

CBGS SCHEME

LSN 2020-2024

BESCK204A/BESCKA204

Second Semester B.E./B.Tech. Degree Examination, June/July 2024 Introduction to Civil Engineering

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: Bloom's level, C: Course outcomes.*

Module - 1		M	L	C
Q.1	a. Explain the scope of following branches of Civil Engineering i) Geotechnical Engineering ii) Irrigation engineering and water resources	10	L1	CO1
	b. Explain any four tests on bricks.	10	L1	CO1
OR				
Q.2	a. Explain the following. i) Reinforced Cement Concrete (RCC) ii) Construction chemicals iii) Structural Steel	10	L1	CO1
	b. Explain the functions of the following structural elements of a building i) Beam ii) Column iii) Foundation.	10	L1	CO1
Module - 2				
Q.3	a. Explain the advantages and disadvantages of Infrastructural development of a nation.	10	L1	CO2
	b. Explain Sustainable development. What are the goals of sustainable development?	10	L1	CO2
OR				
Q.4	a. Explain the concept of i) Smart city ii) Clean city.	10	L1	CO2
	b. Explain management of i) Urban Air Pollution ii) Solid waste	10	L1	CO2
Module - 3				
Q.5	a. Explain classification of force system with neat sketches.	10	L2	CO3
	b. Find the resultant, magnitude, direction and distance from point A of the force system shown in Fig Q5(b).	10	L3	CO3

Fig Q5(b)

OR

Q.6 a. State and prove Varignon's theorem

10 L3

b. Find the forces in all the wires (AB, BC and CD) and the load W_1 to keep the system in equilibrium. Take $W_2 = 1000\text{ N}$. (Refer Q6(b)).

10 L3

CO

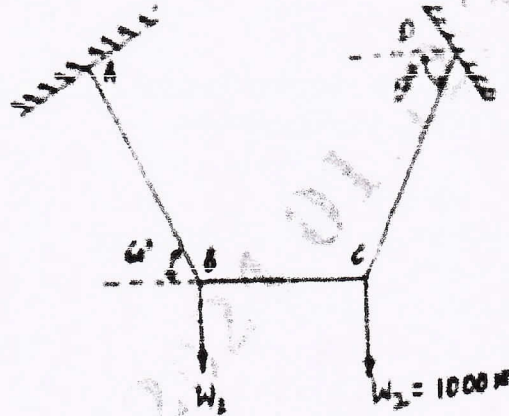


Fig Q6(b)

Module - 4

Q.7 a. Explain the following

- i) Centroid
- ii) Center of Gravity
- iii) Lamina
- iv) Centroidal Axis
- v) Axis of Symmetry.

10

L1

CO4

b. Determine the centroid of UO, Fig Q7(b)

10

L2

CO4

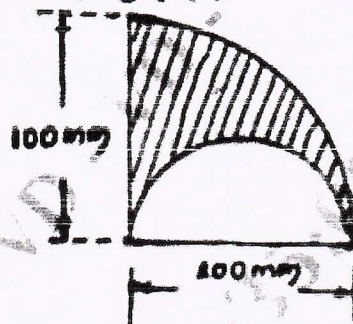


Fig Q7(b)

OR

Q.8 a. Determine the centroid of a Semi-circle of radius 'r' from the first principle.

10

L1

CO4

b. Locate the centroid of the lamina shown in Fig Q8(b)

10

L2

CO4

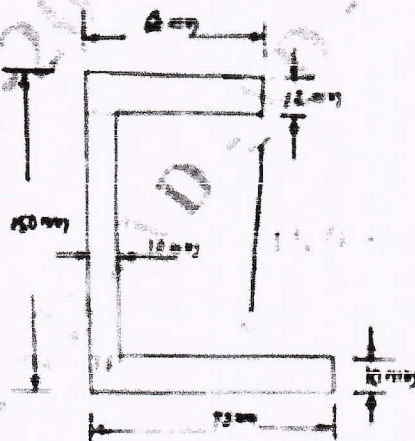


Fig Q8(b)

Module - 5

- Q.9 a. State and prove parallel axis theorem. 10 L2 CO5
 b. Determine the moment of inertia about horizontal central axis for the Fig Q9(b) 10 L2 CO5

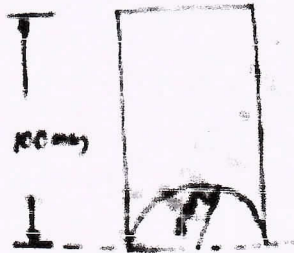


Fig Q9(b)

OR

- Q.10 a. Derive an expression for moment of inertia of a semicircle 10 L1 CO5
 b. Determine the moment of inertia of Fig Q10(b) as shown below. Determine radius of gyration 10 L2 CO5

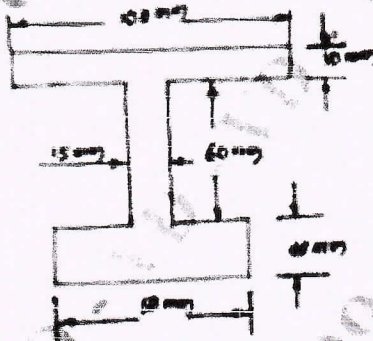


Fig Q10(b)

1078-6362
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June July 2024

INTRODUCTION TO CIVIL ENGINEERING.
(BESCK 104/204A)

Q.1 a) Explain the scope of following branches of Civil Engineering.
i) Geotechnical Engineering.
ii) Irrigation & Water Resource engineering.

