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ISBN : 978-93-93531-25-4

First Edition : 2013
Second Edition : 2014
Third Edition : 2015
Fourth Edition : 2016
Fifth Edition : 2017
Sixth Edition : 2018
Seventh Edition : 2020
Eighth Edition : 2022

Price : ₹1000.00

Preface

This book has been written to meet the growing requirements of candidates appearing for State Engineering Service Examination, Junior Engineer, Public Sector Units, RRB-JE and Metro Exams. Though every candidate has ability to succeed but competitive environment, in-depth knowledge, quality guidance, time management and good source of study is required to achieve goals.

This book includes Multiple Choice Questions (MCQ Volume-II) which works as a mock exam practice for the reader. Questions of all the subject have been organized in systematic, concepts oriented and error less manner so that it become easy and interesting for even a beginner to understand. It is a very convenient book and must be solved by candidate aiming for competitive exams.

After solving this booklet students can feel encouraged and develop confidence to attempt each and every type of numerical as well as theoretical problems. Each problems explains solving approach so that at the end, so the reader is well equipped to be able to apply any type of problem solving requirement and distinctly choose one strategy or type from the other.

We hope this book will be proved an important tool to succeed in State Engineering Service Examination, Junior Engineer, Public Sector Units, RRB-JE and Metro Exams.

It is earnestly hoped that with the extensive additions and revisions, the present edition will facilitate the students not only in preparing themselves for competitive examinations but also in preparing for their regular examinations and prove more useful to the students than the earlier editions.

Even though, enough readings were given for correcting the error and printing mistakes, due to human tendency there could be some minor typos in the book. If any such typos found, they will be highly appreciated and incorporated in the next edition. Also, please provide your valuable suggestions at :engineers.academy.india@gmail.com

All the Best!

Engineers Academy Editorial Board

CONTENTS

UNIT-I

STRENGTH OF MATERIALS

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CHAPTER 1

INTRODUCTION

OBJECTIVE QUESTIONS

1. Actual rupture stress is
   (a) Breaking stress
   (b) Maximum load/original cross-sectional area
   (c) Load at breaking point/true strain
   (d) Load at breaking point/neck area

2. Elasticity of various materials is controlled by its
   (a) Ultimate tensile stress
   (b) Proof stress
   (c) Stress at yield point
   (d) Stress at elastic limit

3. Ratio of lateral strain to linear strain within elastic limit, is known as
   (a) Young's modulus
   (b) Bulk modulus
   (c) Modulus of rigidity
   (d) Poisson's ratio

4. Ratio of direct stress to volumetric strain in case of a body subjected to three mutually perpendicular stress of equal intensity, is
   (a) Young's modulus
   (b) Bulk modulus
   (c) Modulus of rigidity
   (d) None of the above

5. If a material expands freely due to heating it will develop
   (a) Thermal stresses (b) Tensile stress
   (c) No stress (d) Bending

6. In a tensile test, near the elastic limit zone,
   (a) Tensile strain increases more quickly
   (b) Tensile strain decreases more quickly
   (c) Tensile strain increases in proportion to the stress
   (d) Tensile strain decreases in proportion to the stress

7. The property of a material by virtue of which it can be beaten or rolled into plates is called
   (a) Malleability (b) Ductility
   (c) Plasticity (d) Elasticity

8. Change in the unit volume of a material under tension with increase in its Poisson's ratio will
   (a) Increase (b) Decrease
   (c) Remain same (d) Unpredictable

9. The phenomenon of slow extension of the material, i.e. stress increasing with the time at a constant load is called
   (a) Creeping (b) Yielding
   (c) Breaking (d) Plasticity

10. For steel, the ultimate strength in shear as compared to in tension is nearly
    (a) same (b) half
    (c) one-third (d) two-third

11. Tensile strength of a material is obtained by dividing the maximum load during the test by the

(a) Area at the time of fracture

(b) Original cross-sectional area

(c) Average of (a) and (b)

