

SHIGLEY MECHANICAL ENGINEERING DESIGN 9TH EDITION SOLUTIONS CHAPTER 5

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Shigley's Mechanical Engineering Design, 9th Edition: Chapter 5 Solutions

Chapter 5 of Shigley's Mechanical Engineering Design, 9th Edition covers the topic of shafts. In this chapter, students learn about the design and analysis of shafts subjected to various types of loads.

Question 1: A solid shaft of diameter $d = 20$ mm is subjected to a torque of $T = 100$ N-m. Determine the maximum shear stress in the shaft.

Answer: The maximum shear stress is given by:

$$\tau_{\max} = Tr/J$$

where:

- $r = d/2 = 10$ mm is the radius of the shaft
- $J = \pi d^4/32 = 1.257 \times 10^{-6} \text{ m}^4$ is the polar moment of inertia

Substituting these values into the equation, we get:

$$\tau_{\max} = (100 \text{ N-m})(10 \text{ mm}) / (1.257 \times 10^{-6} \text{ m}^4) = 79.5 \text{ MPa}$$

Question 2: A hollow shaft has an outer diameter of $D = 50$ mm and an inner diameter of $d = 30$ mm. If the shaft is subjected to a torque of $T = 200$ N-m, determine the maximum shear stress in the shaft.

Answer: The maximum shear stress is given by:

$$\tau_{\max} = Tr / (J_o - J_i)$$

where:

- $J_o = \pi D^4 / 32 = 6.55 \times 10^{-6} \text{ m}^4$ is the polar moment of inertia of the outer shaft
- $J_i = \pi d^4 / 32 = 2.36 \times 10^{-6} \text{ m}^4$ is the polar moment of inertia of the inner shaft

Substituting these values into the equation, we get:

$$\tau_{\max} = (200 \text{ N-m})(50 \text{ mm}) / (6.55 \times 10^{-6} \text{ m}^4 - 2.36 \times 10^{-6} \text{ m}^4) = 118.6$$

Question 3: A shaft is supported by two bearings and subjected to a distributed load of $p = 100 \text{ N/m}$ over a length of $L = 500 \text{ mm}$. The shaft diameter is $d = 25 \text{ mm}$. Determine the maximum bending moment and deflection in the shaft.

Answer: The maximum bending moment is given by:

$$M_{\max} = pL^2 / 8 = 3125 \text{ N-mm}$$

The maximum deflection is given by:

$$\delta_{\max} = pL^3 / (3EI) = 0.0039 \text{ mm}$$

where:

- $E = 200 \text{ GPa}$ is the modulus of elasticity
- $I = \pi d^4 / 64 = 1.227 \times 10^{-8} \text{ m}^4$ is the moment of inertia

Question 4: A shaft is subjected to a combined loading of torque and bending moment. The torque is $T = 150 \text{ N-m}$ and the bending moment is $M = 200 \text{ N-m}$. The shaft diameter is $d = 30 \text{ mm}$. Determine the equivalent bending moment using the von Mises criterion.

Answer: The equivalent bending moment is given by:

$$M_{\text{eq}} = \sqrt{M^2 + (T/2)^2} = 224 \text{ N-m}$$

Question 5: A shaft is made of steel with a yield strength of $S_y = 350$ MPa. The shaft is subjected to a fatigue loading of alternating torque with a maximum value of $T_m = 120$ N-m. Determine the fatigue strength of the shaft using the Goodman criterion.

Answer: The fatigue strength using the Goodman criterion is given by:

$$S_{fat} = S_e * (1 - (T_m/S_{ut})^b)$$

where:

- $S_e = S_y = 350$ MPa is the yield strength
- $S_{ut} = 500$ MPa is the ultimate tensile strength
- $b = 0.125$ is a constant

Substituting these values into the equation, we get:

$$S_{fat} = 350 \text{ MPa} * (1 - (120 \text{ N-m} / 500 \text{ N-m})^{0.125}) = 250 \text{ MPa}$$

Star Wars in the Public Square: The Clone Wars as Political Dialogue

Introduction

Star Wars, a beloved sci-fi franchise, has long captured the imagination of audiences worldwide. However, beyond its thrilling space battles and iconic characters, it also serves as a valuable lens through which to explore contemporary political issues.

Paragraph 1: The Clone Wars and the War on Terror

The Clone Wars, a major conflict depicted in the prequel trilogy, has been interpreted as an allegory for the United States' War on Terror. The separatists' desire for independence mirrors the struggles of real-world insurgent groups, while the Republic's tactics and reliance on a standing army raise questions about the erosion of civil liberties.

Q1: How does the portrayal of the Clone Wars reflect the challenges of fighting an asymmetric war?

Paragraph 2: The Rise of Palpatine and the Authoritarian Turn

The Clone Wars provides a cautionary tale about the dangers of authoritarianism. Chancellor Palpatine, exploiting the crisis, manipulates public opinion and gradually assumes dictatorial powers. His rise parallels the real-world trend towards populism and the erosion of democratic institutions.

Q2: What are the similarities between Palpatine's rise to power and the rise of modern-day authoritarian leaders?

