Code: DE02   **Subject: APPLIED MECHANICS**
Time: 3 Hours   **Max. Marks: 100**

DECEMBER 2009

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.**
- **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:**   **(2x10)**

a. When the mass centers of the colliding bodies are not located on the line of impact, the impact is specifically referred to as

   (A) direct impact   **(B)** eccentric impact
   (C) oblique impact   **(D)** line of impact

b. Which of the following equation is an equation of motion

   (A) $v = u + at^2$ **(B)** $v^2 - u^2 = 2at$

   (C) $s = ut + \dfrac{1}{2}at^2$ **(D)** $u = s + at$

c. Limiting force of friction is the minimum value of kinetic friction

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

d. A truss having 6 joints and 8 members is termed as _____ truss.

   (A) perfect   **(B)** imperfect or deficient
   (C) redundant   **(D)** none

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

   (A) PL   **(B)** PL/2
   (C) PL/4   **(D)** PL/8

f. The unit of shearing stress in SI units is

   (A) kg/m^2 **(B)** kgf/m

(C) N/m^2 **(D)** N/m

g. For analyzing a frame by method of joints, a joint is selected where number of unknowns are not more than:

(A) 2   **(B)** 3
(C) 4   **(D)** 5

h. The C.G. of a triangular lamina lies at a point where the three medians of the triangle meet

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

i. Power transmitted by a circular shaft is given by

(A) πNT /60 joules   **(B)** 2πNT / 60 watts
(C) πNT/ 1000 watts   **(D)** 2πNT / 1000 watts

j. The angle which an inclined surface makes with the horizontal when a body placed on it is just on the point of moving down is called

(A) Coefficient of friction   **(B)** Angle of inclination
(C) Angle of friction   **(D)** Angle of repose

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

Q.2   a. Define (i) coplanar forces   (ii) concurrent forces   **(3)**

b. A spherical ball of weight 50 N is suspended vertically by a string 50 cm long. Find the magnitude and direction of the least force, which can hold the ball 10 cm above the lowest position as shown in Fig.1. Also find the tension in the string at that point.   **(13)**
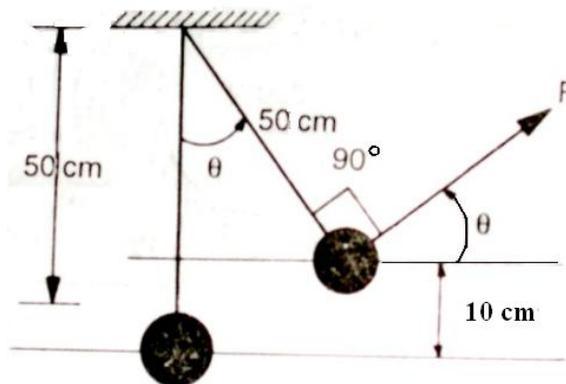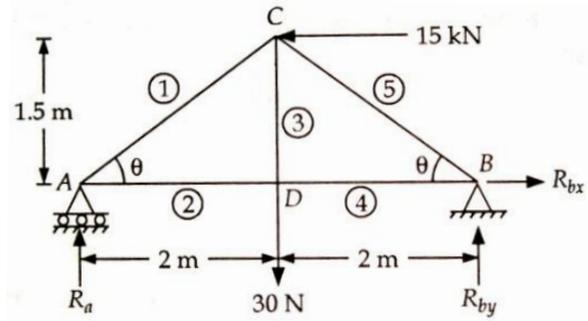

Fig. 1

Q.3 a. Explain *Polygon law of forces* (4)

b. Find the magnitude and nature of forces in the truss shown in Fig.2 using method of joints and tabulate the results. **(12)**

Fig. 2

Q.4 a. ...nd moment of area (ii) Radius of gyration (4)