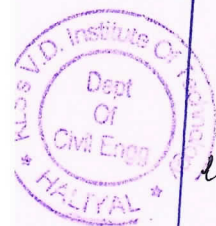
Ans: i) Geotechnical Engineering:

It is a branch of civil Engineering mainly deals with properties of soil strata related to strength. This is also called as soil mechanics. All the structures have to finally transfer the load acting on them to soil of earth safely, hence it becomes essential for a civil Engineer to properly investigate soil and decide the safe load that can be spread on the soil.

ii) Irrigation and Water Resource engineering:

Artificial supply of water to the crops to increase the yield is called irrigation. Irrigation engineering is a field of civil engineering which mainly deals with the parameters, like duty, delta etc & also involves the studies related to different types of crops. Study on water bearing structures i.e aquifers, rain gauges, etc.

In water resources, suitable water resources are identified. Identifying



Planning, building water retaining structures like tanks & dams and carrying stored water to fields is known as water resource engineering. $2 \times 05 = 10M$

Q.1 b) Explain any four tests on bricks.

Bricks are the construction material used to build walls, pavements, and other elements in masonry construction. Bricks are laid in courses and numerous bonds, collectively known as brickwork. $02M.$

* Tests on bricks:

1. Water absorption test: Determines how much water a brick can absorb, which can indicate its durability and how well it resists freezing.
2. Crushing strength test: Determines how much pressure a brick can withstand before breaking.
3. Sound test: Determines the quality of a brick by striking two bricks together to see if they produce clear metallic sound.
4. Impact test: Determines the quality of bricks by dropping it from a height to see how it holds up.

$2 \times 04 = 08M$

Total 10M.



Q.2 a)

OR

Explain the following.

- i) Reinforced Cement-Concrete (RCC)
- ii) Construction chemicals.
- iii) Structural steel.

Ans:

i) Reinforced Cement-Concrete.

If the reinforcement in the form of metal bars in the moulds used before placing the concrete mix, it is called RCC, used very commonly for multi-storied framed structures. RCC can resist both compressive, tensile or bending stresses. — — — — — 03M.

ii) Construction chemicals:

Construction chemicals are the compounds that are added to concrete and mortars to enhance the quality of structural members, related to strength, durability etc.

Construction chemicals basically consist of the following areas although they are not limited to them.

- 1) Concrete admixtures.
- 2) Water proofing materials.
- 3) Cementitious grouts.
- 4) Industrial floorings
- 5) Sealants
- 6) Bonding agents etc.



— — — — — 04M

iii) Structural Steel:

The iron having carbon 0.15 to 0.5% along with small percentage of manganese, sulphur etc is known as steel.

Steel in the form of solid bars can be used as reinforcement in concrete. Square sections & round sections are also used for fabrication of grills, gates etc.

----- 03M
Total 10M.

Q-2 by

Explain the functions of the following structural elements of a building.

i) Beam ii) Column iii) Foundation.

Ans:

i) Beam:

Beam is a structural member whose one dimension i.e. length considerably larger than other two dimension in cross section and supported at few points.

i) The roof beam safely transfers the load coming from roof to the columns.

ii) The plinth beam safely transfers the load coming from roof, roof beam & columns to foundation.

----- 03M

ii) Columns:

or Support: columns are vertical structural components that support beams, arches, and upper parts of the walls & ceilings.



ii) Decoration: Columns can be decorative elements, and come in a variety of styles & designs.

iii) Engineering: Column can be designed to resist lateral forces, such as those caused by earthquakes or wind. --- 03M.

iii) Foundation:

a) Distributes the load from the structure to the soil evenly & safely.

b) To anchor the buildings to the ground so that under lateral loads building will not move.

c) It prevents the building from overturning due to lateral forces.

d) It gives level surface for the construction of superstructure. --- 04M

Total 10M.

Module 2.

Q.3. a)

Explain the advantages & disadvantages of Infrastructural development of a nation.

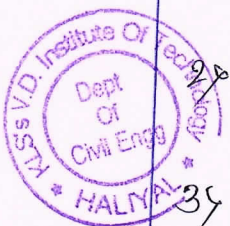
Ans:

Advantages:

1) It can increase the quality of life of citizens by providing access to clean water, energy and transportation.

It can create jobs and attract foreign investment.