Paragraph 3: The Jedi as a Force for Good and Evil

The Jedi, revered as guardians of justice and peace, face moral dilemmas as the Clone Wars escalate. Their unwavering obedience to the Republic compromises their ability to remain neutral and impartial. This raises questions about the role of ethics in a time of war and the limits of good intentions.

Q3: How does the portrayal of the Jedi grapple with the complexities of serving as both warriors and peacekeepers?

Paragraph 4: The Rebels and the Fight against Oppression

The original Star Wars trilogy depicts the Rebel Alliance's struggle against the Empire, a symbol of tyranny. The rebellion embodies the spirit of resistance against oppression and provides a source of hope in the face of overwhelming odds.

Q4: What insights does Star Wars offer about the importance of dissent and the resilience of the human spirit?

Conclusion

Star Wars remains a powerful cultural artifact that provides a rich tapestry for exploring political and ethical themes. Through the lens of the Clone Wars, the franchise challenges us to consider the complexities of war, the rise of authoritarianism, and the role of individuals in shaping their own destinies. By engaging with Star Wars in the public square, we can foster critical dialogue and strive for a more just and equitable society.

Unlocking Programming Expertise with "Special Collections on Programming Volume 1"

"Special Collections on Programming Volume 1" offers a comprehensive collection of programming interview questions designed to challenge and expand your skillset. Covering a wide array of fundamental concepts, this volume provides valuable insights into the complexities of algorithms, data structures, and design patterns.

Tree Mastery with Tree-Based Questions

One of the key topics explored in this volume is trees. Questions such as "Find the Maximum Depth of a Binary Tree" and "Construct Binary Tree from Inorder and Postorder Traversal" test your understanding of tree traversal techniques and the ability to manipulate tree structures efficiently.

Unveiling Intricacies of Graphs

Graphs are another crucial data structure addressed in the volume. Questions like "Find the Shortest Path in a Directed Acyclic Graph" and "Detect Cycle in a Directed Graph" assess your proficiency in graph traversal algorithms and the ability to unravel complex graph relationships.

Dynamic Programming: Unlocking Optimization

Dynamic programming questions play a prominent role in this collection. Examples include "Longest Common Subsequence" and "Optimal Matrix Chain Multiplication." These questions demonstrate the power of memoization and dynamic programming techniques in solving complex optimization problems.

Design Patterns: Architecting Software Solutions

The volume also covers design patterns, an essential concept in software engineering. Questions like "Implement the Singleton Pattern" and "Apply the Factory Method Pattern" test your understanding of creational design patterns and their application in real-world scenarios.

Special Collections: A Gateway to Advanced Concepts

In addition to these core topics, "Special Collections on Programming Volume 1" also features questions on advanced concepts such as bit manipulation, sliding windows, segment trees, and union-find data structures. By tackling these challenges, you can

expand your programming knowledge and unlock your potential as a software engineer.

The Impact of Cemeteries on the Environment and Public Health

Cemeteries are an integral part of our society, providing a place for us to mourn and remember our loved ones. However, they can also have a significant impact on the environment and our public health.

1. What are the environmental impacts of cemeteries?

Cemeteries can have a variety of negative environmental impacts, including:

- **Water pollution:** The chemicals used in embalming and burial can leach into the groundwater, polluting water supplies.
- **Air pollution:** The burning of funeral pyres and the decomposition of bodies can release harmful pollutants into the air.
- **Land pollution:** Cemeteries can take up a lot of land, which can lead to habitat loss and deforestation.

2. What are the public health impacts of cemeteries?

Cemeteries can also pose a number of public health risks, including:

- **Diseases:** Cemeteries can provide a breeding ground for mosquitoes and other insects that can transmit diseases.
- **Exposure to chemicals:** The chemicals used in embalming and burial can be harmful to human health if they are inhaled or ingested.
- **Mental health:** Cemeteries can be a reminder of death and loss, which can trigger feelings of anxiety and depression.

3. What can be done to reduce the environmental and public health impacts of cemeteries?

There are a number of things that can be done to reduce the environmental and public health impacts of cemeteries, including:

- **Using environmentally friendly burial practices:** There are a number of environmentally friendly burial practices that can be used, such as green burials and cremation.
- **Managing cemeteries in a sustainable way:** Cemeteries can be managed in a way that minimizes their environmental impact, such as by using renewable energy sources and planting trees.
- **Raising awareness of the environmental and public health impacts of cemeteries:** It is important to raise awareness of the environmental and public health impacts of cemeteries so that people can make informed decisions about how they want to be buried.

4. What are the benefits of cemeteries?

Despite their environmental and public health impacts, cemeteries can also provide a number of benefits, including:

- **A place for mourning and remembrance:** Cemeteries provide a place for people to mourn and remember their loved ones.
- **A place for reflection and contemplation:** Cemeteries can be a place for people to reflect and contemplate on life and death.
- **A place for community:** Cemeteries can be a place for people to connect with others who have lost loved ones.

5. How can we balance the benefits of cemeteries with their environmental and public health impacts?

It is important to find a way to balance the benefits of cemeteries with their environmental and public health impacts. This can be done by using environmentally friendly burial practices, managing cemeteries in a sustainable way, and raising awareness of their impacts. By taking these steps, we can minimize the negative impacts of cemeteries and preserve their many benefits.

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