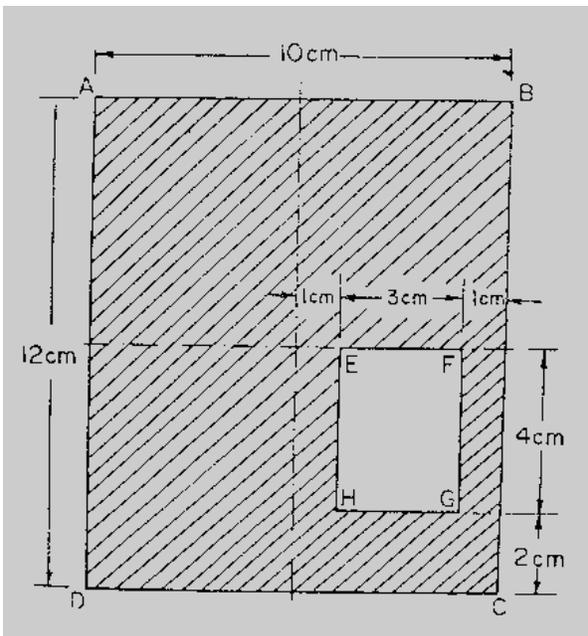b. Find the centroid of the shaded area shown in Fig.3 **(12)**

Fig.3

Q.5 a. State Newton's second law of motion. **(2)**

b. The equation of motion of a particle moving in a straight line is given by
$$x = 15t + 3t^2 - t^3$$

where x is in metres and t is in seconds. Find

(i) the velocity and acceleration at start
(ii) the time when the particle reaches its maximum velocity and the corresponding position
(iii) the maximum velocity of the particle **(14)**

Q.6 a. Derive equation for the work done by force of gravity. **(7)**

b. A 50 N block slides from rest at a point A along a frictionless inclined plane making an angle of 30^0 with horizontal as shown in Fig.4 Find the speed of the block at B which is at a distance of 5 m from A. **(9)**
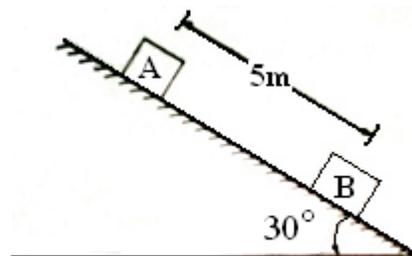

Fig.4

Q.7   a.   Explain the concept of kinetic energy of rotation   **(5)**

b.   The block shown in Fig.5 has a mass of 6 kg. It is attached to a cord which is wrapped around the periphery of a 20 kg. disk that has a moment of inertia $I_A = 0.40$ kg-m^2. If the block is initially moving downward with a speed of 2 m/sec, determine its speed in 3 secs. Neglect the mass of the cord.
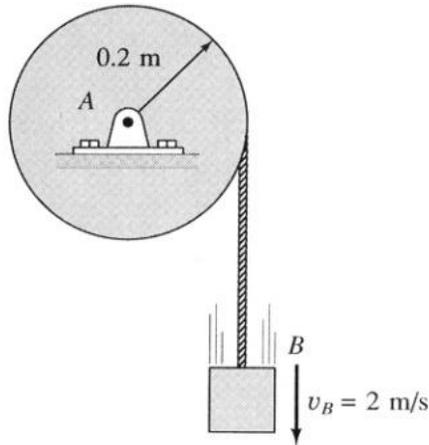**(11)**

0.2 m

A

B

$v_B = 2$ m/s

Fig. 5

Q.8   gran

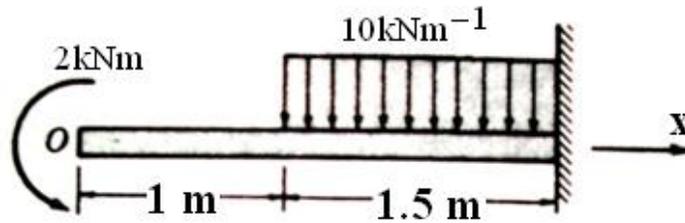

10kNm^{-1}

2kNm

O

X

1 m   1.5 m

Fig.6

Q.9   a.   A solid circular shaft of 3 m length and 200 mm diameter is subjected to torque of 100 kN-m. Find the relative rotation between the end cross section of the shaft. Take G $=1$ x 10^5 N/mm^2.   **(8)**

b.   A wooden tie is 60 mm wide, 120 mm deep and 1.5 m long. It is subjected to an axial pull of 30 kN. The stretch of the member is found to be 0.625 mm. Determine Young's modulus of the tie material.   **(8)**