $\mu_1 = 0.2$ and $\mu_2 = 0.3$, respectively, find the angle of inclination of the plane for which sliding will impend. Given: $W_1 = W_2 = 22.25$N.

fig 19

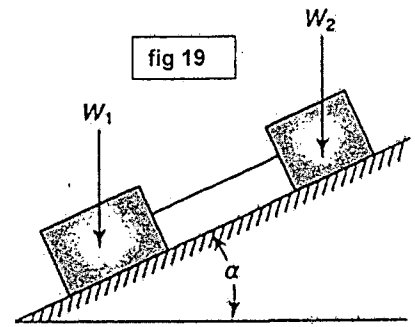
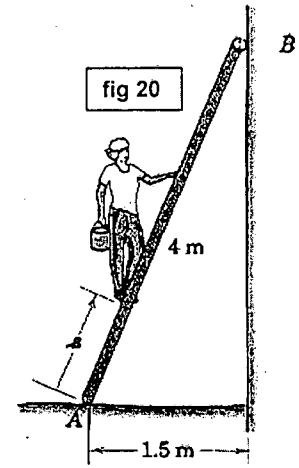


fig 20



[OR]

b) (i) Determine the distance s to which the 90 kg painter can climb without causing the 4-m ladder to slip at its lower end A **(fig. 20)**. The top of the 15-kg ladder has a small roller, and at the ground the coefficient of static friction is 0.25. The mass center of the painter is directly above her feet. **(8 marks)**

(ii) A 120 kg block **(fig. 21)** is supported by a rope that is wrapped 1½ times around a horizontal rod. Knowing that the coefficient of static friction between the rope and the rod is 0.15, determine the range of values of P for which equilibrium is maintained. **(8 marks)**

fig 21