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| **Building Materials****First Stage****Theoretical Lecturer problems****Sherzad Qadir Majid****sherzad.majid@su.edu.krd****sherzadq@live.com****00964 750 475 7000** |
| **Q1\** a rectangular block of aluminum 30 x 60 x 90 mm is placed into a pressure and subjected to a pressure of 100 MPa . if the modulus of elasticity is 70 GPa and Poisson s ratio is 0.33, what will be the decrease in the longest side of the block, assuming that the material remain within the elastic region ? what will be the decrease in the volume of the block. |
| **Q2 \** A material has a stress-strain relationship that can be approximately by the equation :  ε =8.75 x 10-11 σ3Where the stress is in MPa. Find the secant modulus and the tangent modulus for the stress level of 350 MPa |
| **Q3\** The rectangular block shown in the figure is subjected to tension within the elastic range . the increase in the length of a is 0.05 mm and the contraction of b is 0.008 . if the original lengths of a and b were 50 and 25 mm , respectively, what is poisons ratio for the material of the specimen?  |
| **Q4\** A cylindrical rod with a length of 380 mm and a diameter of 10 mm is to be subjected to a tensile load. The rod must not experience plastic deformation or an increase in length of more than 0.9 mm when a load of 24.5 kN is applied. Which of the four materials below are possible candidates? Justify your answer. |
| Material | EGPa | Yield StrengthMPa | Tensile StrengthMPa |
| Copper | 110 | 248 | 289 |
| Aluminum Alloy | 70 | 255 | 420 |
| Steel | 207 | 448 | 551 |
| Brass alloy | 101 | 345 | 420 |
| **Q5\** The following stress-strain relation was obtained during tensile test of an aluminum alloy specimen, Determine the following :1. Young s modulus within the linear portion.
2. Tangent modulus at a stress of 300MPa.
3. Yield stress using an offset of 0.002 strain.
4. If the yield stress in part c is considered failure stress, what is the maximum working stress to be applied to this material if factor of safety of 1.5 is used.