(d) Minimum area after fracture

12. Maximum elastic strain energy that can be stored in a body is known as

(a) Impact energy (b) Resilience

(c) Proof resilience (d) None of the above

13. Proof stress

(a) Is the safest stress

(b) Causes a specified permanent deformation in a material, usually 0.1%-0.2%

(c) Is used in connection with materials like mild steel

(d) Does not exist

14. A material having same properties in all directions at a given point is known as

(a) Orthotropic material

(b) Isotropic material

(c) Elastic material

(d) Homogenous material

15. The Bulk modulus K, the modulus of rigidity N and Poisson's ratio 1/m are related by

(a) $\frac{1}{m}=\frac{9KN}{3K+N}$ (b) $\frac{1}{m}=\frac{3K-2N}{2N+6K}$

(c) $\frac{1}{m}=\frac{6K+2N}{3K-2N}$ (d) None of the above

16. The stress at which extension of the material takes place more quickly as compared to the increase in load is called

(a) Elastic point of the material

(b) Plastic point of the material

(c) Breaking point of the material

(d) Yielding point of the material

17. When it is indicated that member is elastic, it means that when force is applied, it will

(a) Not deform (b) Be safest

(c) Stretch (d) Not stretch

18. A material capable of absorbing large amount of energy before fracture is known as

(a) ductility (b) toughness

(b) resilience (d) shock proof

19. If the thickness and width of each plate of a laminated spring be t and w respectively, then its moment of inertia is equal to

(a) $\frac{wt^3}{12}$ (b) $\frac{t^2w^3}{12}$

(c) $\frac{wt^2}{12}$ (d) $\frac{tw^2}{12}$

20. During a tensile test on a specimen of $1cm^2$ cross-section, maximum load observed was 8 tonnes and area of cross-section at neck was 0.5 cm^2. Ultimate tensile strength of specimen is

(a) 4 tonnes/cm^2 (b) 8 tonnes/cm^2

(c) 16 tonnes/cm^2 (d) 22 tonnes/cm^2

21. A material obey's hooke's law up to

(a) Plastic limit

(b) Elastic limit

(c) Yield point

(d) Limit of proportionality

22. True stress-strain curve for materials is plotted between

(a) Load/original cross-sectional area and change in length/original length

(b) Load/instantaneous cross-sectional area and $\log_e\left(\frac{\text{Original area}}{\text{Instantaneous area}}\right)$

(c) Load/instantaneous cross-sectional area and change in length/original length

(d) Load/instantaneous area and instantaneous area/original area

23. The intensity of stress which causes unit longitudinal is called

(a) Unit stress

(b) Modulus of rigidity

(c) Bulk modulus

(d) Modulus of elasticity

24. Modulus of rigidity is defined as the ratio of

(a) Longitudinal stress and longitudinal strain

(b) Volumetric stress and volumetric strain

(c) Lateral stress and lateral strain

(d) Shear stress and shear strain

25. The ultimate tensile stress of mild steel compared to ultimate compressive stress is

(a) Same (b) More

(c) Less (d) Unpredictable

26. Modular ratio of two materials is the ratio of

(a) Strains

(b) Stress and strain

(c) Shear stress and shear strain

(d) Moduli of elasticity

27. Elasticity of a M.S. specimen is defined by

(a) Hooke's law (b) Yield point

(c) Plastic flow (d) Proof stress

28. If a material is loaded beyond yield point stress

(a) It becomes elastic

(b) It becomes ductile

(c) Its resistance to fatigue increases

(d) It loses its tendency to return to its original shape

29. A cylindrical section having no joint is known as

(a) Jointless section (b) Homogeneous section

(c) Perfect section (d) Seamless section

30. The bulk modulus of a material is defined as the ratio of

(a) Volume change to modulus of elasticity

(b) Stress intensity to volumetric strain

(c) Volume change to original volume

(d) Pressure applied to the change in volume

31. During the tensile test of a glass rod the nature of stress-strain curve is

(a) Straight and dropping

(b) Sudden break

(c) Straight line

(d) Parabolic

32. Modulus of resilience is

(a) Property to resist shocks

(b) The property to store energy without undergoing permanent deformation

(c) An index of elasticity

(d) An index of compressibility

33. Moment of inertia of a square of side d about the diagonal is

(a) $\frac{d^4}{12}$ (d) $\frac{d^4}{24}$

(c) $\frac{d^4}{18}$ (d) $\frac{d^4}{8}$

34. Disruptive strength is the maximum strength of a metal.

(a) When subjected to three principal tensile stresses at right angles to one another and all of equal magnitude.

