Department of Mechanical

Engineering College of Engineering

University of Sallahaddin

Subject: Strength Of Materials

Course Book – 2nd Year

Lecturer's name, MSc, Shereen Amin AbdulRahman

Academic Year: 2017/2018

Course Book

1. Course name	**Strength Of Materials**
2. Lecturer in charge	**Shereen Amin AbdulRahman**
3. Department/ College	**Mechanical Eng./Engineering Collage**
4. Contact	shereen.abdalrahman@su.edu.krd,she59rahman@gmail.com
5. Time (in hours) per week	**Theory: 2 hr/week** **Tetural: 2 hr/week**
6. Office hours	**6 hours office time availability for students questions**
7. Course code	**ME -202**
8. Teacher's academic profile	**Education:-** **University of Technology – Baghdad – Iraq** **M.Sc./Engineering Metallurgy – 1988** **University of Technology – Baghdad – Iraq** **B.Sc / Production Engineering &Metallurgy -1982** **Work Experience:** • **University Of Technology – Baghdad – Iraq – from 1982 to Aug. 2006 -as a lecturer in Production engineering and Metallurgy Department, and, at the Materials Eng. Departments.** • **University of Salahaddin – Erbil – Iraq – from Sep. 2006 till now- Engineering Collage – Mechanical Engineering Department.** **Subjects will have been taught before:** • **Metal deformation.** • **Plasticity.** • **Engineering metallurgy.** • **Strength of materials.** • **Mechanics of solids –dynamic.** • **Corrosion Engineering.**
9. Keywords	**Strength of materials, mechanics of materials ,Stress, Strain ,Torsion ,Bending ,Stress Analysis ,Mohr's circle, deflection, Buckling,**

10. Course overview:

"Strength of Materials" is a well established topic in Mechanical Engineering, taught to the senior students (2nd year), through a theoretical weekly program of four hours supported by "laboratory applications" which is a separate "multi discipline subject" with its own credit hours .

Mechanics of Solids or **Strength of Materials** is a popular branch of Engineering Mechanics. It deals with the relation of externally applied loads and its internal effect on the bodies. In general study we assume bodies and objects to be rigid but in Mechanics of Solids we do consider the deformation/deflection however small they may be. The subject of **mechanics of materials** involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system. The behaviour of a member depends not only on the fundamental laws that govern the equilibrium of forces, but also on the mechanical characteristics of the material.

11. Course objective:

The main objective of the study of mechanics of materials is to provide the students with the means of analyzing and designing various mechanics and load bearing structures, to ensure that the structure used will

be safe against the maximum internal effects that may be produced by any combination of external loading.
After completing, a student should be able to:

1. Solve axially loaded members in statically Determinate or Indeterminate cases
2. Solve torsionally loaded shafts in statically Determinate or Indeterminate cases
3- compute the principal stresses, principal angles, maximum shear stress and angles, and stresses on any arbitrary plane, given the state of stress at a point.
4. Solve beams under bending for stresses.
5. Solve transversely loaded beams for internal shear forces, bending moments and deflection.
6. Apply singularity functions to beam problems.
7. Solve for stresses in beams with combined axial and transverse loads.
8. Know the basics of mechanical design of process vessels that they use in the processing industry.
9. Use some of the available computer packages which solve strength of materials problems.
10. Communicate effectively by writing technical reports.

12. Student's obligation

Class attendance is imperative, because we will do many problems and show animated learning tools which contribute strongly to your understanding of the subject.
All students are expected to maintain professional behavior in the classroom setting,

1. Students are strongly encouraged to attend all lectures. On administrative level if the student absence rate exceeded (15 %) of the total lecture hours, the student will be expelled, i.e., when there are (4) lecture hours a week and there is (30X4) lectures per academic year, the total lecture hours is (120).
2. **NO CELL PHONES** are allowed during lectures. PLEASE turn them off before lecture! (not silent or vibrating mode)
3. **Quizzes may** be given unannounced throughout the term.
4. **During examinations**, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behaviour during the examinations will result in failure of the exam, and may lead to failure of the course and Collage disciplinary action.

13. Forms of teaching

The essence of the teaching program is prepared on MS power point presentations and. Elaborations and explanations of the details are done verbally and when needed on white board. As an assisting instruction tool, multimedia presentations are used to demonstrate the presented ideas through basic diagrams or real life applications. There are also assignments and seasonal projects appointed to individual students or groups that help the evaluation process and also support the team work effort.

