Code: AE03 **Subject: APPLIED MECHANICS**
Time: 3 Hours **JUNE 2011** **Max. Marks: 100**

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following (2×10)

a. For a cantilever beam of length 'L' having a point load 'P' at its free end, the bending moment at the fixed end is given by

(A) PL **(B)** (P/2)L
(C) P/L **(D)** L/P

b. A body isolated from all the members which are connected to it is called the _____ body

(A) free **(B)** rigid
(C) plane **(D)** solid

c. Analysis of bodies in motion without any references to forces causing the motion is known as

(A) Dynamics **(B)** Kinetics
(C) Kinematics **(D)** none

d. In plane motion, the acceleration will be

(A) non uniform **(B)** increasing
(C) uniform **(D)** none

e. Coulomb friction is friction between dry surfaces

(A) True **(B)** False

f. In a cantilever beam the bending moment is maximum at

(A) the center **(B)** the free end
(C) the fixed end **(D)** any point on the beam

g. Centroid of a semicircle lies at a distance of 0.424 r from the base, where 'r' is the radius of semicircle

(A) True **(B)** False

h. Moment of Inertia of an area dA at a distance x from a reference axis is

(A) $\int xdA$ **(B)** $\int x^2 dA$

(C) $\int x^3 dA$ **(D)** $\int x^4 dA$

i. A point in a body where the entire weight of the body is assumed to be concentrated is known as

(A) axis **(B)** centre of gravity
(C) moment of inertia **(D)** centroid

j. For determining the forces in truss members, using 'Method of Section', the imaginary section should not cut more than _____ number of members

(A) 1 **(B)** 2
(C) 3 **(D)** 4

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Explain the parallelogram of forces. **(6)**

b. A smooth sphere weighing 200 N is lying in a triangular groove as shown in Fig.1. Draw the free body diagram and find the reactions at the surfaces of contact, assuming surfaces of groove to be smooth. **(10)**

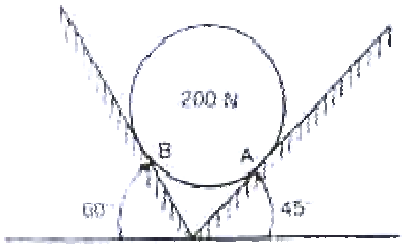

Fig. 1

Q.3 a. Define work and energy. **(4)**

b. A ladder AB supported as shown in Fig.2 carries a vertical load of 6000 N. Find the force P required horizontally at B to keep the ladder in equilibrium. Assume all contact surfaces as smooth. **(12)**

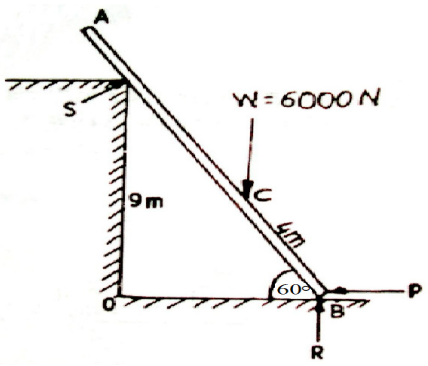

Fig. 2

Q.4 a. Define (i) Buoyancy (ii) Control volume (iii) Drag (iv) Turbulence **(4)**

b. A 10 gm bullet is shot horizontally in to wooden block of mass 1 kg. The bullet gets embedded in the block and the block is displaced on a rough horizontal table ($\mu = 0.2$) through 1 m. what was the velocity of bullet? **(12)**

Q.5 a. Explain Impulse-momentum principle **(5)**

b. Determine the centroid of the plane shown in Fig.3. **(11)**

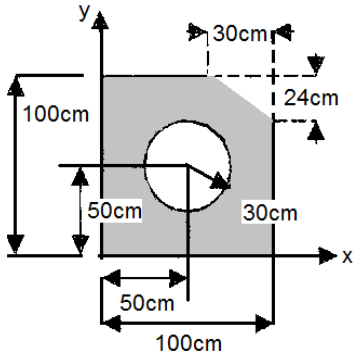

Fig.3

Q.6 Determine shear force and bending moments and construct the shear force and bending moment diagrams for the beam loaded as shown in Fig 4. **(16)**

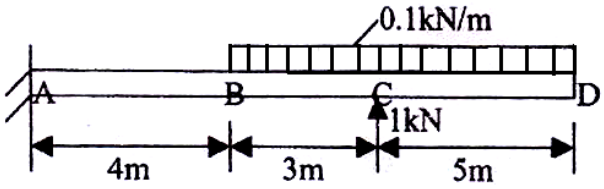

Fig. 4

Q.7 a. Explain stress, strain and Hooke's law. **(6)**

b. Derive the torque equation: $\frac{T}{J} = \frac{fs}{r} = \frac{G\theta}{\ell}$ stating all the assumptions made in proving it. **(10)**

Q.8 If for a two dimensional flow the stream function is given by $\psi = 2xy$, calculate the velocity at the point (3, 6). Show that the potential ψ exists for this case and deduce it. **(16)**

Q.9 The velocity potential function ϕ is given below:

$$\phi = -\frac{xy^3}{3} - x^2 + \frac{x^3y}{3} + y^2$$

Find the velocity components is x and y directions and show that ϕ represents a possible case of flow. **(16)**