December 2005

Code: D-02 **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 A 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 A Choose the correct or best alternative in the following: **(2x10)**

a. If the line of action of all the forces meet at a single point, then the force system is known as
(A) Collinear **(B)** Coplanar
(C) Concurrent **(D)** Parallel.

b. A Free body diagram of an hinged support contains
(A) Vertical reaction only
(B) Horizontal reaction only
(C) Both horizontal and vertical reactions
(D) Horizontal, vertical reactions and a moment

c. 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)** 2 PL

d. The kinetic energy of a body of mass 'm' moving with a velocity 'v' is equal to
(A) mv **(B)** $(m^2v)/2$
(C) (mv)/2 **(D)** $(mv^2)/2$

e. A triangular three member frame is an example of _____ frame
(A) Perfect **(B)** Imperfect
(C) Redundant **(D)** Collapsible

f. The unit of bending moment in SI units is
(A) Kg/m **(B)** Kg-m
(C) N/m **(D)** N-m

B State which of the statement is true and which are false.

g. First moment of area about the centroidal axis is positive

h. A body moving along a curved path has only tangential acceleration

i. The instantaneous center of rotation of a body lies always outside the body

j. Velocity of a body is a scalar quantity

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

Q.2 a. Define Lami's theorem. **(2)**

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 groove is also smooth. **(8)**

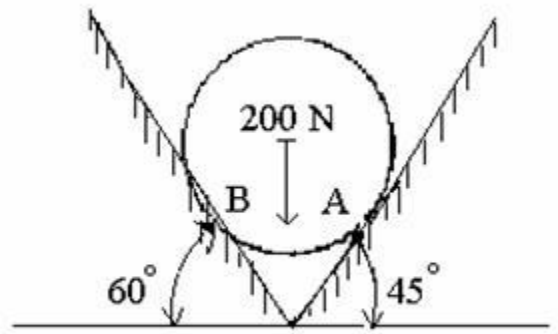

Fig.1

c. A system of forces in equilibrium is shown in Fig.2. Determine the force 'P' and the angle 'θ'. **(6)**

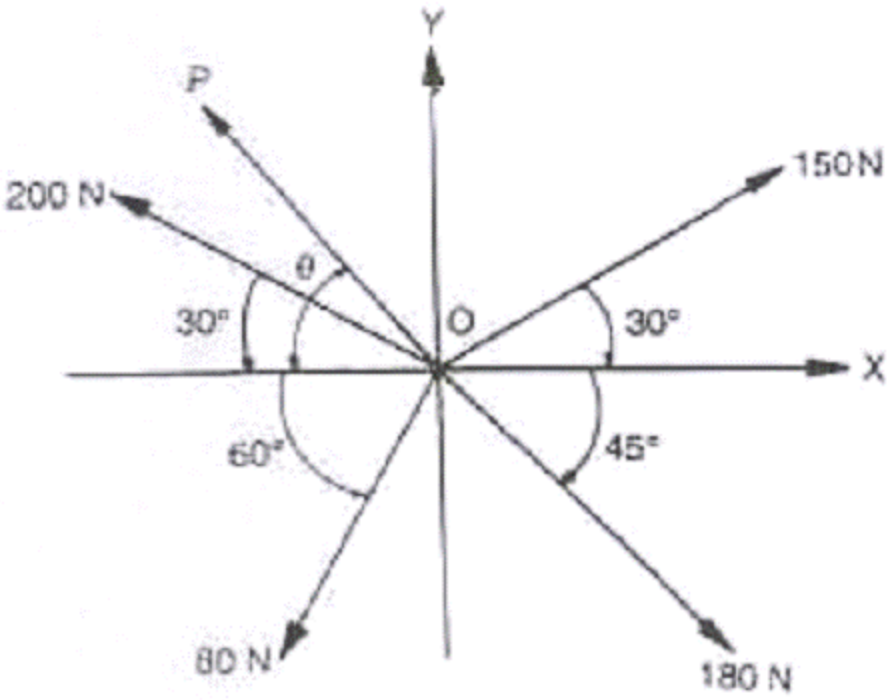

Fig.2

Q.3 a. Derive the expression for moment of inertia of a circular lamina of radius 'r' about a horizontal axis passing through the centre. **(8)**

b. Find the distance of centroid of the shaded portion shown in Fig.3 about axis AB.
(8)

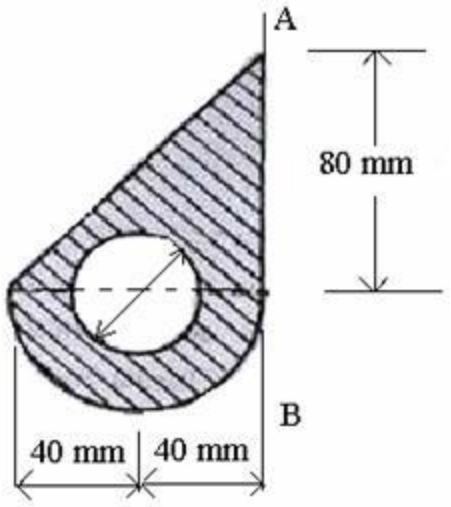

Fig. 3

Q.4 a. Define:

