



**KING SAUD UNIVERSITY  
COLLEGE OF ENGINEERING  
MECHANICAL ENGINEERING DEPARTMENT**

**Subject Report**

**ME 304 Mechanical Engineering Design (1)**

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## **Course Description**

Introduction to design: design process, problem formulation, engineering model, factors of safety and codes, overall design considerations; Stresses: stress concentration factors, residual stresses; Deflection and Stiffness; Stability and Buckling; Theories of failure: failure under static loading, fatigue loading; fracture mechanics.

## **Course Topics**

1. Shaft Design
2. Theory of Failure: Static Loading
3. Deflection of Beams and shafts
4. Stability of Structures: Column Buckling
5. Energy Methods
6. Theory of Failure: Dynamic Loading
7. Introduction to Fracture Mechanics

## **Assessment Tools**

Project (5%)

Quiz Homework Assignments (15%)

Midterms (30%)

Final Examination (40%)

## Textbook

1. R.C.Hibbeler. Mechanics of Materials, SI 8<sup>th</sup> Edition.
2. J. E. Shigley, C. R. Mischke and R. G. Budynas, [Mechanical Engineering Design](#), SI 9<sup>th</sup> Edition, [McGraw Hill](#), 2008.
3. Mechanical Analysis and Design, By Arthur B. Burr, Elsevier
4. Fundamentals of Machine component Design, By Robert Juvinall and Kurt Marshek, Wiley

## **Course objectives**

To develop an understanding of the relationship between factors of safety and codes

To show proficiency in mathematics and basic sciences required to solve structural engineering and mechanics problem.

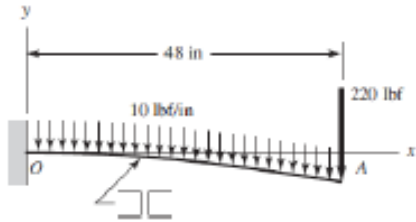
To develop analytical and graphical problem solving skills.

## Exams samples

**Student Name:**

**NO. :**

The cantilever shown in the figure consists of two structural-steel channels size 3 in, 5.0 lb/ft. Using superposition, find the deflection at A.



**Student Name:**

**NO. :**

A  $\frac{1}{4}$ -in drill rod was heat-treated and ground. The measured hardness was found to be 490 Brinell. Estimate the endurance strength if the rod is used in rotating bending.

## Exam answers

$$I = 2(1.85) = 3.7 \text{ in}^4$$

Adding the weight of the channels,  $2(5)/12 = 0.833 \text{ lbf/in}$ ,

$$\begin{aligned} y_A &= -\frac{wl^4}{8EI} - \frac{Fl^3}{3EI} = -\frac{10.833(48^4)}{8(30)(10^6)(3.7)} - \frac{220(48^3)}{3(30)(10^6)(3.7)} \\ &= -0.1378 \text{ in} \end{aligned}$$



$$HB = 490$$

$$S_{ut} = 0.495(490) = 242.6 \text{ kpsi} > 212 \text{ kpsi}$$

$$S_e = 100 \text{ kpsi}$$

$$a = 1.34, b = -0.085$$

$$ka = 1.34(242.6) - 0.085 = 0.840$$

$$kb = (1/4/0.3)^{-0.107} = 1.02$$

$$S_e = k_a k_b S_e = 0.840(1.02)(100) = 85.7 \text{ kpsi}$$

## Student results

Will be completed by the end of semester.