It can increase the productivity and growth which promote economic inclusion.



4) Social infrastructure such as education, Public health and sanitation can increase quality of life.

5) Modern infrastructure can be designed to be sustainable, minimizing environmental impact. ——— 05M.

Disadvantages

1) Construction can lead to habitat destruction, Pollution of air & water.

2) It can force communities to relocate, disrupting their livelihood and social structures.

3) It leads improper planning, project-selection.

4) Increased infrastructure sometimes lead to increased traffic in urban areas, causing congestion and delays.

5) Infrastructure may not be resilient to extreme weather events caused by climate change. ——— 05M

Q.36.

Explain Sustainable development. Total 10M.
What are the goals of Sustainable development.

Ans:

"Sustainable development" is a way of developing the world that meets the needs of the present without compromising the future. It involves balancing the needs of people and the planet, while also preserving resources for future generations.

The SDGs can be structured around five pillars: People, Planet, Prosperity, Peace & Partnership. ——— 04M.



Goals of Sustainable development:

- 1) Intergenerational equity
Preserving resources for future generation
- 2) Environmental conservation
Protecting biodiversity & ecosystems.
- 3) Efficient-resource use
Reducing waste and using renewable resources.

--- 06M

Total 10M.

OR.

Q.N. 4(a)

Explain the concept of
i) Smart city ii) Clean city:

Ans:

i) Smart city Concept:

The smart city concept is a holistic approach to urban development that uses digital technology to improve the quality of life for residents. Smart cities use data analysis and smart technology to optimize city functions and drive economic growth.

Benefits of smart cities:

1) Improved quality of life:

Smart cities can improve quality of life for residents by providing better services, safer public spaces.

2) Economic growth: smart cities can drive economic growth by optimizing city functions and improving official efficiency. 05M



ix Clean city

The concept of a clean city is to keep a city clean and free of pollution, litter, and visual clutter. Clean cities can be achieved through good governance, cooperative leadership, and the use of clean technology.

Benefits of clean city:

1/ Healthy environment: A clean environment can help keep diseases away and promote growth and development.

2/ Safe food and water: A clean environment can provide safe food and water supply.

— — — — — 05M

—————
Total 10M.

Q 4 b)

Explain the management of
i) Urban air pollution ii) Solid waste.

Ans:

Management of Urban air pollution:

Urban air pollution management is the process of reducing harmful emissions from cities to improve air quality. This helps to protect human health, animals, plants and ecosystems.

Strategies for Urban air pollution management.

1/ Monitor air quality: Use an air pollution monitoring network to measure air quality and make informed decisions

2/ Set emission standards:



Set stricter standards for vehicles and encourage the use of cleaner technologies.

3) Promote Electric Vehicles:

Incentivize the use of electric vehicles and hybrid vehicles, and build charging infrastructure. — — — — 05M.

ii) Management of Solid Wastes:

Solid waste management (SWM) is the process of handling solid waste to reduce its environmental impact and protect public health. SWM techniques include recycling, composting, incineration and landfilling.

1) Recycling: Separates and reuses materials like glass, paper, plastic and metals. Recycling reduces the need for raw materials, energy use and green house gas emissions.

2) Incineration: Burns waste at high temperatures to produce energy. The ash byproduct of incineration needs to be disposed of properly.

Proper SWM can improve public health and hygiene and reduce the risk of harmful diseases. — — — — 05

Total 10M.



Module 3

Q. 5ay

Explain classification of force system with neat sketches.

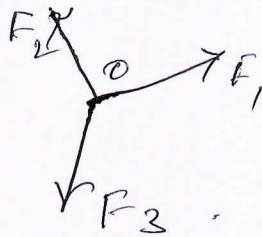
Ans:

i) Coplanar ~~Parallel~~ Parallel like force system.
This ^{is a} system of forces in which all the forces lie in a ~~single~~ single plane, parallel to each other & the direction of all forces is same.

Ex: A stationary train standing on straight tracks. The forces exerted by the wheels on track will constitute such system of forces. $\downarrow \downarrow \downarrow \downarrow$

ii) Coplanar concurrent - force system:

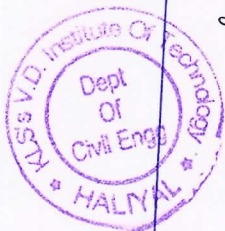
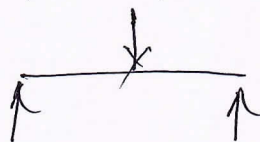
This is a system of forces in which all the forces lie in a single plane & the line of action of all the forces passes through the single point.



iii) Coplanar non concurrent - force system.

This is a system of forces in which all the forces lie in a same plane & the line of action of all the forces don't pass through single point.

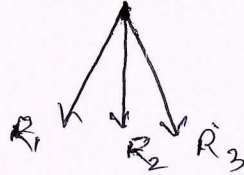
Ex: All the coplanar parallel forces.



iii) non coplanar concurrent force system:

This is a system of forces in which all the forces do not lie in single plane, but all the forces pass through single point.