(i) Static friction
(ii) Coefficient of friction
(iii) Angle of friction
(iv) Angle of repose **(8)**

b. A body resting on a horizontal rough surface requires a pull of 180 N inclined at 30^o to the surface for just to move it. It was found that a push of 220 N inclined at 30^o to the surface was able to just move the body. Determine the weight of the body and coefficient of friction between the body and the surface. **(8)**

Q.5 Using method of joints, determine the forces and their nature in all the members of the pin jointed plane truss shown in Fig. 4. Tabulate the results. **(16)**

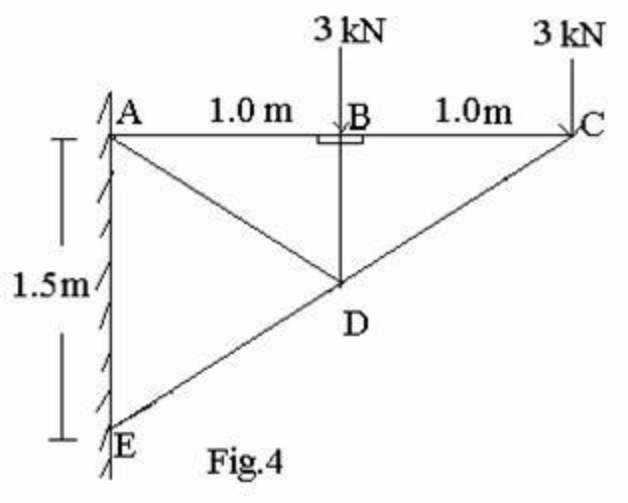

Fig.4

Q.6 a. Explain (i) Impulse-momentum principle (ii) Law of conservation of linear momentum. **(8)**

b. The angle of rotation of a body is given by the equation:

$$\theta = 2\,t^3 - 5\,t^2 + 8\,t + 6$$

Where θ is in radians and t is in secs.
Determine (i) angular velocity (ii) angular acceleration of the body When t = 0 and t = 4 secs. **(8)**

Q.7 a. Define:

(i) Hooke's law
(ii) Moment of Inertia
(iii) Poisson's ratio
(iv) Thermal stress **(8)**

b. A hollow cast iron cylinder 4 m long, 300 mm outer diameter, and thickness of metal 50 mm is subjected to a central load on the top when standing straight. The stress produced is 75000 k N/m^2. Assume Young's modulus for cast iron as 1.5×10^8 kN/m^2. Determine the magnitude of the load applied, longitudinal strain and total decrease in length. **(8)**

Q.8 a. Derive the Torque equation for pure torsion of shaft stating clearly the assumptions made.

$$\frac{f_s}{R} = \frac{C\theta}{l}$$ **(6)**

b. Determine the diameter of a solid shaft which will transmit 90 kW at 160 rpm, if the shear stress in the shaft is limited to 60 N / mm^2. Find also the length of the shaft, if the twist must not exceed 1 degree over the entire length. Take C = 8 x 10^4 N/mm^2 **(10)**

Q.9 a. Define point of contraflexure. **(2)**

b. For the beam loaded as shown in Fig.5, draw the shear force and bending moment diagrams. **(14)**

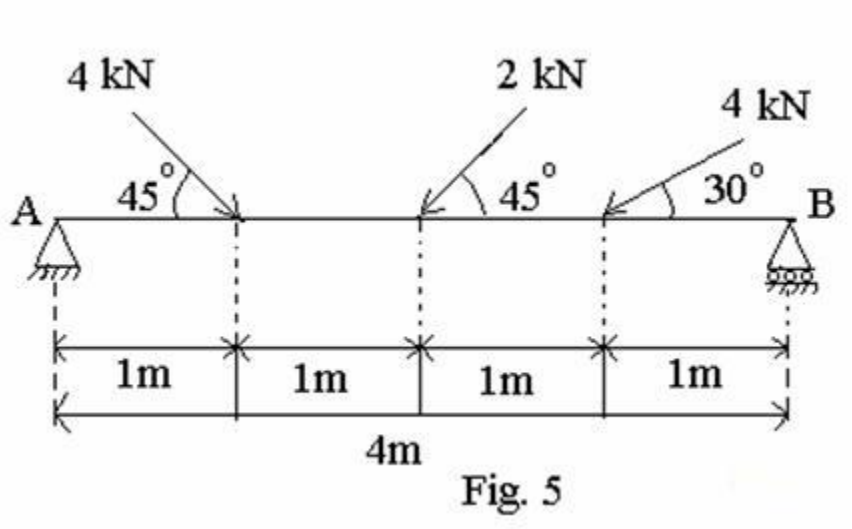

Fig. 5

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