KADI SARVA VISHWAVIDYALAYA

BE SEMESTER III (Mech. /Auto Engg. Reg. /ATKT) EXAMINATION DECEMBER 2016

SUBJECT CODE: ME 305/AE 305 SUBJECT NAME: Advance Strength of Material

DATE: 28/12/2016 TIME: 10.30 TO 13.30 TOTAL MARKS: 70

Instructions:

1. Answer each section in separate Answer Sheet.
2. All questions are compulsory.
3. Indicate **clearly,** the options you attempted along with its respective question number.
4. Assume suitable data whenever necessary.

Section 1

Q.1 (A) State and explain: Castigliano's first theorem **05**

(B) A uniform metal bar of rectangular section 40 mm × 80 mm is of length 1 m. Find the maximum stress and strain energy stored in the bar when it is subjected to axial load of 1 kN applied gradually and suddenly. Take E = 200 GPa **05**

(C) Define strain energy and derive the expression for strain energy due to bending. **05**

OR

(C) Find the energy of distortion and the total strain energy per unit volume at a point in a shaft where the shear stress is 40 MN/m^2, E = 200 GPa and $\mu = 0.25$. **05**

Q.2 (A) Plot shear stress distribution diagram for any five standard sections. **05**

(B) A beam of triangular section having base width 150 mm and height 200 mm is subjected to a shear force of 20 kN. Find the value of maximum shear stress. **05**

OR

(A) A simply supported beam having 250 mm width and 500 mm depth and of 6 m span is subjected to a point load in the centre. What should be the permissible load if maximum shear stress is limited to 3 N/mm^2 and bending stress is 30 N/mm^2? **05**

(B) Derive expression of hoop stress in rotating ring (rim). **05**

Q.3 (A) Find the speed at which a thin steel ring of 1.5 m diameter will fail if the elastic limit tensile stress of material is 250 N/mm^2. Take ρ = 7500 kg/m^3. **05**

(B) A simple chain link consists of a semi circular ends of mean radius of curvature 80 mm and the length of straight sides also equals 80 mm. The radius of circular cross section of the link is 40 mm. Estimate the stresses only in curved portion when a pull of 100 kN is applied at the ends. **05**

OR

(A) Derive the formula for bending of the beam having small initial curvature. **05**

(B) A curved bar of triangular section 50 mm base and 75 mm height is subjected to bending moment of 2 kN m. The mean radius of curvature is 100 mm. Determine the flexural stresses at the innermost and outermost fibre. **05**

[P.T.O.]

Section 2

Q.4 (A) State the assumptions made in Lame's theory and compare thin shell and thick shell. **05**

(B) A pipe of 400 mm internal diameter and 100 mm thickness contains a fluid at a pressure of 8 N/mm^2. Find the maximum and minimum hoop stress across the section. **05**

(C) Derive Lame's equations to find out the stresses in a thick cylindrical shell. **05**

OR

(C) A thick cylinder of inside diameter100 mm and outside diameter 200 mm is subjected to internal and external pressures of 30 MPa and 15 MPa respectively. Calculate maximum tensile and compressive hoop stresses in the cylinder. **05**

Q.5 (A) Derive the formulae for maximum bending stress and deflection of a semi elliptical leaf-spring. **05**

(B) A hub is shrunk onto a solid shaft and the final dimensions are: **05**
External diameter of hub = 200 mm
Diameter at junction = 120 mm
Find the initial difference in the dimater of hub and the shaft to produce a radial contact pressure of 30 MPa. E = 205 GPa

OR

(A) A flat spiral spring 6 m long has wire of rectangular cross section 25 mm x 0.5 mm having maximum bending stress limited to 600 N/mm2; find the maximum twisting moment that can be exerted at center spindle. How many turns are required to wind the spring from the 'no stress' condition? **05**
What is the energy stored in the spring? Find the force exerted at fastening in the fully wound condition if the fastening is at a distance of 50 mm from center of spindle. E = 200 GPa.