Ex: The reactions developed at the legs of tripod.



iv) collinear force system:

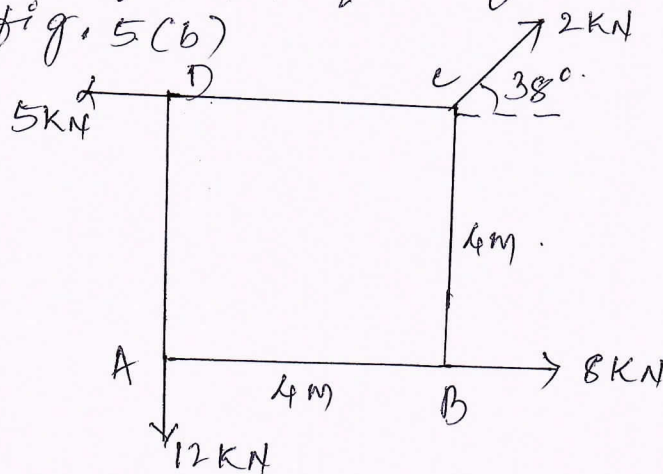
This is a force system in which all the lines of action of forces pass through the single line.

Ex: Fing of war. $F_1 F_2 F_3$ $F_4 F_5 F_6$

$0.5 \times 2 = 10M.$

Q.No. 5b

Find the resultant, magnitude, direction and distance from A of the force system shown in fig. 5(b)



Solu

$\sum F_x = 8 - 5 + 2 \cos 38 = 4.58 \text{ kN}$ } — 04

$\sum F_y = -12 + 2 \sin 38 = -10.77 \text{ kN}$ }

$R = \sqrt{4.58^2 + 10.77^2} = \sqrt{136.97} = 11.70 \text{ kN}$ } 01

$\alpha = \tan^{-1} \frac{10.77}{4.58} = \tan^{-1} 2.352 = 66.96^\circ$ }

$\sum M_A = -5 \times 4 - 2 \sin 38 \times 4 + 2 \cos 38 \times 4$ — 03

$= -20 - 4.93 + 6.30$

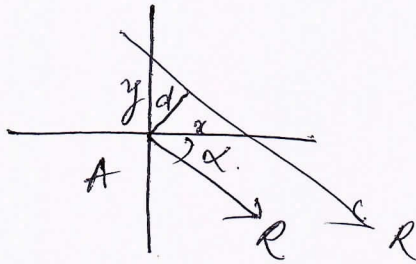


$$\sum M_A = -18.62 \text{ KN}\cdot\text{m}$$

$$d = \frac{\sum M_A}{R} = \frac{18.62}{11.70} = 1.59 \text{ m}$$

$$x = \frac{\sum M_A}{\sum F_y} = \frac{18.62}{10.77} = 1.73 \text{ m}$$

$$y = \frac{\sum M_A}{\sum F_x} = \frac{18.62}{4.58} = 4.06 \text{ m}$$



OR.

Total 10M.

Q.6 a)

State and prove Bignon's theorem.

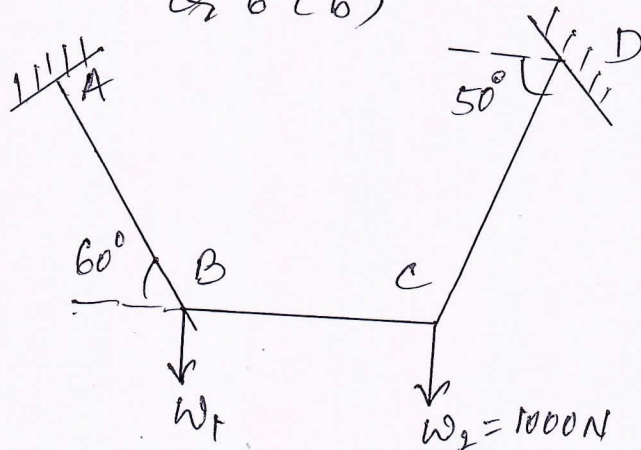
Ans:

Refer ICE (BESCK104/204A) QP solution of June-July 2023 (Q.No.6a)

Q.6 b)

Find the forces in all the wires (AB, BC and CD) and the load W_1 to keep the system in equilibrium. Take $W_2 = 1000 \text{ N}$

Refer Q.6 (b)



Refer ICE (BESCK104/204A) QP solution of June July 2023 (Q.No.6b)

Module 4:

Q.7 a)

Explain the following
i) Centroid is Centre of gravity of Lamina
ii) Centroidal axis is Axis of Symmetry.

Ans:

i) Centroid:

The centroid of a shape is the geometric center, or the average location of all its points. It can be used to describe the center of a line, area or volume.