Strain mm/mm |  |
| **Q6\** A brass alloy has a yield strength of 280 MPa , a tensile strength of 390 MPa , and an elastic modulus of 105GPa. A cylindrical specimen of this alloy 12.7 mm in diameter and 250 mm long is stressed in tension and found to elongate 7.6 mm. on the basis of the information given, is it possible to compute the magnitude of the load that is necessary to produce this change in length? If so, calculate the load. If not, explain why. |
| **Q7\** the figure show (i) elastic-perfectly plastic and (ii) elasto-plastic with strain hardening idealized responses. What stress is needed in each case to have :1. A strain of 0.001?
2. A strain of 0.004?
 | Strain mm/mm |
| **Q8/** A metal rod having a diameter of 10mm is subjected to a repeated tensile load. The material of the rod has a tensile strength of 290 MPa and a fatigue behavior as shown in figure. How many load repetitions can be applied to this rod before it fails if the magnitude of the load is :1. 5 kN.
2. 11kN.
 |  |
| **Q9/** An aluminum alloy specimen with a radius of 7.1mm was subjected to tension until fracture and produced the following results:  |
| Stress MPa | Strain .x 10-3m/m |   |
| 55 | 0.6 |  |
| 117 | 1.5 |  |
| 186 | 2.4 |  |
| 242 | 3.2 |  |
| 297 | 4.0 |  |
| 345 | 4.6 |  |
| 400 | 5.2 |  |
| 428 | 5.8 |  |
| 442 | 6.2 |  |
| 449 | 6.5 |  |
| 462 | 7.3 |  |
| 469 | 8.1 |  |
| 483 | 9.7 |  |
| 1. Using a graph paper plot the stress-strain relationship.
2. Calculate the modulus of elasticity of the aluminum alloys.
3. Determine the proportion limit.
4. What is the maximum load if the stress in the bar is not exceed the proportion limit.
5. Determine the 0.2% offset yield strength.
6. Determine the tensile strength.
7. Determine the percent of elongation at failure.
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| **Q10/** an aluminum alloys rod with 12.5 mm diameter is subjected to 9100N tensile load. Calculate the resulting diameter of the rod. If the rod is subjected to a compressive load of 9100N, what will be the diameter of the rod? Assume that the modulus of elasticity is 69000MPa, poissons ratio is 0.33, and the yield strength is 145MPa. |
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| **Q11/** The stress-strain relation of an aluminum alloy bar having a length of 2 m and a diameter of 10 mm is expressed by the equation:$$ϵ=\frac{σ}{70 000}\left[1+\frac{3}{7}\left(\frac{σ}{270}\right)^{9}\right]$$Where σ is in MPa .if the rod is axially loaded by a tensile force of 20 kN and then unloaded, what is the permanent deformation of the bar? |
| **Q12/** A wood specimen having a square cross section of 50 x 50 mm was tested by applying a load at the middle of the span where the span was 710 mm. the deflection under the load was measured at different load levels as follows: |
| LoadN | Deflection.mm |  |
| 0 | 0 |  |
| 454 | 0.71 |  |
| 900 | 1.41 |  |
| 1350 | 2.11 |  |
| 1800 | 2.82 |  |
| 2250 | 3.56 |  |
| 2700 | 4.23 |  |
| 3150 | 4.94 |  |
| 3600 | 5.64 |  |
| 4050 | 6.35 |  |
| 4500 | 7.00 |  |
| 4950 | 8.00 |  |
| 5400 | 9.13 |  |
| 5850 | 10.29 |  |
| 6300 | 11.9 (failure) |  |
| 1. Using a graph aper plot the load-deflection relationship.
2. Mark the proportion limit on the graph.
3. Calculate the modulus of rapture( flexural strength).
 |
| **Q13\** A pine-wood specimen was prepared with dimensions of ( 50 x 50 x 200 ) mm and grains parallel to its length. The specimen was subjected to compression parallel to grains, and the load-deflection results are as shown. |
| LoadkN | Deformation.mm |  |
| 0.0 | 0.000 |  |
| 8.9 | 0.457 |  |
| 17.8 | 0.597 |  |
| 26.7 | 0.724 |  |
| 35.6 | 0.838 |  |
| 44.5 | 0.965 |  |
| 53.4 | 1.111 |  |
| 62.3 | 1.270 |  |
| 71.2 | 1.422 |  |
| 80.1 | 1.588 |  |
| 89.0 | 1.765 |  |
| 97.9 | 1.956 |  |
| 106.8 | 2.159 |  |
| 111.3 | 2.311 |  |
| 1. Using a graph paper plot the load-deflection relationship.
2. Calculate the modulus of elasticity .
3. What is the failure stress?
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Q14/ Explain each of the following by drawing:

Steel stress strain curve.

Elastic and Plastic Strain.

Poissons ratio in tension and compression.

Fatigue failure.

Porosity and void ratio with equation and drawing.

Q15/A rode made of an alloy with length of 1000 mm and diameter 30 mm, is subjected to tensile force 157 kN. If the modulus of elasticity of the alloy is 100 Gpa and poissons ratio is 0.27. What will be the final dimension of the rode?.

Q16/Explain how the deformation is occurred in elastic behavoir and plastic behavoir of any material.

Q17/Define each of the following in detail:

1-Frost resistance 2- Thermal conductivity 3-Isotropic material

4-Economical factor 5- Mechanical properties

Q18/ What are the criteria that must be considered for material properties.

Q19 What are the loading conditions, explain all the types with giving examples.

Q20/



Q21/ Explain the Stress-strain relationship for five type of different material

Q22/



Q23/what is mean by Strain softening and strain hardening.

Q24/



Q25/ Explain the lateral and transverse strain and what is there relation with each other?

Q26/ Write the table for offset values typical used to determine yiel stress.

Q27/ What are the arbitrary methods to identify the elastic method, draw and then explane each one.

Q28/ Explain the fatigue in detail with drawing.

Q29/ The rails of a railroad track are welded together at their ends (to form continuous rails and thus eliminate the clacking sound of the wheels) when the temperature is 60° F.

 What compressive stress s is produced in the rails when they are heated by the sun to 120° F if the coefficient of thermal expansion $α$ =6.5 X 10-6 /°F and the modulus of elasticity E = 30X 106 psi?