(B) A semi elliptic leaf spring 750 mm long is required to carry a central point load of 8 kN. If the central deflection is not to exceed 20 mm and the bending stress is not greater than 200 MPa, determine the thickness, width and number of plates. Assume width of plates equals 12 times its thickness and E = 200 Gpa. **05**

Q.6 (A) Explain maximum principal stress theory. **05**

(B) A member having rectangular section having depth to width ratio 1.2 is subjected to axial pull of 12 kN and shear force of 3.6 kN. Design the cross section of member based on total strain energy theory. Take yield stress of steel 300 MPa, Poisson's Ratio = 0.3 and Factor of safety = 2.5. **05**

OR

(A) Explain maximum shear stress theory. **05**

(B) A bolt is subjected to a direct pull of 20 kN together with a transverse shear force of 10 kN. Determine the diameter of the bolt according to Shear strain energy theory. Take yield stress 250 MPa, factor of safety 2 and Poisson's ratio 0.3. **05**

******All the Best******

KADI SARVA VISHWAVIDYALAYA

B.E. Semester-III (Mech./Auto. Engg.) Examination (November-2015)

Subject code: ME/AE305 **Subject Name: Advance Strength of Material**

Date:- 07/12/2015 **Time:- 10.30 am to 1.30 pm** **Total Marks:- 70**

Instructions:

1. **Answer each section in separate answer sheet**
2. **All questions are compulsory.**
3. **Indicate clearly, the options you attempt along with its respective question number.**
4. **Assume suitable data, wherever necessary.**

Section-I

Q.1	[A]	1) Define the term 1) Sudden load 2) Impact load	02
		2) Derive the equation of stress for sudden loading.	03
	[B]	A steel rod 40mm in diameter is 2.5m long. Find the maximum instantaneous stress induced when a pull of 80kN is applied, 1) gradually 2) suddenly. Also find instantaneous elongation. Take E = 105GPa. Comment on result.	05
	[C]	Write the statement of Maxwell's theorem and prove it.	05
		OR	
	[C]	In a material the principal stresses are 60MN/m^2, 48MN/m^2, and -36MN/m^2. Calculate: 1) Total strain energy 2) Volumetric strain energy. E=210GPa and μ=0.3.	05
Q.2	[A]	Draw the shear stress distribution diagram for 1) L-section 2) T- section 3) Rectangle section 4) I – section 5) Circular section	05
	[B]	A beam of rectangular section is 100mm wide and 200mm depth. If the section is subjected to a maximum shear force of 10000N, find the maximum shear stress. Also draw the shear stress distribution across the section.	05
		OR	
Q.2	[A]	Draw the three cross section for which the shear stress diagram are same. Also, draw that shear stress diagram along with three cross section.	05
	[B]	For rectangular section, derive the relation between maximum shear stress and average shear stress.	05
Q.3	[A]	Find the C.G. for T section. Flange = 100mm*12mm and web = 88mm*12mm.	05
	[B]	For triangular section, derive the relation between maximum shear stress and average shear stress.	05
		OR	

Q.3	[A]	Derive the equation for hoop stress for rotating ring (rim).	05
	[B]	A thin steel disc of uniform thickness and of 250mm diameter with a central hole of 50mm diameter rotates at 10000rpm. Calculate the maximum principal stresses and maximum shear stress in the disc. Also, draw stress distribution diagram. Density = 7000kg/m^3 and μ=0.3.	05

Section-II

Q.4 [A] For semi-elliptical leaf spring having n no of leaves derive the formula for deflection. **05**

[B] A laminated steel spring simply supported at ends with a span of 750mm is centrally loaded with a load of 7500N. The central deflection under the above load is not to exceed 50mm and the bending stress is to be 400N/mm^2. Determine : 1) width of plates 2) thickness of leaves 3) number of leaves 4) overlap of leaves 5) radius to which the leaves should be bent so that the spring become straight under the given load of 7500N. Assume that width = 12*thickness, E = 200kN/mm^2. **05**

[C] A central horizontal section of a hook is a symmetrical trapezium 60 mm deep. The inner width of 60 mm and outer width of 30 mm. Calculate the extreme stresses when the hook carries a load of 27 KN. The load line is passing 40 mm from the inside edge of the section and centre of curvature being in the load line. Also plot the stress distribution across the section. Draw the hook also. **05**

OR

[C] 1) Difference between straight and curved beam. **03**

2) Write the Winkler Bach formula for curved beam. **01**

3) What is the meaning of mA? Write the formula for m. **01**

Q.5 [A] Difference between thin and thick shell. **05**

[B] A rectangular section of steel having depth to width ratio 1.2 is subjected to axial pull of 12 KN and shear force of 3.6 KN with a factor of safety 2.5. Design the cross section based on total strain energy theory. The yield stress of steel is 300 MPa. **05**

