DipIETE – ET (OLD SCHEME)

JUNE 2009 **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 the best alternative in the following: (2 × 10)

a. Newton's first law of motion gives the concept of
(A) work **(B)** force
(C) inertia **(D)** energy

b. The free body diagram of a body shows the body.
(A) with its surroundings and external forces acting on it.
(B) isolated from all external effects.
(C) isolated from its surroundings.
(D) isolated from its surroundings and all external actions acting upon it.

c. When a bullet is fired from a gun, it is recoiled in the backward direction. It is due to
(A) Impulse. **(B)** inertia.
(C) conservation of momentum. **(D)** conservation of energy.

d. A second's pendulum of a clock executes ……. per second
(A) half a beat **(B)** one beat
(C) two beats **(D)** ten beats

e. A particle is moving along a circular path with uniform speed. The force acting on the particle is
(A) zero.
(B) constant in magnitude only.
(C) continuously varying in magnitude and direction.
(D) constant both in magnitude and direction.

f. The MOI of a body does not depend upon
(A) shape of the body.
(B) mass of the body and its distribution within the body.

(C) axis of rotation of the body.
(D) angular velocity of the body.

g. The magnitude of coefficient of static friction between two bodies in contact
(A) always lies between zero and unity.
(B) may exceed unity.
(C) is less than the coefficient of dynamic friction between the same pair of bodies.
(D) depends upon areas of contact.

h. The elastic constant E, G and K are related by expression

(A) $E = \frac{GK}{2K + G}$ **(B)** $E = \frac{GK}{K + 2G}$

(C) $E = \frac{3GK}{K + 2G}$ **(D)** $E = \frac{9GK}{3K + G}$

i. The product EI is known as

(A) section modulus **(B)** modulus of rupture
(C) flexural rigidity **(D)** polar modulus

j. A solid circular shaft is to transmit power P kW when turning N revolution per minute. For a given shear stress, the shaft diameter will be proportional to

(A) $\left(\frac{P}{N}\right)^{\frac{1}{3}}$ **(B)** $\left(\frac{P}{N}\right)$

(C) $\left(\frac{P}{N}\right)^{\frac{2}{3}}$ **(D)** $\left(\frac{P}{N}\right)^{3}$

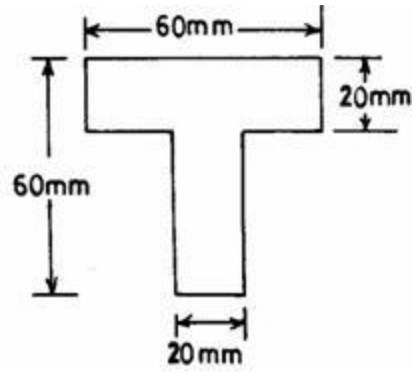
Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. What is the concept of free body diagram? **(6)**

b. Find the greatest and the least resultant of two forces whose magnitudes are 50 N and 30 N respectively acting at an angle of 30° to each other by making the suitable assumptions in respect of their angle of inclination. **(10)**

Q.3 a. Define the terms 'Centroid', 'Centre of gravity' and 'Moment of inertia'. **(6)**

b. Determine the position of the centroid of T-section as shown in figure. Also calculate the moment of inertia of T-section about the horizontal and vertical centroidal axes (I_{xx} and I_{yy}) **(10)**



Q.4 a. State the laws of static friction **(6)**

b. A block of wood weighs 25 N. It can be just drawn along a table by a horizontal force of 15 N. Find

(i) Co-efficient of friction,

(ii) If the block is then loaded with another 10 N load, which least force would be able to move the block? **(10)**

Q.5 a. Define Newton's second law of motion and derive force equation f = ma. **(6)**

b. A car of mass 2500 kg moves on a level road under the action of 1 kN propelling force. Find the time taken by the car to increase its velocity from 36 kmph to 54 kmph. **(10)**

Q.6 a. State D'Alembert's principle. **(6)**

b. A hammer weighing 20 N is moving with a speed of 5 m/s, strikes the head of a nail and drives it 20 mm into the wall. Neglecting the mass of nail, calculate:

(i) Acceleration during impact; (ii) Time taken to drive the nail

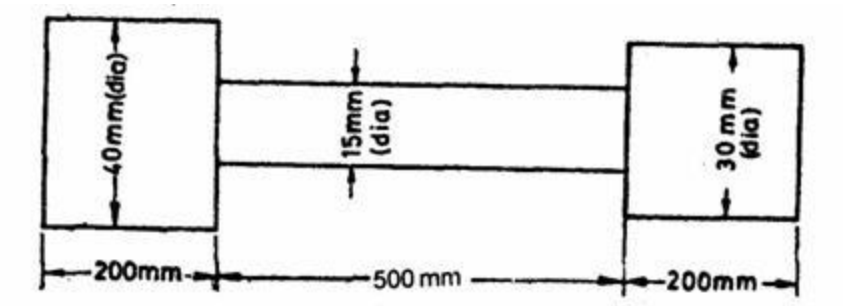
(iii) Impulse; (iv) Impulsive force. **(10)**

Q.7 a. Define stress, strain and poisson's ratio. **(6)**

b. A steel bar 900 mm long; its two ends are 40 mm and 30 mm in diameter and the length of each enlarged end is 200 mm. The middle portion of the bar is 15 mm in diameter and 500 mm long. If the bar is subjected to an axial tensile load of 15 kN, find its total extension.

Take $E = 2 \times 10^8 \text{ kN/m}^2$

(10)



Q.8 a. What assumptions are made while driving the torsion equation? **(6)**

b. What must be the length of a 5 mm diameter aluminium wire be so that it can be twisted through one complete revolution without exceeding a shearing stress of 42 MN/m^2. Take C= $27GN/m^2$ **(10)**

Q.9 a. Define bending moment, shear force and point of contraflexure. **(6)**

b. Draw the B.M. and S.F. diagrams for the beam loaded as shown in Fig.9(b). **(10)**

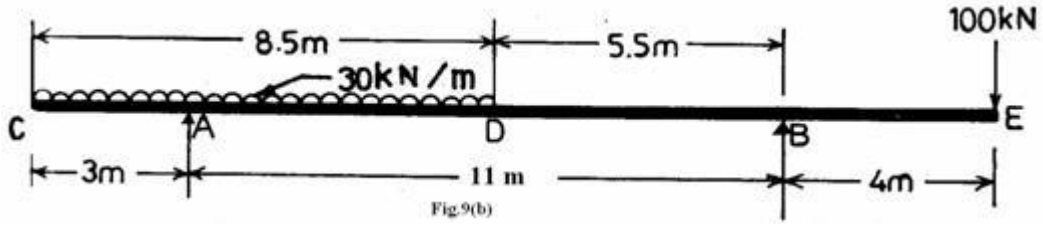


Fig.9(b)