Total No. of printed pages = 9

APPLIED MECHANICS

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks
for the questions.

Answer Part – A and any *five* from Part – B

PART – A

1. Choose the correct answer : $1 \times 10 = 10$

   (a) The Lami's Theorem is applicable only for

      (i)   Coplanar forces

      (ii) Concurrent forces

      (iii) Coplanar and Concurrent forces

      (iv) Any type of forces

[Turn over

(b) If the sum of all the forces acting on a body is zero, then the body may be in equilibrium provided the forces are

(i) Concurrent

(ii) Parallel

(iii) Like parallel

(iv) Unlike parallel

(c) The centre of gravity of an equilateral triangle with each side (a) is …….. from any of the three sides.

(i) $\dfrac{a\sqrt{3}}{2}$

(ii) $\dfrac{a\sqrt{2}}{3}$

(iii) $\dfrac{a}{2\sqrt{3}}$

(iv) $\dfrac{a}{3\sqrt{2}}$

(d) If the area of a section is in mm^2 and the distance of the centre of area from a line is in mm, then units of the moment of inertia of the section about the line is expressed in

(i) mm^2

(ii) mm^3

(iii) mm^4

(iv) mm^5

(e) The moment of inertia of a triangular section of base (b) and height (h) about an axis through its c.g. and parallel to the base is given by the relation

(i) $\dfrac{bh^3}{12}$

(ii) $\dfrac{bh^3}{24}$

(iii) $\dfrac{bh^3}{36}$

(iv) $\dfrac{bh^3}{48}$

(f) The coefficient of friction depends upon

(i) Nature of the surface

(ii) Area of contact

(iii) Shape of the surface

(iv) All of the above

(g) The maximum frictional force which comes into play when a body just begins to slide over another surface is called

(i) Sliding friction (ii) Limiting friction

(iii) Rolling friction (iv) Kinetic friction

(h) Dynamic friction as compare to static friction is

(i) Same

(ii) More

(iii) Less

(iv) Has no correlation

(i) A framed structure is perfect if it contains member equal to

(i) $2n - 1$ (ii) $2n - 2$

(iii) $2n - 3$ (iv) $2n - 4$

where n is number of joints in a frame

(j) A force is completely define when we specify

(i) Magnitude

(ii) Direction

(iii) Point of application

(iv) All of the above.

2. Fill up the blanks : $1 \times 10 = 10$

(a) If a system of coplanar concurrent forces is in equilibrium, then the vector diagram drawn with these forces must be a ——— figure.

(b) The centroid of triangle is the point of ——— of its medians.

(c) The unit of power in SI system of units is ———.

(d) The co-efficient of friction is independent of ——— of contact surface.

(e) The friction experienced by a body in motion is known as ———.

(f) The process of splitting up a force into components is called ———.

(g) The maximum value of static friction is called ———.

(h) Angle of repose is always equal to ———.

(i) The rate of change of velocity is called ———.

(j) The moment of inertia of a circular section of diameter (d) is given by ———.

3. Answer right or wrong : 1×5=5

(i) The forces, which meet at one point, are known as coplanar forces.

(ii) The resultant of two forces equal to 50 N and 30 N acting at an angle of 60° is 70 N.

(iii) The units of moment of a force may be kN/kg.

(iv) Lami's Theorem cannot be applied in case of concurrent forces.

(v) A redundant frame is also called imperfect frame.

PART – B

4. (a) Define resultant and equilibriant of forces.
2

(b) Show that the moment of a force about a point is equal to twice the area of the triangle formed by joining the point with two ends of the force represented by a straight line as magnitude.
3

(c) Find the magnitude of the resultant force if 30 N, 40 N, 50 N and 60 N forces are acting along the lines joining the centre of a square to its vertices. 4

5. (a) State the specifications required to define a force. 3

   (b) What is a free body diagram ? Illustrate it with the help of figures. 2

   (c) A lamp weighing 5 N is suspended from the ceiling by a chain. It is pulled aside by a horizontal chord until the chain makes an angle of 60° with the ceiling. Determine the tensions in the chain and the chord. 4

6. (a) State the principles of equilibrium. 3

   (b) Three forces of 2P, 3P and 4P act along the three sides of an equilateral triangle of side 100 mm taken in order. Find the magnitude and position of the resultant force. 6

7. (a) A number of forces are acting on a body. What are the conditions of equilibrium, so that the body is in equilibrium ? 2

(b) Two identical rollers, each of weight W = 445 N are supported by an inclined plane and a vertical wall as shown in fig.(i). Assuming smooth surfaces, find the reactions at the points of support A, B and C.   7
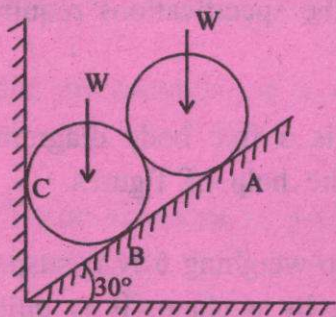

Fig.(i)

8. (a) Define co-efficient of friction.   1

(b) Find the moment of inertia of a T- section with flange as 150 mm × 50 mm and web as 150 mm × 50 mm about X – X and Y – Y axes through the centre of gravity of the section.   8

9. A body of weight (W) is placed on a rough inclined plane having inclination (α) to the horizontal. The force (P) is applied horizontally to drag the body. If (ϕ) is the angle of friction, prove that minimum force (P_{min}) which will keep

the body in equilibrium when it is at the point of sliding downward is $P_{min} = W\tan(\alpha - \varphi)$.

Also show that the maximum force (P_{max}) which will kept the body in equilibrium, when it is at the point of sliding upward is $P_{max} = W\tan(\alpha + \varphi)$.

9

10. Find all the forces in the members of a cantilever truss shown in fig.(ii).
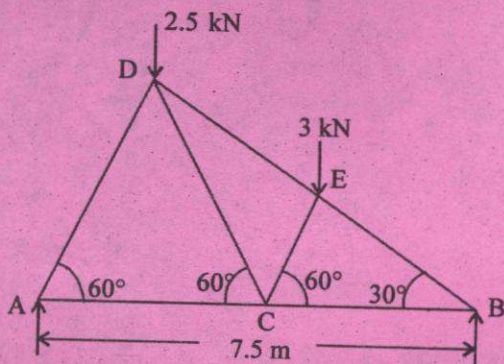
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Fig.(ii)