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# First/Second Semester B.E. Degree Examination, June/July 2015 Elements of Civil Engineering and Engineering Mechanics 

Time: $\mathbf{3}$ hrs.
Max. Marks:100
Note: Answer FIVE questions, selecting ONE full question from each part

## PART - A -

1 a. Explain in brief the scope of the following civil engineering fields:
i) Structural engineering
ii) Water resources engineering.
b. State and explain the basic idealizations in mechanics.
(06 Marks)
c. A system of forces are acting on a rigid bar as shown in Fig.Q. 1
k(O)
(06 Marks)

1) A single force
ii) A single force and a couple at ' A '
iii) A single force and a couple at 'IV.
(08 Marks)

Fig.Q.1(c)


2 a. Define couple moment and list the chareteristics of a couple.
(06 Marks)
b. With the help of the neat sketzflw)xplain the cross-section of road and its structural components.
(08 Marks)
c. Replace the force and couple system by an equivalent force and moment at ' 0 ' for the Fig.Q.2(c).
(06 Marks)

Fig.Q.2(c)


PART--B
3 a. Define the following: i) Resultant force; ii) Composition of force; iii) Resolution of force.
(06 Marks)
b Two cables attached at the top of tower carries a guy cable AB. Determine the tension in guy cable such that the resultant of the forces in all three cables acts vertically down. Also find the resultant force [refer Fig.Q.3(b)].
c. Find the moment of a force about ${ }^{\prime} \mathbf{1}^{3}$ [ [Fig.Q.3(c)].


Fig.Q.3(b)


Fig.Q.3(c)

1 of 3

4 a. State and prove parallelogram law of forces.
(05 Marks)
b. Four forces are acting on a vertical bar AB as shown in Fig.Q.4(b). Determine the resultant and its point of intersection from ' A '.
(05 Marks)
c. Find the resultant magnitude, direction and its point of application from ' A ' for the square subjected to load as shown in Fig.Q.4(c).
(10 Marks)


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\underline{\text { PART - C }}
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5 a. State and prove Lami's theorem.
(04 Marks)
b. State the laws of dry friction.
(06 Marks)
c. Determine the reactions at contact points sh owinfi on $^{\circ}=$
(10 Marks)
if. 5 (1


6 a. For the ISokelt shown in Fig.Q.6(a), find the minimum value of ' $\mathbf{P}$ ' which will just disturb the equililikOn of the system ( $\mathbf{p} .=0.5$ ).
(05 Marks)
b. KikAvihg that $W A=100 \mathrm{~N}$ and $0=30^{\circ}$, determine the smallest and largest value of WB for Which the system is in equilibrium [Refer Fig.Q.6(b)].
(10 Marks)

- 4 A ladder weighing 200N is to be kept in position as shown in Fig.Q.6(c) resting on a smooth floor and leaning against a small wall. Determine the horizontal force required to prevent it from slipping when a man weighing 700 N is at a height of 2 m above the floor level.


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PART -D
7 a. Derive an expression for the moment of inertia of a rectangle from first principles about its vertical centroidal axis.
(06 Marks)
b. A thin homogeneous wire is bent into a triangle shape $A B C$ such that $A B=240 \mathrm{~mm}$, $B C=260 \mathrm{~mm}$ and $A C=100 \mathrm{~mm}$. Locate the C.G of wire with respect to coordinate axes. Angle at 'A' is a right angle. [Refer Fig.Q.7(b)].
(08 Marks)
c. Calculate the MOI of the lamina shown in Fig.Q.7(c) about 'AB'.
(06 Maw)


Fig.Q.7(b)

, ${ }^{2}$

8 a. Derive an expression for the centroid of a quarter circle on \&metrical axis. (08 Marks) b. Find the moment of inertia of the lamina shown in Ftg.,, 8 (b) about its horizontal (xx) centroidal axis. [Unshaded area]
i'";
(12 N'arks)


Fig.Q.8(b)


PART - E
a. Define the foil
i) Displacement ; ii) Velocity; iii) Acceleration ; iv) Speed; v) Decelerati (05 Marks)
b. Derive eq ftas of motion:

1) With_14Wrm acceleration
ii) Distance travelled.
(05 Marks)
c. A poliee officer observes a car approaching at the unlawful speed of 60 kmph . He gets on his motor cycle and starts chasing the car, just as it passes in front of him. After accelerating for 10 secs, at a constant rate, the officer reaches his top speed of 75 kmph . How long does it take the officer to overtake the car from the time he started?
(10 Marks)
9- a. A flywheel starts rotating from rest and is given an angular acceleration of $1 \mathrm{rad} / \mathrm{sec}^{2}$. Determine the angular velocity and speed in rpm after 90 seconds.
If the flywheel is brought to rest with an uniform angular retardation of $0.5 \mathrm{rad} / \mathrm{sec}^{2}$. Find the time required by the flywheel to come to rest.
(06 Marks)
b. What is super elevation and why it is provided?
(04 Marks)
c. A projectile is fired from the top of cliff 150 m height with an initial velocity of $180 \mathrm{~m} / \mathrm{sec}$ at an angle of elevation of $30^{\circ}$ to horizontal. Neglecting air resistance; determine: i) the greatest elevation above the cliff; ii) the great elevation above the ground reached by the particle; iii) The horizontal distance from the gun to the point where the projectile strikes the ground.
(10 Marks)