The centroid is the same as the center of mass when the density of the shape is uniform. — — — 02M

ii) Centre of gravity:

The center of Gravity (C.G) is the average location of an object's weight. It's also the point at which an object would balance if it is suspended at that point.

The C.G determines how stable an object is. For example, a drum standing on end is in stable equilibrium because its C.G is supported. — — — 02M

iii) Lamina: It is a Latin word that means "thin plate" or "layer" it can refer to number things like

* the expanded part of leaf

* A thin flat layer of membrane.



— — — 02M

iv) Centroidal axis:

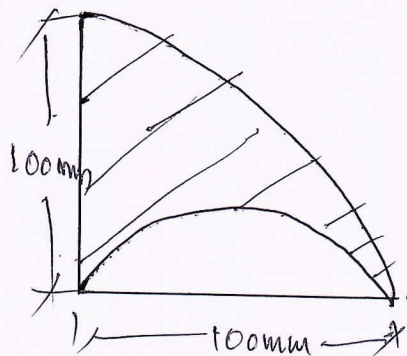
The centroidal axis is an imaginary line that passes through the centroid of an object. The second moment with respect to a centroidal axis is called the centroidal moment. — — — — — 0.2M

v) Axis of Symmetry:

The axis of symmetry is an imaginary straight line that divides the shape into two identical parts, thereby creating one part as the mirror image of the other part. When folded along the axis of symmetry the two parts get superimposed. — — — — — 0.2M

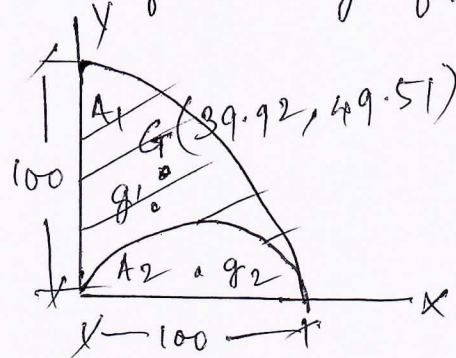
Total 10M

Q.7 b) Determine the centroid of I/O Fig 8.7(b)



Soln

Consider the following fig.



Let A_1 & A_2 be the segmental areas & g_1 & g_2 be their positions of centroid respectively as shown in fig.

$$A_1 = \frac{\pi R^2}{4} = \frac{\pi \times 100^2}{4} = 15707.96 \text{ mm}^2$$

$$A_2 = \frac{\pi 50^2}{4} = 3927 \text{ mm}^2$$

$$\begin{aligned} \cancel{L}A &= A_1 - A_2 = 15707.96 - 3927 \\ &= 11781 \text{ mm}^2 \quad \text{--- } 0.4 \text{ M} \end{aligned}$$

$$\bar{X} = \frac{A_1 \bar{x}_1 - A_2 \bar{x}_2}{\cancel{L}A}$$

where \bar{x}_1 & \bar{x}_2 are the x coordinates of g_1 & g_2 respectively.

$$\bar{X} = \frac{15707.96 \times \frac{4 \times 100}{3\pi} - 3927 \times 50}{11781}$$

$$\bar{X} = 39.92 \text{ mm} \quad \text{--- } 0.3 \text{ M}$$

$$\bar{Y} = \frac{A_1 \bar{y}_1 - A_2 \bar{y}_2}{\cancel{L}A}$$

$$= \frac{15707.96 \times \frac{4 \times 100}{3\pi} - 3927 \times \frac{4 \times 50}{3\pi}}{11781}$$

$$= \frac{666666.53 - 83333.53}{11781}$$

$$\bar{Y} = 49.51 \text{ mm}$$

$$G \equiv (39.92, 49.51) \quad \text{--- } 0.3 \text{ M}$$

Total 10M.



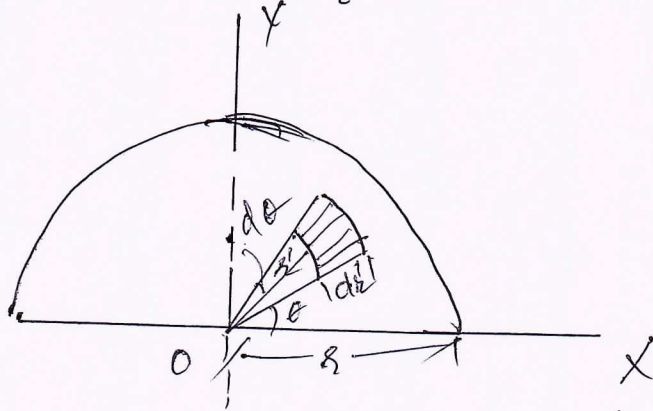
OR:

Q.8 a)

Determine the centroid of semicircle of radius R from the first principle.