OR

Q.5 [A] Define thick shell. Write the assumption for LAME'S theory. Also, draw the hoop and radial stress distribution diagram for thick shell. **05**

[B] A thin spherical shell has 400mm diameter and wall thickness. The shell is subjected to an internal pressure of 5MPa. The yield strength of material is 265MPa and F.O.S is 3. Determine thickness of the shell using distortion energy theory. **05**

Q.6 [A] Derive the m for rectangular cross section. **05**

[B] A thick cylindrical shell having internal and external diameters of 100 mm and 200 mm respectively is subjected to simultaneously internal fluid pressure of 30 MPa and external pressure of 15MPa. Calculate the maximum tensile and compressive hoop stresses in the cylinder. Also, plot stress distribution diagram. **05**

OR

Q.6 [A] A curved beam of trapezoidal section with widths 30mm and 20mm and depth 40mm has mean radius of curvature 50mm. It is subjected to pure bending moment of 400N.m. Calculate the ratio of maximum and minimum stresses. Also, find the position of neutral axis and plot the bending stress variation across the section. **05**

[B] A disc of 150mm diameter and 40mm thick at the centre is to be designed for uniform strength. The disc is rotated at the speed of 3000rad/sec. Calculate the thickness of the disc at a radius of 50mm if the material density is 7000kg/m^3 and maximum permissible stress in the disc material is 150MPa. **05**

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KADI SARVA VISHWAVIDHYALAYA
B.E MECHANICAL Semester–III

Subject: Advance Strength of Material **Date: 25/11/2013**
Subject Code: ME-305 **Time: 10:00 am to 1:00 pm**
Total Marks: 70

Instructions:
1. Answer each section in separate Answer sheet.
2. Use of Scientific calculator is permitted.
3. All questions are **Compulsory**.
4. Indicate **clearly**, the options you attempt along with its respective question number.
5. Use the last page of main supplementary of **rough work**.

SECTION-I

Que:1 (A) Define following
a) Strain energy.
b) Resilience. **[5]**
c) Proof resilience.
d) Modulus of resilience

(B) Write short note on mechanical failures theories. **[5]**

(C) A closed coiled helical spring has mean diameter of 75 mm and spring constant of 90 KN/m. It has 8 coils. What is the suitable diameter of the spring wire if maximum shear stress is not to exceed 250 MN/m2.? Modulus of rigidity of the spring wire material is 80GN/m2. What is max. axial load the spring can carry? **[5]**

OR

(C) Write short note on Castiglione's theorem. **[5]**

Que:2 (A) Prove that "strain energy in tension (strain energy developed due to tensile load) $U = \frac{\sigma^2}{2E} V$ " **[5]**

(B) Write short note on
a) Energy of distortion. **[5]**
b) Energy of dilation

OR

(A) Explain strain energy in pure shearing. **[5]**

(B) Explain graphical method for representation of failure theories of 2-D stress systems. **[5]**

Que:3 (A) Derive Lami's equations for thick cylindrical shells. **[5]**

(B) Find stresses in thick spherical shells. **[5]**

OR

(A) Derive equation for stresses acting on thick cylinder for cases below.
a) External pressure = P2 ; Internal pressure = P1.
b) Internal pressure = P1 ; external pressure = zero. **[5]**
c) External pressure = P2 ; Internal pressure = zero.

Solid circular shaft subjected to external pressure =P2

(B) Differentiate open coiled and closed coiled helical spring. [5]

SECTION-II

Que:4 (A) Derive energy equation of spring subjected to Axial twist. [5]

(B) Derive energy equation of semi-elliptical spring. [5]

(C) A composite spring has two close-coiled springs connected in series; one spring has 12 coils of a mean diameter of 25 mm and wire diameter 2.5 mm. Find the wire diameter of the other spring, if it has 15 coils of mean diameter 40mm. The stiffness of the composite spring is 1.5 KN/m. Determine the greatest load that can be carried by the composite spring and the corresponding extension if maximum stress is 250 MN/m^2. C=80 GN/m^2. [5]

OR

(C) A closed coiled helical spring has mean diameter of 75 mm and spring constant of 90 KN/m. It has 8 coils. What is the suitable diameter of the spring wire if maximum shear stress is not to exceed 250 MN/m2.? Modulus of rigidity of the spring wire material is 80GN/m2. What is max. axial load the spring can carry? [5]

