First/Second Semester B.E. Degree Examination, Dec.2017/Jan.2018
Elements of Civil Engineering & Engineering Mechanics

Time: 3 hrs.

Max. Marks:100

Note: *Answer any FIVE full questions, choosing at least two from each part.*

PART – A

1 a. Choose the correct answers for the following : **(04 Marks)**
   i)   The person who designs the synchronization of the signals,
         A) Geo-technical Engineering   B) Transportation Engineering
         C) Water-Resource Engineering   D) Surveyor
   ii)   The person involved in locating the centre line of the road or dam is,
         A) Geotechnical engineer   B) Transportation engineer
         C) Structural engineer   D) Surveyor
   iii) London bridge is an example for,
         A) Bascule bridge   B) Suspension bridge   C) Stone bridge   D) Arch bridge
   iv)   Krishnaraja Sagar Dam is an example for _____ dam.
         A) Gravity   B) Arch   C) Earthen   D) Concrete

   b. Explain the role of a civil engineer with an example for each activity. **(08 Marks)**
   c. Draw a neat sketch and mark the salient features of, (i) National Highway (ii) Earthen Dam. **(08 Marks)**

2 a. Choose the correct answers for the following : **(04 Marks)**
   i)   The tendency of a force to cause rotation about a point is called as,
         A) Force   B) First moment   C) Second moment   D) None of these
   ii)   If a force system has only a rotational motion then,
         A) R = M = 0   B) R = 0   C) M = 0   D) R & M ≠ 0
   iii) State in which of the following actions the applied force does not produce a moment,
         A) Peadling of bicycle   B) Stretching of spring
         C) Opening of water tap   D) Opening of a door
   iv)   While taking a left turn the driver of an automobile exert 200 N forces of equal magnitude on the strering with outer radius of 15 cm. Moment of the couple about its rotation is,
         A) 6 N-m   B) 0.6 N-m   C) 60 N-m   D) 30 N-m

   b. Explain the basic idealization of engineering mechanics. **(04 Marks)**
   c. A triangle AB = 8 m, BC = 6 m and AC = 10 m. The force creates a clockwise moment 400 kN-m about point B and counter clockwise moment of 119.62 kN-m about C. The moment about A is zero. Find the magnitude and direction of the force. **(06 Marks)**
   d. A force 2 kN acting at a point A on the lever shown in Fig. Q2 (d).
       (i)   Replace this force by a horizontal force and find its magnitude, which produces same moment about point B.
       (ii) Find the magnitude of least force acting at point and produces the same moment. **(06 Marks)**

3 a. Choose the correct answers for the following : **(04 Marks)**
   i)   Varignon's theorem used to find_____ of the resultant.
         A) Direction   B) Magnitude   C) Position   D) All the above
   ii)   The resultant of two forces P & Q is at right angle to P.then the angle between P & Q is,
         A) $\cos^{-1}\left(\dfrac{-P}{Q}\right)$ B) $\cos^{-1}\left(\dfrac{Q}{P}\right)$ C) $\cos^{-1}\left(\dfrac{P}{Q}\right)$ D) $\cos^{-1}\left(\dfrac{-Q}{P}\right)$

   iii) Collinear forces are those which,
         A) are concurrent at a point   B) are parallel to each other
         C) lie on the same plane   D) Act on different plane.

iv) The rectangular components of the force 100 N acting along the direction of SSE are,
A) $-100\cos 292.5, -100\sin 292.5$
B) $-100\cos 292.5, 100\sin 292.5$
C) $100\cos 292.5, -100\sin 292.5$
D) $100\cos 292.5, 100\sin 292.5$

b. Find the magnitude of the force Q and the angle θ made by the force P shown in Fig. Q3 (b). If their resultant acts along the horizontal line with a magnitude of 1.5 kN.
(06 Marks)

c. State and prove Varignon's theorem. **(04 Marks)**

d. Find the magnitude, direction and position of the resultant for the force system, acting on a square of side 'a', of magnitude 2P, 3P, 4P and 5P taken in order. [From any one vertex] **(06 Marks)**