Ans:

Consider a semicircle of radius R as shown in fig



Due to symmetry centroid must lie on y -axis. Let its distance from diametral axis be \bar{y} . To find \bar{y} consider an element at dist r' from the centre O of the semicircle, radial width be dr' and bounded by radii at θ & $\theta + d\theta$

The elemental area may be treated as rectangle of sides $r'd\theta$ and dr' . Hence

$$\text{Area of element} = r'd\theta dr'$$

Its moment about diametral axis x is given by

$$r'd\theta \times dr' \times r' \sin\theta = r'^2 \sin\theta dr' d\theta \quad \text{--- OSM}$$

\therefore Total moment of area about diametral axis

$$= \int_0^\pi \int_0^R r'^2 \sin\theta dr' d\theta = \int_0^\pi \left[\frac{r'^3}{3} \right]_0^R \sin\theta d\theta$$

$$= \frac{R^3}{3} [-\cos\theta]_0^\pi$$

$$= \frac{R^3}{3} [1+1] = \frac{2R^3}{3}$$

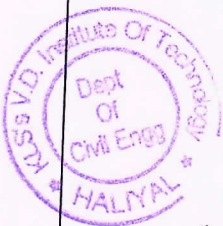
$$\text{Area of semi circle} = \frac{1}{2} \pi R^2$$

$$\bar{y} = \frac{\text{Moment of area}}{\text{Total area}}$$

$$= \frac{\frac{2R^3}{3}}{\frac{1}{2} \pi R^2}$$

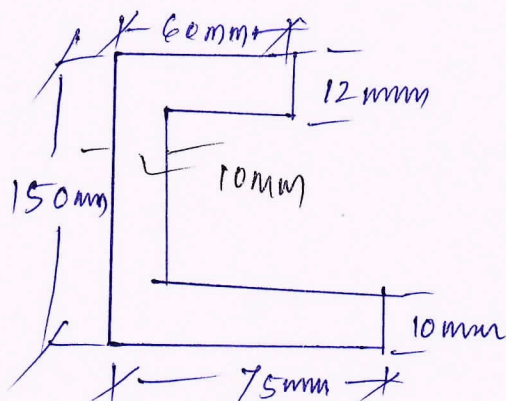
$$\Rightarrow \bar{y} = \frac{4R}{3\pi}$$

--- OSM



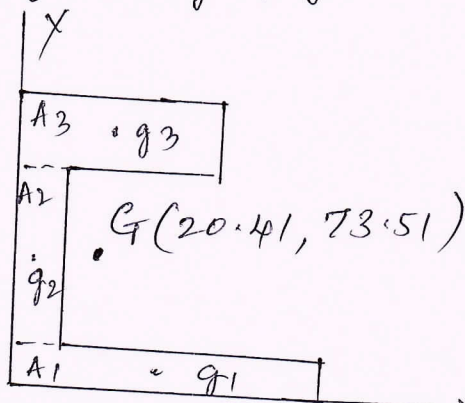
Q-8 b)

Locate the centroid of the lamina shown in fig 9.8(c)



Solu

considers the following fig.



Let A_1, A_2 & A_3 be the segmental areas & g_1, g_2 & g_3 be their centroids as shown in fig.

$$A_1 = 75 \times 10 = 750 \text{ mm}^2$$

$$A_2 = 128 \times 10 = 1280 \text{ mm}^2$$

$$A_3 = 60 \times 12 = 720 \text{ mm}^2$$

$$\therefore \Sigma A = A_1 + A_2 + A_3 = 750 + 1280 + 720 = 2750 \text{ mm}^2 \quad \text{--- 04M}$$

$$\bar{X} = \frac{A_1 \bar{x}_1 + A_2 \bar{x}_2 + A_3 \bar{x}_3}{\Sigma A}$$

where \bar{x}_1, \bar{x}_2 & \bar{x}_3 be the x coordinates of g_1, g_2 & g_3 respectively

$$\bar{X} = \frac{750 \times 37.5 + 1280 \times 5 + 720 \times 30}{2750}$$

$$\bar{X} = 20.41 \text{ mm}$$

$$\bar{Y} = \frac{A_1 \bar{y}_1 + A_2 \bar{y}_2 + A_3 \bar{y}_3}{\Sigma A} \quad \text{--- 03M}$$



When \bar{y}_1, \bar{y}_2 & \bar{y}_3 be the y coordinates of g_1, g_2 & g_3 respectively.

$$\bar{y} = \frac{750 \times 5 + 1280 \times 74 + 720 \times 144}{2750}$$

$$\bar{y} = 73.51 \text{ mm}$$

0.3 m

Total 10M.

Module 5:

Q.9 a)

State and prove Parallel axis theorem.

