Code: DE02
Subject: APPLIED MECHANICS
Time: 3 Hours   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.**
- **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 best alternative in the following:**
   **(2x10)**

a.   When the mass centers of the colliding bodies are located on the line of impact, the impact is specifically referred to as
   (A) direct impact   **(B)** central impact
   (C) oblique impact   **(D)** line of impact

b. In plane motion, the acceleration will be
   (A) non-uniform   **(B)** increasing
   (C) uniform   **(D)** None of the above

c. A screw is self locking if the friction angle is _____ helix angle.
   (A) less than   **(B)** more than
   (C) equal to   **(D)** None of the above

d. Moment of Inertia of an area **dA** at a distance **x** from a reference axis is
   (A) $\int x\,dA$ **(B)** $\int x^2\,dA$
   (C) $\int x^3\,dA$ **(D)** $\int x^4\,dA$

e. A point in a body where the entire weight of the body is assumed to be concentrated is known as
   (A) axis   **(B)** center of gravity
   (C) moment of inertia   **(D)** centroid

f. A truss having 5 joints and 7 members is termed as _____ truss.
   (A) perfect   **(B)** imperfect or deficient
          (C)   redundant   **(D)**   None   of   the
   above

g. A body isolated from all the members which are connected to it and all forces shown acting on it is called the
   (A) free body.   **(B)** rigid body.

(C) plane body.   **(D)** solid body.

h.   Newton-meter is the unit of
     (A) force   **(B)** momentum
     (C) moment   **(D)** deflection

i.   Coulomb friction is friction between dry surfaces
     (A) True   **(B)** False
j.   A couple is formed by two unequal but parallel forces.
     (A) True   **(B)** False

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

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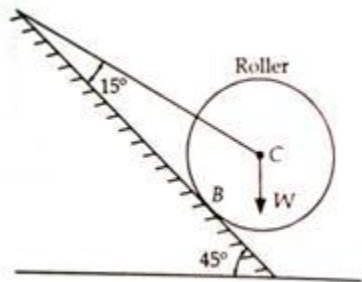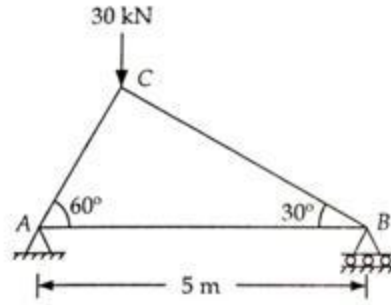

                                                           b.   A roller of 850 N is resting on a smooth
         inclined plane and is held by a string as shown in Fig.1. Determine the (i) reaction
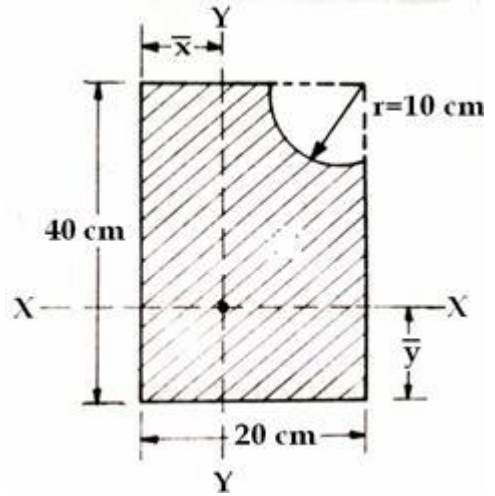   at B (ii) tension in the string.   **(10)**

Fig.1

Q.3   a.   Define (i) perfect frame (ii) deficient frame (iii) redundant frame.
              (6)

          b.   Determine the forces in all the members of the truss shown in Fig.2.
              (10)

Fig.2

**Q.4** a. Define perpendicular axis theorem and prove the same. **(6)**

r=10 cm

40 cm

20 cm

b. Locate the centroid of the shaded
area   shown   in   Fig.3.

(10)

Fig.3

Q.5 a. Define
   (i) angle of friction
   (ii) dry friction
   (iii) frictional force
   (iv) limiting frictional force   **(6)**

   b.   An object weighing 200 N is 1.8 m wide and
   2.5 m high rests on a rough horizontal floor, the coefficient of friction for which is
   0.2. A pull P is applied at 25^0 with the horizontal as shown in Fig.4. If P is
   gradually increased till equilibrium is broken, state clearly whether the block will
   be at the point of sliding or at the point of toppling about A.
   (10)
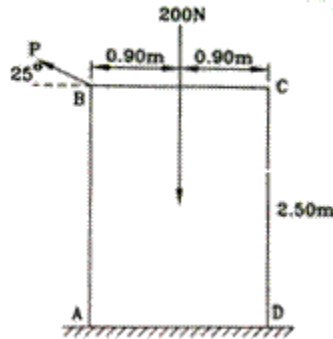
Fig.4

Q.6 a. Define
   (i) point of contra flexure
   (ii) bending moment   **(3)**

   b. Determine shear force and bending moments and construct the shear force and
   bending moment diagrams for the beam loaded as shown in Fig.5.   **(13)**
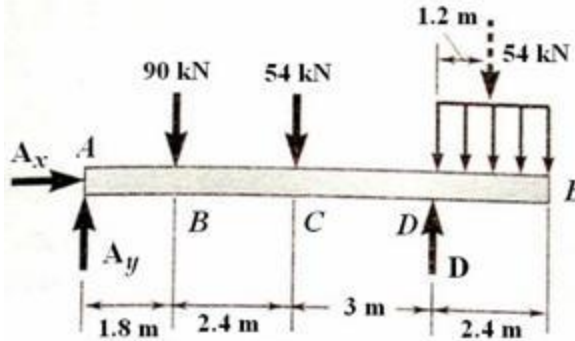
Fig.5

Q.7 a. State and prove Lami's theorem. **(4)**

b. A steel shaft transmits 105 kW at 160 rpm. If the shaft is 100 mm in diameter, find the torque on the shaft and the maximum shearing stress induced. Find also the twist of the shaft in a length of 6 m. Take $G = 8 \times 10^4$ N/mm^2 **(12)**

Q.8 a. Explain work-energy principle and principle of conservation of energy. **(4)**

b. A body falling freely under the action of gravity passes two points 20 m apart vertically in 0.4 secs. From what height, above the higher point, did the body start to fall? Take $g = 9.8$ m/sec^2. **(12)**

Q.9 a. A round copper rod, 560 mm long, has a diameter of 30 mm over a length AB of 200 mm, a diameter of 20 mm over a length BC of 200 mm and a diameter of 10 mm over its remaining length CD. Determine the stress in each section and elongation of the rod when it is subjected to a pull of 30kN. Take E = 100 kN/mm^2.
(8)

b. A particle initially at origin, moves along a straight line with velocity $v = t^2 - t$ m/sec. Determine average velocity, average speed and distance travelled during interval $0 < t < 3.5$ secs **(8)**