(b) When loaded in tension

(c) When loaded in compression

(d) When loaded in shear

35. Radius of gyration for a circular section is

(a) Directly proportional to the diameter of the section

(b) Square root of the diameter of the section

(c) Inversely proportional to the diameter of the section

(d) None of the above

36. Strain energy stored in a body of volume V with stress due to gradually applied load is

(a) $\frac{\sigma E}{V}$ (b) $\frac{\sigma E^2}{V}$

(c) $\frac{\sigma V^2}{E}$ (d) $\frac{\sigma^2 V}{2E}$

117. ***Ans. (a)***

118. ***Ans. (d)***

119. ***Ans. (c)***

120. ***Ans. (a)***

121. ***Ans. (a)***

122. ***Ans. (d)***

$$\varepsilon_t = \ln\left(\frac{A_0}{A_r}\right) = 2\ln\left(\frac{d_0}{d_r}\right)$$

$$= 2\ln\left(\frac{5}{4}\right) = 0.446$$

123. ***Ans. (a)***

$$\text{Engineering Strain} = \frac{\Delta L}{\text{Initial Length}}$$

$$\varepsilon_{eng} = \frac{\Delta L}{L} = \frac{2L - L}{L} = 1$$

$$\varepsilon_T = \ln(1 + \varepsilon_{eng})$$

$$= \ln(1 + 1) = 0.693$$

124. ***Ans. (c)***

$D = 100$ mm, $L = 500$ m

$P = 1000$ kN

$G = ??$

$E = 2 \times 10^5$

$E = 2G[1 + \mu]$

$E = 2 \times G[1 + 0.3]$

$2 \times 10^5 = 2 \times G \times 1.3$

$G = 0.7692 \times 10^5$ N/mm^2

125. ***Ans. (c)***

126. ***Ans. (b)***

127. ***Ans. (b)***

128. ***Ans. (d)***

129. ***Ans. (a)***

$$E = 2G(1 + \mu)$$

$$\frac{E}{G} = 2(1 + 0.2) = 2.4$$

$$\frac{E}{G} = \frac{12}{5}$$

130. ***Ans. (b)***

131. ***Ans. (c)***

$E = 200$ GPa

$G = 80$ GPa

$E = 2G(1 + \mu)$

$200 = 80 \times 2(1 + \mu)$

$$\frac{200}{160} - 1 = \mu$$

$$\mu = \frac{40}{160} = \frac{1}{4} = 0.25$$

132. ***Ans. (c)***

133. ***Ans. (c)***

134. ***Ans. (c)***

135. ***Ans. (c)***

136. ***Ans. (b)***

137. ***Ans. (b)***

138. ***Ans. (d)***

According to Hooke's low

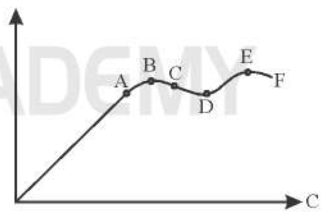
Stress μ Strain

$\sigma \propto e$

$\sigma = Ee$

$$E = \frac{\sigma}{e} = \frac{\text{Stress}}{\text{Strain}} = \frac{F/A}{\Delta l/l}, \text{ or } \Delta\ell = \frac{F\ell}{AE}$$

139. ***Ans. (a)***



A = Proportional limit

B = Elastic limit

C = Yield point

E = Fracture point

140. ***Ans. (b)***

The elastic limit of brittle materials is comparatively low, there is no yield point in brittle materials.

