ROLL NO. ___________________

Code: AE03 **Subject: APPLIED MECHANICS**

AMIETE – ET (OLD SCHEME)

Time: 3 Hours **OCTOBER 2012** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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. The moment of inertia of a rectangular section of base (b) and height (h) about an horizontal axis passing through C.G. is given by the reaction.

(A) $\frac{bh^3}{12}$ **(B)** $\frac{bh^3}{24}$

(C) $\frac{bh^3}{36}$ **(D)** $\frac{bh^3}{48}$

b. Jet engine works on the principle of

(A) Conservation of linear momentum
(B) Conservation of mass
(C) Conservation of energy
(D) Conservation of angular momentum

c. A body rebounds after impacting a fixed smooth surface. If the impact is perfectly elastic, the following is conserved

(A) Momentum. **(B)** Kinetic energy.
(C) Momentum and Kinetic energy. **(D)** Velocity.

d. The relationship $s = ut + \frac{1}{2}at^2$ is applicable to bodies

(A) Moving with any type of motion
(B) Moving with uniform velocity
(C) Moving with uniform acceleration
(D) Both **(B)** and **(C)**

e. A framed structure is perfect, if the numbers of members are ____ 2j–3, where j is the number of joints

(A) less than **(B)** equal to
(C) greater than **(D)** either **(A)** or **(C)**

f. A rigid body in translation

(A) cannot move on a circular path.
(B) can move along a straight or curved path.
(C) must under go plane motion only.
(D) can move only in a straight line.

g. Three forces acting on a rigid body are in equilibrium. They must be

(A) coplanar. **(B)** concurrent.
(C) parallel. **(D)** collinear.

h. A cantilever AB of length L has a moment M applied at its free end. The deflection at the free end B is given as

(A) M^2L/EI **(B)** $ML^2/2EI$
(C) $ML/2EI$ **(D)** $M^2L/2EI$

i. 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

j. Total pressure on a horizontal immersed surface is –

(A) wA **(B)** $w\bar{x}$
(C) $wA\bar{x}$ **(D)** $wA^2\bar{x}$

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

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

b. A 7.0 m long ladder rests against a vertical wall, with which it makes an angle of 45°. If a man whose weight is one half of that of the ladder, climbs it, at what distance along the ladder will he be, when the ladder is about to slip?
The coefficient of friction between the ladder and the wall is 1/3 and that between the ladder and the floor is 1/2. **(10)**

Q.3 a. Explain the principle of work and energy for a rigid body. **(4)**

b. Two blocks of masses M_1 and M_2 are placed on two inclined planes of elevation θ_1 and θ_2 and are connected by a string as shown in (Fig.1). Find the acceleration of masses. The coefficient of friction between the blocks and the plane is μ.

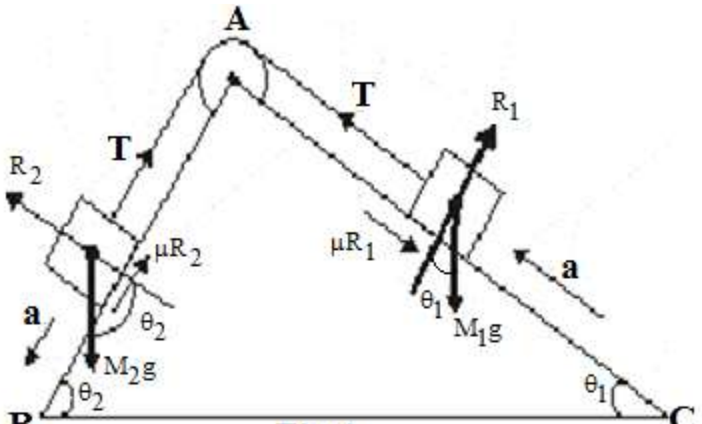

Fig.1

Assume the following numerical data

$M_1 = 5$kg, $\theta_1 = 30°$

$M_2 = 10$kg, $\theta_2 = 60°$ and $\mu = 0.33$ **(12)**

Q.4 a. Explain Impulse- Momentum Principle. **(5)**

b. A man of mass 50 kg stands at the one end of a 5m long floating boat of mass 250 kg. (Fig.2). If the man walks towards the other end of the boat at a steady rate of 1.0 m/s, determine –

(i) the velocity of the boat as observed from the ground.

(ii) the distance by which the boat gets shifted. **(11)**

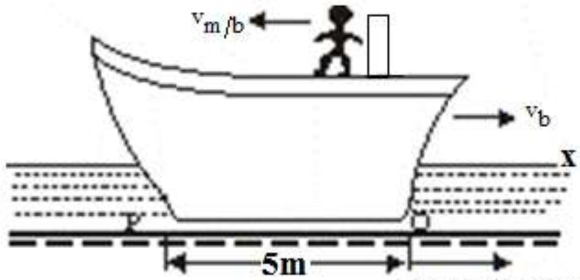

Fig.2

velocity positive in this direction

Q.5 a. Explain stress, strain and Hooke's law. **(5)**

b. Find the position of centroid and moment of Inertia about the X-X and Y-Y axes of the angle section shown in Fig.3. **(11)**

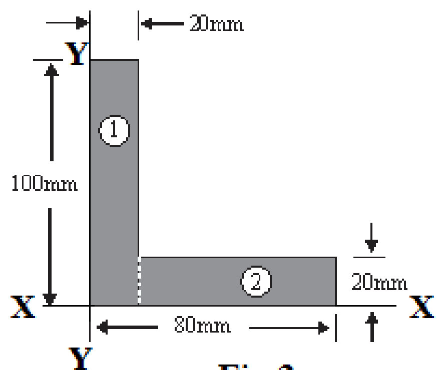

Fig.3

Q.6 a. Define: shear force, bending moment and point of inflection. **(6)**

b. A beam AB 10 meters long has supports at its ends A and B. It carries a point load of 5 KN at 3 meters from A and a point load of 5 KN at 7meters from A and a uniformly distributed load of 1KN per meter between the point loads. Draw SF and BM diagrams for the beam. **(10)**

Q.7 a. Explain:
(i) Stream function (ii) velocity potential function. **(6)**

b. A beam section is 10m. long and is simply supported at the ends. It carries concentrated load of 100KN at the centre of beam. Calculate the deflection at the centre. Take I= 18 X 10^8 mm^4 and E= 200KN/ mm^2 **(10)**

Q.8 a. Derive the torque equation $\frac{T}{J} = \frac{f_s}{r} - \frac{G\theta}{\ell}$ stating all assumptions. **(8)**

b. A circular shaft 45 mm diameter is subjected to a twisting moment of 9000 Nm. Its length is 1m. Find the maximum shear stress and angle of twist. **(8)**

Q.9 a. Define Pascal's law. **(4)**

b. A triangular plate of 1m base and 1.5 m altitude is immersed in water. The plane of the plate is inclined at 30° with water surface, while the base is parallel to and at a depth of 2m from the water surface. Find the total pressure on the plate and the centre of pressure. **(12)**