

## Fifth Semester B.E. Degree Examination, June/July 2013

**Design of Machine Elements – I**

Time: 3 hrs.

Max. Marks: 100

*Notes: 1. Answer FIVE full questions, selecting at least TWO questions from each part.*

*2. Use of design data Hand book is permitted.*

**PART – A**

1.
  - a. What are the basic requirements of machine elements? Explain briefly. (05 Marks)
  - b. What are the factors to be considered for selection of material for a machine component? (05 Marks)
  - c. A hollow shaft of 40 mm diameter and 25 mm inner diameter is subjected to a twisting moment of 118 N-m, a axial thrust of 9806 N and a bending moment of 79 N-m. Calculate the maximum compressive and shear stresses. (10 Marks)
2.
  - a. The frames of an automobile engine connecting rod have been so as to allow play which gives shock loading equivalent to a weight of 5886 N falling through a height of 0.2 mm. The connecting rod is 250 mm long and has a cross-sectional area of  $3 \times 10^{-4} \text{ m}^2$ . Determine the stress induced in the connecting rod. Compare the maximum stress induced with that of a static load of 5886 N. (06 Marks)
  - b. A bolt is subjected to a direct tensile load of 20 kN and a transverse shear force of 15 kN. Material of the bolt has a normal stress of 450 MPa at yield and Poisson's ratio of 0.25. Compute the root diameter of the bolt according to:
    - i) Maximum shear stress theory of failure and
    - ii) Von Mises's criterion for failure.
 Hence suggest suitable size of the bolt. Take a value of 3 for factor of safety. (07 Marks)
  - c. Determine the maximum stress induced in the following cases taking stress concentration into account:
    - i) A rectangular plate 50 mm wide, 8 mm thick and with a central hole of 10 mm is loaded in axial tension of 14.7 kN.
    - ii) A stepped shaft, stepped down from 45 mm to 30 mm with a fillet radius of 6 mm is subjected to a twisting moment of 98 N-m. (07 Marks)
3.
  - a. Derive Soderberg's equation for designing of a machine element with change in cross section, to sustain loads that fluctuate between two limits. (05 Marks)
  - b. A hot rolled steel shaft is subjected to a torsional moment that varies from 500 N-m clockwise to 100 N-m counter-clockwise as the bending moment at the critical junction varies from 400 N-m to -200 N-m. Neglecting the stress concentration effect, determine the required shaft diameter. The material has an ultimate strength of 550 MPa and a yield strength of 410 MPa. Take the endurance limit as half the ultimate strength and a factor of safety as 2. Assume surface, size and load factor for bending as 1.111, 1.1765 and 1 and that for torsion as 1.05263, 1.1765 and 1.7 respectively. (10 Marks)
4.
  - a. An M20 x 2 steel bolt of 100 mm long is subjected to impact load. The energy absorbed by the bolt is 2 N-m.
    - i) Determine the stress in the shank of the bolt if there is no threaded portion between the nut and bolt head.
    - ii) Determine the stress in the shank if the entire length of the bolt is threaded. Assume modulus of elasticity for steel as 206 GPa. (08 Marks)

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## **Table of Contents Mechanical Technology Grade1exam Papers 2014**

1. Understanding the eBook Mechanical Technology Grade1exam Papers 2014
  - The Rise of Digital Reading Mechanical Technology Grade1exam Papers 2014
  - Advantages of eBooks Over Traditional Books
2. Identifying Mechanical Technology Grade1exam Papers 2014
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Mechanical Technology Grade1exam Papers 2014
  - User-Friendly Interface
4. Exploring eBook Recommendations from Mechanical Technology Grade1exam Papers 2014
  - Personalized Recommendations
  - Mechanical Technology Grade1exam Papers 2014 User Reviews and Ratings
  - Mechanical Technology Grade1exam Papers 2014 and Bestseller Lists
5. Accessing Mechanical Technology Grade1exam Papers 2014 Free and Paid eBooks
  - Mechanical Technology Grade1exam Papers 2014 Public Domain eBooks
  - Mechanical Technology Grade1exam Papers 2014 eBook Subscription Services
  - Mechanical Technology Grade1exam Papers 2014 Budget-Friendly Options

6. Navigating Mechanical Technology Grade1exam Papers 2014 eBook Formats
  - ePub, PDF, MOBI, and More
  - Mechanical Technology Grade1exam Papers 2014 Compatibility with Devices
  - Mechanical Technology Grade1exam Papers 2014 Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Mechanical Technology Grade1exam Papers 2014
  - Highlighting and Note-Taking Mechanical Technology Grade1exam Papers 2014
  - Interactive Elements Mechanical Technology Grade1exam Papers 2014
8. Staying Engaged with Mechanical Technology Grade1exam Papers 2014
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Mechanical Technology Grade1exam Papers 2014
9. Balancing eBooks and Physical Books Mechanical Technology Grade1exam Papers 2014
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Mechanical Technology Grade1exam Papers 2014
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Mechanical Technology Grade1exam Papers 2014
  - Setting Reading Goals Mechanical Technology Grade1exam Papers 2014
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Mechanical Technology Grade1exam Papers 2014
  - Fact-Checking eBook Content of Mechanical Technology Grade1exam Papers 2014
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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