4 a. Choose the correct answers for the following : **(04 Marks)**
   i) Centre of gravity of a body and centre of the mass coincide when _____ is uniform throughout,
      A) Mass   B) Area   C) Thickness   D) Acceleration due to gravity
   ii) If an area has an axis of symmetry,
      A) First moment is zero on that axis   B) Its centroid lies on that axis
      C) Both (A) & (B)   D) None of these
   iii) The centroid of an arc of circle symmetric about x-axis, with subtended angle '2α' is,
      A) $\dfrac{2R}{3\alpha}$ B) $\dfrac{2R\tan\alpha}{3\alpha}$ C) $\dfrac{2R\cos\alpha}{3\alpha}$ D) $\dfrac{2R\sin\alpha}{3\alpha}$
   iv) The centroid of an equilateral triangle of breadth 'b' is
      A) $\dfrac{1}{2\sqrt{3}b}$ B) $\dfrac{1}{3\sqrt{2}b}$ C) $\dfrac{1}{\sqrt{6}b}$ D) $\dfrac{1}{\sqrt{8}b}$

b. Find the relationship between 'a and b' in the Fig. Q4 (b) if the centroid lies along the axis AB. **(07 Marks)**

c. Find the centroid of the lamina shown in Fig. Q4 (c). **(09 Marks)**

PART – B

5 a. Choose the correct answers for the following : **(04 Marks)**
   i) The example of statically indeterminate beam,
      A) Cantilever beam   B) Over hang beam
      C) Propped Cantilever beam   D) Simply supported beam
   ii) A rigid body has _____ degree of freedom,
      A) one   B) two   C) four   D) six
   iii) The type of joint that can resist the moment is,
      A) Roller   B) Pin   C) Hinge   D) Fixed
   iv) In the method of section for trusses the section must pass, so as to cut not more than _____ members.
      A) 2   B) 3   C) 4   D) 5

b. Find the magnitude of W, which produce a magnitude of 160 N in member AB of the truss shown in Fig. Q5 (b). For this loading calculate the force in the member AE and FE of the truss using method of section. **(08 Marks)**

c. The beam AB supports two concentrated loads and rests on soil which exerts a linearly distributed upward load as shown in Fig. Q5 (c). Determine (i) the distance 'a' for which $W_A = 20$ kN/m and (ii) corresponding W_B. **(08 Marks)**

6 a. Choose the correct answers for the following : **(04 Marks)**

i) The equilibrium equation for the concurrent forces are,

A) $\sum H = 0$ B) $\sum V = 0$ C) Either A or B D) Both A and B

ii) The reaction force at the contact point between two surfaces,

A) Parallel to the contact surfaces
B) Acts normal to the contact surface
C) Acts at an angle 45° to the contact surface
D) acts at the same angle as that with horizontal

iii) If a body is in static equilibrium then it implies that the body,

A) is at rest B) is at rest or moving with constant velocity
C) Moving with constant acceleration D) Is oscillating about a fixed point

iv) Which of the following system of forces cannot be reduced a single force?

A) Non-concurrent forces in space B) Non-concurrent forces in a plane
C) Parallel forces in space D) Parallel forces in a plane.

b. Explain the different internal forces acting in the force system. **(03 Marks)**

c. Two spheres of radius R are placed in a channel having vertical walls of breadth B. Show that the reaction between the two spheres is $\dfrac{2RW}{\sqrt{4BR - B2}}$. (Ref. Fig. Q6 (c)) **(06 Marks)**

d. A rope ABCD 3.6 m long is tied between two points A and D which are 3.2 m apart as shown in Fig. Q6 (d). Determine the tension in each part of the string and weight W (use Lami's theorem) such that BC is horizontal. **(07 Marks)**

7 a. Choose the correct answers for the following : **(04 Marks)**

i) The unit of coefficient of friction is.

