JUNE 2009

AMIETE – ET (OLD SCHEME)

Code: AE03 **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 the best alternative in the following: (2 × 10)

a. Lami's theorem can be applied for:

(A) 3 concurrent and coplanar forces **(B)** 3 non-concurrent forces

(C) 3 parallel forces **(D)** 3 collinear forces

b. One poise is equal to

(A) 1 Ns/m^2 **(B)** 10 Ns/m^2

(C) 0.1 Ns/m^2 **(D)** 0.01 Ns/m^2

c. The tangential velocity of any point "Q" on a body, rotating with angular velocity, with instantaneous center of rotation "C" is equal to:

(A) Q C ω **(B)** Q C ω^2

(C) Q C/ ω **(D)** Q C/ ω^2

d. When coefficient of restitution is zero, the bodies are

(A) inelastic **(B)** partly elastic

(C) perfectly elastic **(D)** none of the above

e. If the resultant between two forces of 120 N and 120 N is 120 N, then the angle between the two forces is _____ degrees

(A) 30 **(B)** 60

(C) 90 **(D)** 120

f. Centrifugal force acting on a body moving along a circular path is given by
(A) $m\ r\ \omega^2$ **(B)** $m\ r\ \omega$

(C) $m^2\ r\ \omega$ **(D)** none

g. When a body is subjected to forces from all the directions, and is in equilibrium the body is said to be under _____ stress
(A) compressive **(B)** tensile

(C) shear **(D)** volumetric

h. In a cantilever beam the bending moment is maximum at
(A) the center **(B)** the free end

(C) the fixed end **(D)** one third of the length from fixed end

i. When a force F acts for a short time *dt* on a body, then F.*dt* is called
(A) momentum **(B)** impulse

(C) work done **(D)** power

j. Instantaneous centre of rotation has a velocity equal to
(A) Zero **(B)** 1

(C) less than 1 **(D)** more than 1

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

Q.2 a. Define coplanar forces and deficient frame **(4)**

b. Give the equations of equilibrium for concurrent force system. **(3)**

c. A beam is subjected to various forces as shown in Fig. 1 Determine the magnitude, direction and location of the resultant force. **(9)**

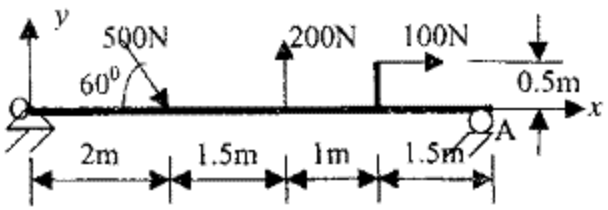
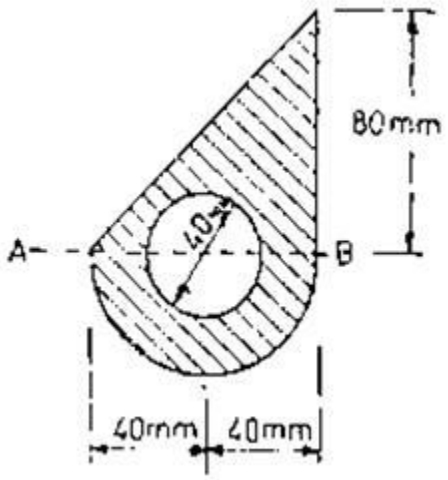


Fig. 1

Q.3 a Define moment of inertia and radius of gyration. **(4)**



b. Determine the moment of inertia of the shaded portion shown in Fig. 2 about axis AB. **(12)**

Fig. 2

Q.4 a. Define:

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

b. A box lying on the ground requires a pulling force of 0.18 kN at an angle 30° for just to move it. Same box needs a pushing force of 0.22 kN inclined at 30° to just move it. Find (i) coefficient of friction between the box and the ground (ii) the weight of the box. **(8)**

Q.5 a. Explain

(i) Work-energy principle (ii) Law of conservation of energy
(6)

b. A truck starts from rest accelerates to a speed of 60 km/hr in a distance of 50 m. The air resistance for the motion of the truck is 0.1 kN. Truck weighs 19.62 kN. Find the average driving force acting on the truck. Using the average force, find the greatest power developed by the engine of the truck. **(10)**

Q.6 a. Explain (i) Impulse-momentum principle (ii) Law of conservation of linear momentum. **(5)**

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 $C = 8 \times 10^4$ N/mm^2. **(11)**

Q.7 a. Prove that $P = (2\pi N T / 60)$ watts,
where,
P = Power
N = Speed of rotation (rpm)
T = Torque Nm **(6)**

b. A hollow metallic pipe is 5 cm thick, 400 cm long, 0.3 m outer diameter is standing up-right. It is subjected to an axial load on the top. The stress produced due to the applied load is 75 MPa. Modulus of elasticity of the pipe material is $0.15x10^6$ MPa. Find the following:
(i) Magnitude of the load applied (ii) longitudinal strain
(iii) change in length **(10)**

Q.8 a. Define
(i) bending moment (ii) Shear force

(iii) point of contra flexure (iv) angular acceleration **(8)**

b. Determine the angular velocity and angular acceleration of a body rotating with following the equation: $\Psi = 0.5\ t^3 - t^2 + 1.3\ t + 4.3$ at (i) t = 0 , (ii) t = 2 and (iii) t = 4 secs.
Where Ψ is in radians and t is in secs. **(8)**

Q.9 a. The discharge in a horizontal water supply pipe with a diameter of 250 mm is increased from 2.453 ltrs/sec to 9.812 ltrs/sec in three seconds. What pressure gradient should exist to cause this acceleration? Calculate the difference of pressure also in a length of 500 m. **(8)**

b. The velocity component along x-axis of a fluid flow is given by :
$u = 8x^2 + 5y^2 + z^2$ and that along y-axis is given by $v = 7x^2 y - 2yz + 6xy$. Using continuity equation, determine the velocity component of fluid flow along z-axis. **(8)**