Que:5 (A) Derive equation to find thickness of disc having uniform strength. [5]

(B) Write assumptions for rotating long cylinders. [5]

OR

(A) Write assumptions for hoop stress in rotating elements. [5]

(B) Write circumferential and radial stress equation for long cylinder, solid cylinder and hollow cylinder. [5]

Que:6 (A) Show shear stress variation in the following sections:
a)Rectangle , b)Solid circle [5]

(B) Find deflection of :
a) Closed ring , b)Chain ring [5]

OR

(A) Derive h^2 for following sections:
a) T-section , b)I- section [5]

(B) Explain in brief : "Winkler-Bach theory" [5]

Best of luck

KADI SARVA VISHWAVIDHYALAYA
B.E. MECHANICAL Semester–III

Subject:Advance Strength of Material **Date: 24/04/2014**
Subject Code: ME305 **Time: 10:30 am to 01:30 pm**
Total Marks: 70

Instructions:
1. Answer each section in separate Answer sheet.
2. Use of Scientific calculator is permitted.
3. All questions are **Compulsory**.
4. Indicate **clearly**, the options you attempt along with its respective question number.
5. Use the last page of main supplementary of **rough work**.

SECTION-I

Que:1 (A) Define following
a) Strain energy.
b) Resilience.
c) Proof resilience.
d)Modulus of resilience **[5]**

(B) Write short note on mechanical failures theories. **[5]**

(C) Explain strain energy theory and derive equation for strain energy per unit volume. **[5]**

OR

(C) A closed coiled helical spring has mean diameter of 75 mm and spring constant of 90 KN/m. It has 8 coils. What is the suitable diameter of the spring wire if maximum shear stress is not to exceed 250 MN/m2.? Modulus of rigidity of the spring wire material is 80GN/m2.What is max. axial load the spring can carry? **[5]**

Que:2 (A) a) Prove that "strain energy in tension (strain energy developed due to tensile load) **[5]**

$$U = \frac{\sigma^2}{2E} V$$

(B) Prove that strain energy due to hydraulic pressure equals to $\frac{P^2}{2K} V$. **[5]**

OR

(A) Write short note on
a) Energy of distortion.
b)Energy of dilation **[5]**

(B) Explain strain energy in pure shearing. **[5]**

Que:3 (A) Find strain energy in tensional systems / shaft. **[5]**

(B) Find strain energy of beam subjected to bending stress. **[5]**

OR

(A) A bar 50cm long has 1.5 cm2 cross sectional area for 30 cm of its length and 1 cm2 for the remaining length. If a load of 50 N falls on the collar which is provided at one end of the rod, the other end being fixed, from a height of 3 cm; find the maximum stress induced in the bar. E = 200GN/m2. **[5]**

(B) Derive Lami's equations for thick cylindrical shells. **[5]**

SECTION-II

Que:4 **(A)** Find strain energy of beam subjected to shear stress in beam. **[5]**

(B) Write short note on Castiglione's theorem. **[5]**

(C) Write short note on application of thick cylinder. **[5]**

OR

(C) A composite spring has two close-coiled spring s connected in series; one spring has 12 coils of a mean diameter of 25 mm and wire diameter 2.5 mm. Find the wire diameter of the other spring ,if it has 15 coils of mean diameter 40 mm. The stiffness of the composite spring and the corresponding extension if max. stress is 250 MN/m2. **[5]**

Que:5 **(A)** Derive equation for series and parallel connection of spring. **[5]**

(B) Find circumferential stress in rotating ring. **[5]**

OR

(A) Derive equation to find thickness of disc having uniform strength. **[5]**

(B) Show shear stress variation in the following sections:

a) I- section
b) T-section
c) L-section

[5]

Que:6 **(A)** Explain in brief : "Winkler-Bach theory" **[5]**

(B) Derive h^2 for following sections:

a) T-section
b) I- section
c) Circular section

[5]

OR

(A) Derive deflection equation for closed coil helical spring / open coiled helical spring having circular cross section. **[5]**

(B) Write short note on maximum principal stress theory **[5]**

Best of luck

KADI SARVA VISHWAVIDYALAYA

B.E. Semester-III (Mech./Auto. Engg.) Examination (November-2014)