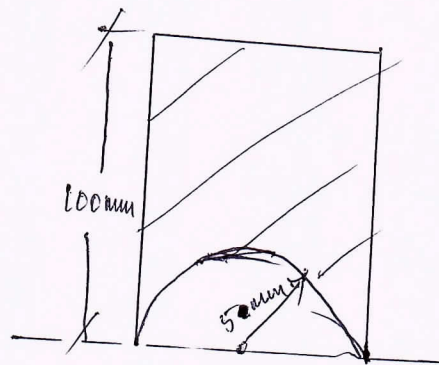
Ans:

Refer. Sun July 2023 QP solution

Q. No. 7a.

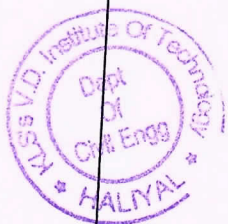
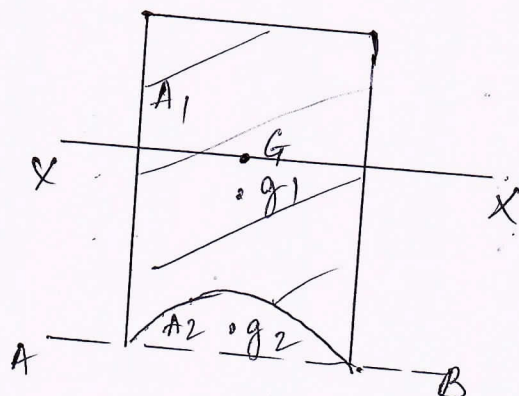
Q.9 b)

Determine the moment of Inertia about horizontal Centroidal axis for the fig Q.9 (b).



Solu

Consider the following fig.



Let A_1 & A_2 be the segmental areas & g_1 & g_2 be the centroid of A_1 & A_2 respectively.

$$A_1 = 100 \times 10 = 1000 \text{ mm}^2$$

$$A_2 = \frac{\pi 5^2}{2} = 39.27 \text{ mm}^2$$

$$\begin{aligned} \Sigma A &= A_1 - A_2 = 1000 - 39.27 \\ &= 960.73 \text{ mm}^2 \quad \text{--- O.M.} \end{aligned}$$

Let us determine \bar{y} from base AB as shown in fig.

$$\begin{aligned} \bar{y} &= \frac{A_1 \bar{y}_1 - A_2 \bar{y}_2}{\Sigma A} \\ &= \frac{1000 \times 50 - 39.27 \times \frac{4 \times 5}{3\pi}}{960.73} \end{aligned}$$

$$= \frac{50000 - 83.33}{960.73}$$

$$\boxed{\bar{y} = 51.96 \text{ mm}} \quad \text{--- O.M.}$$

$$\begin{aligned} I_{xx} &= \frac{10 \times 100^3}{12} + 1000 (1.96)^2 \\ &\quad - \left[0.11 \times 5^4 + 39.27 \left(51.96 - \frac{4 \times 5}{3\pi} \right)^2 \right] \\ &= 8.37174 \times 10^5 - 68.75 - (51.96 - 2.12)^2 \\ &= 8.37174 \times 10^5 - 68.75 - 2484.02 \end{aligned}$$

$$\boxed{I_{xx} = 8.34 \times 10^5 \text{ mm}^4} \quad \text{--- O.M.}$$

OR.

Total 10M.

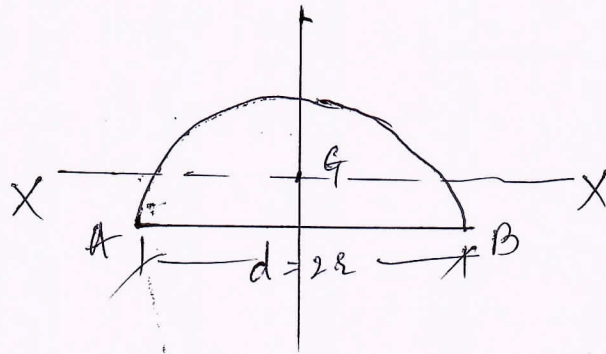
Q.10 ay

Determine the moment of Inertia expression for semi circle.



Ans:

Consider a semi circle of radius r or diameter d & radius r whose MI about centroidal axis has to be determined as shown below in fig.



Now the distance of centroidal axis y_c from diametral axis AB is given by

$$y_c = \frac{4r}{3\pi} = \frac{2d}{3\pi}$$

$$\text{Area} = A = \frac{1}{2} \times \frac{\pi d^2}{4} = \frac{\pi d^2}{8}$$

$$I_{AB} = I_{xx} + Ay_c^2 \quad \text{--- 0.5M}$$

$$\frac{\pi d^4}{128} = I_{xx} + \frac{\pi d^2}{8} \left(\frac{2d}{3\pi} \right)^2$$

