

Instructions to the Students:

1. All the questions are compulsory.
2. The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in () in front of the question.
3. Use of non-programmable scientific calculators is allowed.
4. Assume suitable data wherever necessary and mention it clearly.

(Level/CO) Marks

Q. 1 Solve Any Two of the following.

- A) Classify the system of forces with neat sketches & explain them in detail? **Remember** 6
- B) A system of forces such as 1 kN, 2 kN, 3 kN, 4kN, 5 kN and 6 kN acting along the sides of Regular Hexagon respectively taken in order. Find the resultant of all the system of forces. **CO2** 6

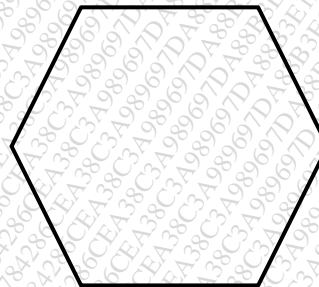


Fig 1.1 (B)

- C) C.1) What are the types loads and explain them in detail with neat sketches? **Remember** 6
- C.2) What are the types of 2D supports and explain them in detail with neat sketches?

Q. 2 Solve Any Two of the following.

- A) A square hole is punched out of circular lamina, the diagonal of the square being the radius of the circle as shown in Fig 2.1 (A) below Find the centre of gravity of the remainder, if ' $r = 4 \text{ cm}$ ' as the radius of the circle. **CO3** 6

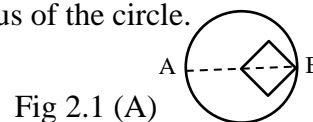


Fig 2.1 (A)

- B) A Uniform wheel of 1200 mm diameter weighing 10 kN rests against a rigid rectangular block of 300 mm height as shown in figure below. Find the least force (P) through the centre of the wheel required just to turn the wheel over the corner A of the block. **CO2** 6
- Also find the reaction at corner A of the block?

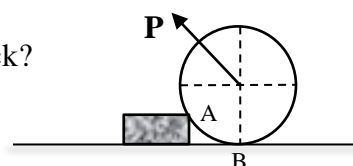


Fig 2.1 (B)

- C) State and explain the Lami's theorem and prove that? **Understand** 6

Q. 3 Solve Any Two of the following.

- A) Define: a) Static Friction, b) Dynamic Friction, c) Angle of Friction, **Remember** **6**
 d) Angle of repose. What are the Coulomb's laws of dry friction?
- B) A ladder 5 meters long rests on a horizontal ground and leans against a smooth vertical wall at an angle 70° with the horizontal. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750 N stands on a rung 1.5 meter from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor. **CO2** **6**
- C) A Warren girder consisting of seven members each of 3 m length freely supported at its end points. The girder is loaded at B and C as shown. Find the forces in all the members of the girder, indicating whether the force is compressive or tensile. Use method of joints. **CO2** **6**

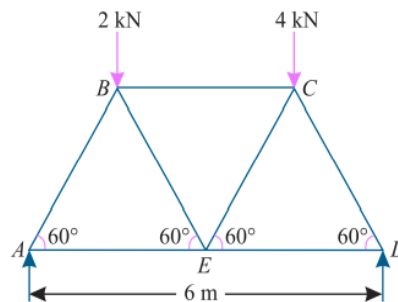


Fig 3.1 (C)

Q. 4 Solve Any Two of the following.

- A) The equation of motion of an engine is given by $s = 2t^3 - 6t^2 - 5$, where (s) is in meters and (t) in seconds. Calculate (i) displacement and acceleration when velocity is zero; and (ii) displacement and velocity when acceleration is zero. **CO 5** **6**
- B) A Projectile is aimed at a target on the horizontal plane and falls 12 m short when the angle of projection is 15° , while it overshoots by 24 m when the angle is 45° . Find the angle of projection to hit the target. **CO 4** **6**
- C) A Passenger train 300 m long, moving with a velocity of 108 kmph, overtakes a goods train moving on a parallel path in the same direction, completely in 45 seconds. If the length of the goods train is 250 m, Determine the speed of the goods train? **CO 4** **6**

Q. 5 Solve Any Two of the following.

- A) A motorist travelling at a speed of 70 kmph suddenly applies a breaks and halts after skidding 50 m. Determine A) The time required to stop the car, B) The coefficient of friction between the tyres and road. **CO 5 6**
- B) An automobile is moving at a speed of 70 kmph, when the breaks are fully applied causing all four wheels to skid. Determine the time required to stop the automobile, a) On concrete road, coeff. of friction = 0.75 **CO 5 6**
b) On ice for which coeff. of friction = 0.08
- C) A ball of mass 10 kg moving with a velocity of 20 m/s impinges directly on a ball of mass 20 kg at rest. The first ball, after impinging, comes to rest. Find the velocity of the second ball after the impact and the coefficient of restitution. **CO 5 6**

***** End *****