141. *Ans. (a)*

142. *Ans. (d)*

$$\text{Strain} = \frac{\text{change in dimension}}{\text{original dimension}}$$

Strain is a dimensionless and unitless quantity.

143. *Ans. (b)*

Longitudinal strain

$$e_1 = \frac{\Delta l}{l} = \frac{l_2 - l_1}{l_1}$$

$$\because \quad l_2 = 2l_1$$

$$e_1 = \frac{2l_1 - l_1}{l_1} = 1.0$$

144. *Ans. (d)*

$$\frac{\Delta V}{V} = \frac{\sigma}{E}(1 - 2\mu)$$

$$\because \quad \frac{\Delta V}{V} > 0 \text{ (Always)}$$

$$\frac{\sigma}{E}(1 - 2\mu) > 0$$

$$1 - 2\mu > \frac{0 \times E}{\sigma}$$

$$1 - 2\mu > 0$$

$$\boxed{\mu < 0.5} \text{ or } \boxed{\mu < \frac{1}{2}}$$

145. *Ans. (c)*

146. *Ans. (d)*

147. *Ans. (c)*

$$E = 2G(1 + \mu)$$

$$\frac{E}{G} = 2(1 + 0.4) = 2 \times 1.4 = 2.8$$

$$\frac{E}{G} = 2.8 = \frac{14}{5}$$

148. *Ans. (d)*

149. *Ans. (c)*

In a rigid body modulus of elasticity is equal infinite because in it value of strain is zero.

150. *Ans. (d)*

151. *Ans. (d)*

152. *Ans. (c)*

Length of cylindrical bar = LM deformation due to axially load = l mm.

$$\text{Then} \quad \text{Strain} = \frac{\text{Elongatinon in length}}{\text{Initial length of Rod}}$$

$$= \frac{\ell \text{ mm}}{\text{Lm}}$$

$$= \frac{\ell}{1000L} \text{ OR } 0.001\left(\frac{\ell}{L}\right)$$

153. *Ans. (d)*

$$\text{Lateral strain} = \Delta d/d = \left(\frac{0.05}{10}\right) = 0.005$$

$$\text{Longitudinal strain} = \Delta l/l = (0.8/40) = 0.02$$

$$\text{Poisson Ratio} = \frac{\text{Lateral strain}}{\text{Longitudnal strain}}$$