$$\Rightarrow I_{xx} = \frac{\pi d^4}{128} - \frac{\pi d^4}{18\pi}$$

$$= 0.0068598d^4$$

$$\boxed{I_{xx} = 0.11r^4}$$

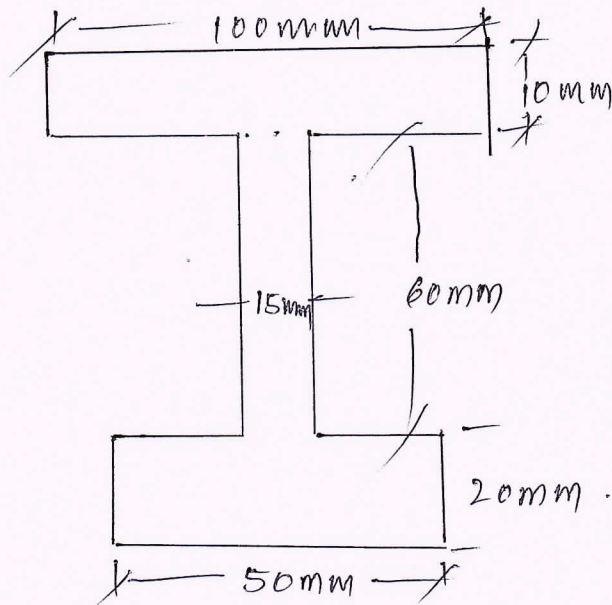
--- 0.5M

Total 10M.



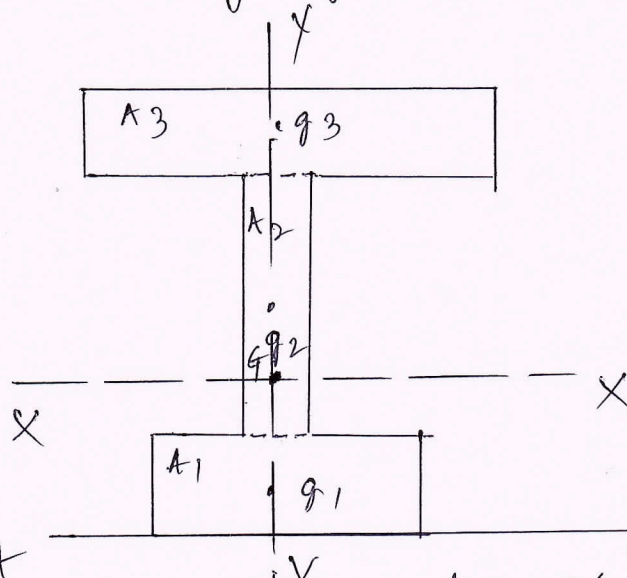
Q.10 b

Determine the moment of Inertia of fig Q.10(b) as shown below. Determine radius of gyration.



Soln

Consider the following fig.



Let A_1, A_2 & A_3 be the segmental areas & g_1, g_2 & g_3 be the centroids of A_1, A_2 & A_3 respectively as shown in fig.

$$A_1 = 50 \times 20 = 1000 \text{ mm}^2$$

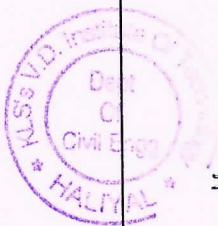
$$A_2 = 60 \times 15 = 900 \text{ mm}^2$$

$$A_3 = 100 \times 10 = 1000 \text{ mm}^2$$

$$\Rightarrow \Sigma A = A_1 + A_2 + A_3 = 1000 + 900 + 1000 = 2900 \text{ mm}^2$$

Let us determine the centroid about base AB

— — — — — 02 M



As given section is symmetric about y -axis

$$x = 0$$

$$\bar{y} = \frac{A_1 \bar{y}_1 + A_2 \bar{y}_2 + A_3 \bar{y}_3}{\Sigma A}$$

$$= \frac{1000 \times 10 + 900 \times 50 + 1000 \times 85}{2900}$$

$$\bar{y} = 48.28 \text{ mm.}$$

02

Applying // axis thm.

$$I_{xx} = \frac{50 \times 20^3}{12} + 1000(38.28)^2 + \frac{15 \times 60^3}{12} + 900(1.72)^2 + \frac{1000 \times 10^3}{12} + 1000(36.72)^2$$

$$I_{xx} = 33333.33 + 1465358.4 + 270000 + 2662.56 + 8333.33 + 1348358.4$$

$$I_{xx} = 3.128045 \times 10^6 \text{ mm}^4$$

03M

$$I_{yy} = \frac{20 \times 50^3}{12} + \frac{60 \times 15^3}{12} + \frac{10 \times 100^3}{12}$$

$$= 208333.33 + 16875 + 833333.33$$

$$I_{yy} = 1.058541 \times 10^6 \text{ mm}^4$$

02M

$$K_{xx} = \sqrt{\frac{I_{xx}}{\Sigma A}} = \sqrt{\frac{3.128045 \times 10^6}{2900}} = 32.84 \text{ mm}$$

$$K_{yy} = \sqrt{\frac{I_{yy}}{\Sigma A}} = \sqrt{\frac{1.058541 \times 10^6}{2900}} = 19.10 \text{ mm}$$

01M



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AB
HEAD
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Total 10M.
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