Q30/ An aluminum pipe has a length of 60 m at a temperature of 10° C. An adjacent steel pipe at the same temperature is 5 mm longer than the aluminum pipe.

 At what temperature (degrees Celsius) will the aluminum pipe be 15 mm longer than the steel pipe?(Assume that the coefficients of thermal expansion of aluminum and steel are $α\_{a}=$ 23 X 10-6/°C and $α\_{s}=$ 12 X 10-6/° C, respectively.)

Q31-Q39



Q40-Q42



Q43/ Define each of the followin:

1. Density 2- Unit weight 3- Bulk Density 4- Bulk Density 5- Porosity 6- Void Ratio

Q44/ Write all you now about the Failure and safety.

Q45/ explain the measuring device with the definition of Dial Gauge, LVDT, Stain gauge and Proving ring.

Q46/ Fill in the blanks:

 Clay bricks are small, rectangular blocks made of ……….. . Clays for bricks making vary widely in composition from one place to another. Clays are composed mainly of ………………………………………………………………………… ………………………., with different proportions. Bricks are manufactured by grinding or crushing the clay in ………. it with water to make it …….. The clay paste is then ……., ………, …….., and finally …….. . Bricks are manufactured with different colors, such as dark red, purple, brown, gray, pink or dull brown, depending on the ………….. of the clay during manufacturing . The firing temperature for brick manufacturing varies from …… to ……. oC . clay bricks have an average density of …….kN/m3.

Q47 / write about how you can make a preparation for brick production?

Q48/ explain the chemical changes in burning process of brick production.

Q49/ In general, what are the types of bricks in the market.

Q50/ write about the brick dimension and Conventional and specially shaped bricks with necessary drawing.

 Q51/ what is mean by light weight brick and write about it is classifications?

Q52/ how many bricks you use as a sample for brick (write about sampling the brick ) and then explain all about test of brickes.

Q53/ What is ferrous metals

Q54/Explain Cast iron and Steel

Q55/ Define pig iron

Q56/ Write about the composition and properties of pig iron and cast iron

Q57/ define steel in detail.

Q58/ Write about the wrough iron, it is properties and uses.

Q59/ make a table for differernt steel carbon content.

Q60/ Make a table to find a difference between cast iron and wrough iron.

Q61/ Make a table to find a difference between cast iron and pig iron.

Q62/ Write about the properties and uses of mild steel.

Q63/ Write about the properties and uses of Carbon steel.

Q64/ Write about the properties and uses of high tensile steel.

Q65/ Write in detail the properties of steel.

Q66/ Fill in the blanks:

1-

 ………. and ……… are alloys of iron and carbon, other alloys elements like …………, …………., …………., ………., etc, may be added to iron to make special steel. Iron is a chemical element. Steel is iron containing ……. than 1.5% carbon. Cast iron is different from steel in the sense that is contain ……. than 1.5% carbon. Wrought iron is different from steel as it contain less than ……… carbon.

2-

Normalizing is similar to ……., with a slight difference in heating temperature. Steel is normalized by heating it into the …….. range, usually ……C° above the austenile line. The material is then …….. . Normalizing produce a uniform, fine-grained ………. . Therefore, ………… is regarded as a corrective treatment, and not a ………….. or ……….. treatment. Normalizing is used in the structural plate production to produce …….-………. toughness.

Q67/ Write about annealing and normalizing.

Q68/Write about hardening and tempering.

Q69/ what are the properties that are improved when alloys agent are added to steel.

Q70/make a table for common steel alloying agents. And any other expalanation.

Q71/ what is a structural steel?. Explain in detail.

Q72/ Draw 10 type of structural steel types

Q73/ what is a Reinforcing steel?. Explain in detail.

Q74/ make a table for all prperties and sppecifications of reinforcing steel.

Q75/ draw two drawings for typical stress-strain curve curvefor mild steel and steel bars with different carbon content Tensile stress-strain diagram of hot rolled.

Q76/Write all you now about the tension test of steel with drawing.

Q77/ what are the main tests for steel.

Q78/ write what you now about welding.

Q79/ what is mean by corrosion, write in detail.

Q80/ what you make to protect from corrosion.