$$\mu = \frac{0.005}{0.02} = 0.25$$

154. *Ans. (b)*

155. *Ans. (d)*

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ANSWERS AND EXPLANATIONS

1. ***Ans. (a)***

For a thin cylindrical shell:-

$$\sigma_n = \frac{pd}{2t}$$

$$\sigma_L = \frac{pd}{4t}$$

$$\varepsilon_h = \frac{\sigma_h}{E} - \frac{\mu\sigma_L}{E}$$

$$= \frac{pd}{4tE}(2 - \mu)$$

2. ***Ans. (b)***

$$e_L = \frac{\sigma_h}{E} - \frac{\mu\sigma_l}{E}$$

$$= \frac{pd}{4tE}(1 - 2\mu)$$

3. ***Ans. (d)***

4. ***Ans. (c)***

$$\sigma_h = \frac{B}{x^2} + A$$

When x is less σ_h is more

5. ***Ans. (d)***

6. ***Ans. (c)***

$$\sigma_L = \frac{pd}{4t}; \ \sigma_h = \frac{pd}{2t}$$

$$\sigma_L = \frac{\sigma_h}{2}$$

7. ***Ans. (b)***

$$\sigma_n = \frac{B}{r^2} + A$$

8. ***Ans. (c)***

9. ***Ans. (a)***

Pressure force = $p\frac{\pi d^2}{4}$

10. ***Ans. (c)***

11. ***Ans. (b)***

$$\varepsilon_v = 2\varepsilon_h + \varepsilon_L$$

12. ***Ans. (a)***

13. ***Ans. (d)***

14. ***Ans. (c)***

$$\mu\varepsilon_L = \frac{\Delta t}{t}$$

$$0.25 \times 0.01 = \frac{1}{t}$$

$$t = \frac{1}{0.25 \times 0.01} = 400 \text{ mm.}$$

15. ***Ans. (b)***

16. ***Ans. (c)***

17. ***Ans. (d)***

18. ***Ans. (c)***

19. ***Ans. (a)***

20. ***Ans. (b)***

P × Projected area of spherical vessel

$$= \sigma_L \times \pi \times t \times d$$

Projected area of spherical vessel

$$= \frac{\pi}{4} \times (2d)^2$$

$$P \times \frac{\pi}{4} \times (2d)^2 = \sigma_L \times \pi \times t \times d$$

$$\frac{Pd}{t} = \sigma_L$$

21. ***Ans (c)***

$$\sigma_h = \frac{pd}{2t}$$

22. ***Ans. (c)***

Tensile strength = min. hoop shear = $\frac{Pd}{2t}$

$$100 \text{ N/mm}^2 = 100 \text{ N} \times 10^6 \text{ m}^2$$

$$100 \times 10^6 = \frac{2 \times 10^6 \times 0.8}{2 \times t}$$

$$t = \frac{0.8}{100} \text{m}$$

$$t = \frac{0.8}{100} \times 1000 \Rightarrow 8 \text{ mm}$$

23. *Ans. (b)*

$$\sigma_{longitudinal} = \frac{pd}{4t}$$

$$= \frac{3.2\times10^6\times1.5\times10^3}{4\times8}$$

$\Rightarrow$ 0.15×10^9

$= 150\times10^6$ N/m²

or $= 150$ N/mm²

24. *Ans. (c)*

$$\tau_{max} = \frac{Pd}{8t}$$

$$= \frac{10\times200}{8\times5}$$

$$\tau_{max} = 100 \text{ N/mm}^2$$

25. *Ans. (d)*

$$\sigma_h = \frac{Pd}{2t} = 250 \text{ MPa},$$

$$\sigma_l = \frac{Pd}{4t} = 125 \text{ MPa}$$

26. *Ans. (d)*

27. *Ans. (d)*

$$\sigma_h = \frac{Pd}{2t} \text{ [Initial]}$$

$$\sigma_h' = \frac{P[d+0.01d]}{2[t-0.01t]} \text{ [Final]}$$

$$\text{Change} = \frac{\sigma_h'-\sigma_h}{\sigma_h}\times100 = 2.02\%$$

28. *Ans. (b)*

29. *Ans. (c)*

30. *Ans. (d)*

31. *Ans. (d)*

32. *Ans. (c)*

$d = 1$m

$P = 10$ Kgf/cm²

$\sigma_H = 200$ kgf/cm²

Circumferential stress or hoop stress

$$\sigma_H = \frac{Pd}{2t}$$

$$200 = \frac{10\times1}{2\times t}$$

$$\Rightarrow t = \frac{10}{400}\times1000 \text{ mm}$$

$$t = 25 \text{ mm}$$

33. *Ans. (a)*

$$P\times\frac{\pi}{4}D^2 = \tau_Y\times\pi\times D\times t_1$$

$$P = \frac{4t_1\tau_Y}{D}$$

34. *Ans. (c)*

$$\sigma_H = \sigma_1 = \frac{Pd}{2t}$$

$$\sigma_L = \sigma_2 = \frac{Pd}{4t}$$

$$\sigma_{R(Radial)}\sigma_3 = 0$$

$$\tau_{max} = \left(\frac{\sigma_1-\sigma_3}{2}\right) = \left(\frac{Pd}{4t}\right)$$

$$= \frac{2\times1}{4\times0.02} = 25 \text{ MPa}$$

35. *Ans. (c)*

36. *Ans. (c)*

37. *Ans. (a)*

38. *Ans. (b)*

39. *Ans. (b)*

40. *Ans. (a)*

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