Subject code: ME305 **Subject Name: Advance Strength of Material**

Date:- 19/11/2014 **Time:- 10.30 am to 1.30 pm** **Total Marks:- 70**

Instructions:

1. **Answer each section in separate answer sheet**
2. **All questions are compulsory.**
3. **Indicate clearly, the options you attempt along with its respective question number.**
4. **Assume suitable data, wherever necessary.**

		Section-I	
Q.1	[A]	1) Define the term with its unit and formula: 1) Resilience 2) Proof resilience 2) Derive the equation of stress for gradual loading.	02 03
	[B]	A steel bar 1m long and rectangular section 40mmx40mm is subjected to an axial load of 1kN. Find the maximum stress induced in the bar if, 1) The load is applied gradually 2) The load is applied suddenly Also, find strain energies in both cases. Take E = 200GPa	05
	[C]	The principal stresses at a point in a body are $30MN/m^2$ (tensile), $40MN/m^2$ (compressive) and $10MN/m^2$ (compressive). Find, a) Energy of distortion per unit volume b) Energy of dilation per unit volume Total strain energy per unit volume. Take E = $2x10^5$ N/mm^2, $\mu = 0.25$	05
		OR	
	[C]	Find the slope and deflection at point B for a cantilever beam shown in **figure 1** using castigliano's first theorem. Take EI = $10*10^{13}$ $N.mm^2$	05
Q.2	[A]	Draw the shear stress distribution diagram for 1) L-section 2) T- section 3) Rectangle section 4) I – section 5) Circular section	05
	[B]	Draw the shear stress distribution for the beam cross section with shear force = 50kN having cross section as shown in **figure 2**. Find shear stress point A, B, C, N.A, and D.	05
		OR	
Q.2	[A]	Draw the shear stress distribution diagram for 1) Triangular section 2) T-section 3) Hollow rectangle section 4) L – section 5) Hollow circular section	05
	[B]	A simply supported beam 150mm wide x 300mm deep is simply supported over a span of 4.5m. It is loaded with a uniform load of 8kN/m. Determine shear stress. see **figure 3**	05

Q.3	[A]	1) For circular cross section, τ_{max} = _____ τ_{avg} 2) For rectangular cross section, τ_{max} = _____ τ_{avg} 3) For triangular cross section, τ_{max} = _____ τ_{avg} and τ_{max} = _____ τ_{na} 4) Define stress.	01 01 02 01
	[B]	Find the centre of gravity for **figure 4**.	05
		OR	
Q.3	[A]	Derive the equation for hoop stress for rotating ring (rim).	05
	[B]	A flywheel rim 5m mean diameter is rotated so that maximum hoop stress in the material is 6MPa. If the density of the material of flywheel is 7000kg/m^3, find the allowable speed of flywheel, neglecting the effect of mass.	05
		Section-II	
Q.4	[A]	Derive the formula for deflection of an open coil helical spring subjected to axial load.	05
	[B]	For a closed coil helical spring subjected to an axial load of 300N having 12 coils of wire diameter of 16mm and made with coil diameter of 250mm. Find (1)Axial Deflection (2) Strain energy stored (3) Max. torsional shear stress in the wire (4) Max. shear stress using Wahl's correction factor. C=80GN/m^2	05
	[C]	A shaft is subjected to a maximum torque of 10 KNm and a maximum bending moment of 7.5KNm at a particular section. If the allowable equivalent stress in simple tension is 160MN/m^2 find the diameter of the shaft according to maximum shear stress theory.	05
		OR	
	[C]	Prove the Stiffness equation when Spring is (1) Series (2) Parallel connection with neat sketch.	05
Q.5	[A]	Explain (1) Maximum Principal Strain Theory (2) Maximum Strain Energy Theory.	05
	[B]	The Principal stresses at a point in an elastic material are 200N/mm^2 (Tensile), 100N/mm^2 (Tensile), and 50N/mm^2 (Compressive). If the stresses at the elastic limit in simple tension is 200N/mm^2. Determine whether the failure of the material will occur according to maximum principal strain theory. Poisson's Ratio=0.3.	05
		OR	
Q.5	[A]	Explain (1) Maximum Principal Strain Theory (2) Maximum Strain Energy Theory.	05
	[B]	Find the diameter of a shaft according to (i) maximum shear stress theory (ii) shear strain energy theory, if the shaft is subjected to a maximum torque of 15 kNm and a maximum bending moment of 10 kNm at a particular section. Take allowable equivalent stress in simple tension as 180 MN/m^2.	05