A) Newton B) Radian C) Metre D) Dimensionless

ii) At the point of impending motion, the static frictional force is,

A) zero B) maximum C) minimum D) infinite

iii) A thin film of water _____ the friction between ice and skate blades

A) Reduces B) increases C) No change D) Depends on ice

iv) The tangent of the angle of friction is _____

A) Angle of repose B) Coefficient of friction
C) Cone of friction D) Limiting friction

b. Two identical blocks A & B are connected by a rod, rest against a vertical wall and horizontal floor as shown in Fig. Q7 (b). Find the coefficient of friction between bar and wall and bar & ground, if they are same. **(06 Marks)**

c. In the system of blocks shown in Fig. Q7 (c), determine the range of weight of block A if weight of block B is 150 N and the coefficient of friction at all contact surface is 0.25. **(10 Marks)**

8 a. Choose the correct answers for the following : **(04 Marks)**

i) The polar moment of inertia of a hollow circular section is,

A) $\dfrac{\pi}{32}\left[d_1^4 - d_2^4\right]$ B) $\dfrac{\pi}{16}\left[d_1^4 - d_2^4\right]$ C) $\dfrac{\pi}{64}\left[d_1^4 - d_2^4\right]$ D) $\dfrac{\pi}{64}\left[d_1^2 - d_2^2\right]$

ii) _____ moment of inertia is used for designing of shafts,

A) MI on x-axis B) Product C) Polar D) None of these

iii) Moment of inertia of a rectangular section on the vertical centrodial axis is 3×10^8 mm^4, if its breadth is 200 mm then its depth is _____.

A) 450 mm B) 445 mm C) 455 mm D) None of these

iv) The radius of gyration of a cross section is 30 cm and its area is 15 cm^2. The moment of inertia is,

A) 13500 cm^4 B) 13500 cm^2 C) 13500 cm D) 13500 (no-units)

b. Derive an expression for the moment of inertia of an equilateral triangle of base 'b' and height 'h' on the vertical centroidal axis. **(08 Marks)**

c. Determine the distance between two C-channels shown in Fig. Q8(c) if their moment of inertia remains same on their centroidal axis. **(08 Marks)**
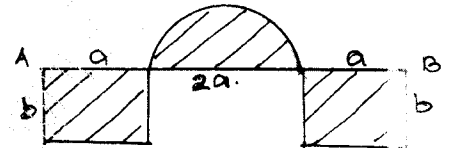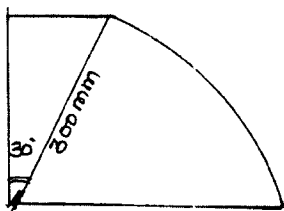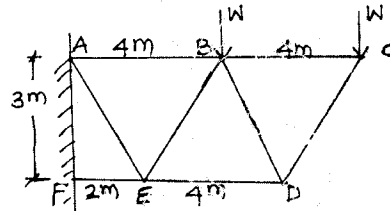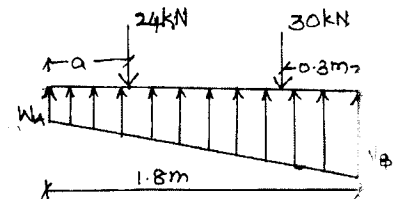

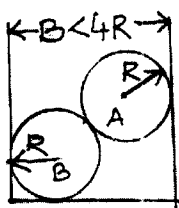Fig. Q2 (d)

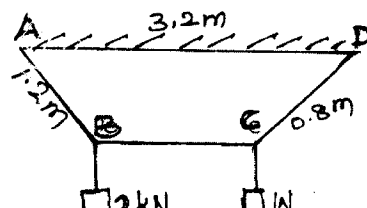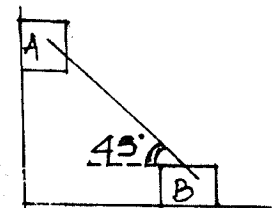
Fig. Q3 (b)

Fig. Q4 (b)

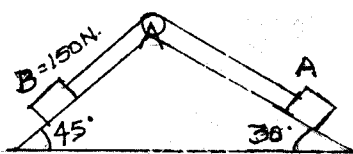Fig. Q4 (c)

Fig. Q5 (b)

Fig. Q5 (c)

Fig. Q6 (c)

Fig. Q6 (d)

Fig. Q7 (b)

Fig. Q7 (c)

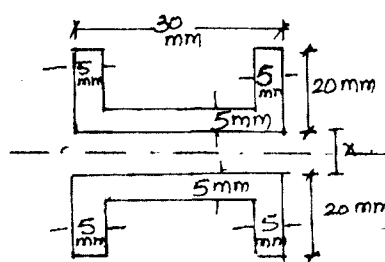Fig. Q8 (c)

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