Q.6	**[A]**	Derive the Link Radius (h) equation for I-Section.	**04**
	[B]	Determine (1) location of neutral axis (2) maximum and minimum stress and (3)ratio of maximum and minimum stress, when a curved beam of rectangular cross-section of width 20mm and depth 40mm is subjected to pure bending moment +600Nm. The beam is curved in a plane parallel to depth. The mean radius of curvature is 50mm.Also plot variation of the stresses across the section.	**06**
		OR	
Q.6	**[A]**	Derive the Lame's equation for the stresses in thick cylinder subjected to internal pressure. Also state the assumptions made.	**05**
	[B]	A thick cylindrical shell having internal and external diameters of 180 mm and 420 mm respectively is subjected to internal fluid pressure of 10 MPa. Find the maximum and minimum hoop stresses in the cylinder material and sketch the stress distribution diagram.	**05**

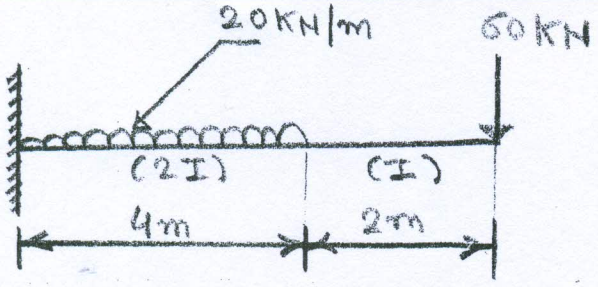

FIGURE : 1

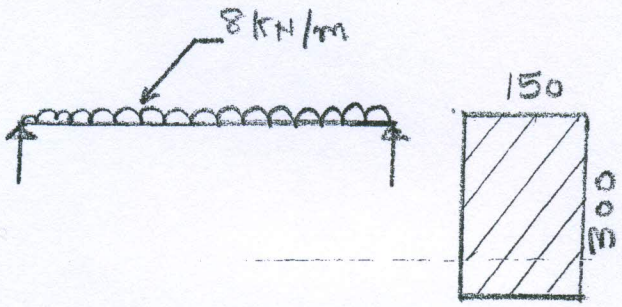

FIGURE : 3

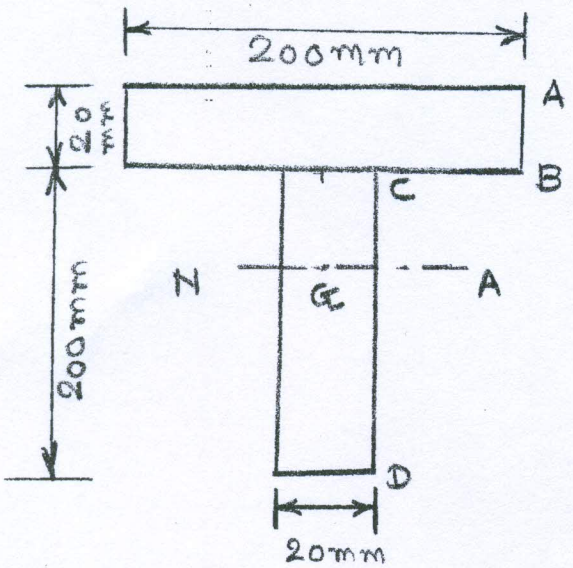

FIGURE : 2

BEST OF LUCK...

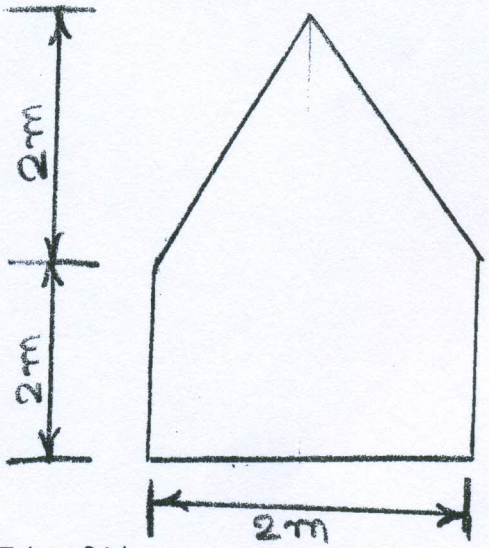

FIGURE : 4