14. Assessment scheme

Attaining the requirements set to succeed in this study subject requires developing an engineering sense, related to this topic, based on emergent analytical and problem solving skills and memorizing topics cannot secure success. All Exams are Closed book and notes

In this system the maximum mark is (100%). The grading system is based on the summation of two categories of evaluations:

- First, (40%) of the mark is based on the academic year effort of the student which includes but is not restricted to the following:

Two end of semester examinations (17% X 2) = 34%, for which the study material is set for the topics reviewed in that particular semester

- Quizzes (6%), for which the study material is limited and assigned by the instructor.
- There will be an optional third exam of 17%,When students attend for this exam Whatever the degree of exam is it will be added to the 17% for the highest degree of one of the former exams

-Second, (60%) of the mark is based on final examination that is comprehensive for the whole of the study material reviewed during the academic year and it usually occurs during the month of June

At the end of the evaluation process, if the students could not secure a minimum of (50%), they are given a chance to repeat the final exam in September and they should be able by then to equal or exceed the (50%) limit otherwise they will have to repeat this subject during the next academic year if it did not contradict with the administrative regulations.

15. Student learning outcome:

The mechanics of materials course is one of the core courses for students in mechanical, civil, aerospace, metallurgical, ceramic, geotechnical, and architectural engineering programs. The course is also included in architecture, engineering mechanics, engineering physics, engineering management, and engineering technology curricula. This course provides a comprehensive coverage of important topics in strength of materials with emphasis on problem solving, applications and design of mechanical devices and systems, Our student outcomes are what students are expected to know and be able to do by the time of their graduation:

- an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives;
- an ability to function effectively as a member or leader on a technical team;
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to function on multi-disciplinary teams
- An ability to identify, formulate and solve engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- A recognition of the need for and an ability to engage in life-long learning
- An ability to use the techniques, skills and modern engineering tools necessary for engineering practice

16. Course Reading List and References:

▪ Text books: 1. R. C. Hibbeler, Mechanics of Materials, (6th Edition) .The book is available for all students by the Department. Please note all homework problems and reading assignments are from this book.

2. Pytel Andrew, Jaan Kiusalaas., Mechanics of Materials Second Edition

3. Ferdinand P Beer, E Russell Johnston, Jr. John T Dewolf. Mechanics of Materials, 5th Edition.

All students can have the References as pdf e-book.

The core material of the course consists of the above books, articles from media and internet, and lecture's notes. Video Flashes used to illustrate the topics and examples of each lecture
http://web.mst.edu/~mecmovie/

The students will be able to use a software program to solve the problems & to be able to make problems by themselves.
http://www.mdsolids.com/

17. The Topics:

Lecturer :Shereen Amin Abdulrahman

Types of loading, types of stresses, Stress & strain **Shear** force, shear stress, shear strain.	October2017
Stress- strain relation, tensile & compressive stresses, Elastic limit, Hook's Law.	

Ductile materials, Brittle materials, Poisson's Ratio, modulus of elasticity, modulus of rigidity, allowable working stress, factor of safety.	
Percentage reduction in area ,percentage elongation, deformation due to self weight, bars of varying sections, Stresses on Oblique Sections	
Mechanical Properties of Materials	
Stress in compound bars	
Statically indeterminate members	November 2017
Thermal stresses.	
Strain Energy, Strain Energy due to shear.	
Torsion of circular shafts- solid and hollow.	
Power Transmitted by a Shaft, shafts in sense and parallel.	
Types of Beams, types of loading, internal forces and moment in beams, resisting shear and resisting, (**S.F.)** & (B.M.) sign convention.	December 2017
Graphical construction of S.F. and B.M. diagrams, Section method for point loading, UDL, VDL, External moment	
Bending stress, Theory of pure Bending, Assumptions, neutral surface, Neutral axis, location of neutral axis ,Section modulus	January 2018
The flexure formula bending stress distribution, Section modulus for different sections, stress concentrations	
Bending of composite beam	
Shear stress in beams ,the shear formula	
Distribution of shear stress	
Shear flow	February2018
Stress Analysis ,Stress transformation	
Principle Stresses, Principle Planes, two dimensional stress transformations	
Mohr's Circle of Stress	March2018
Thin-Walled Pressure Vessels Thin cylindrical & Spherical shells	
Combined stresses, Stress in shafts due to axial load, torsion, and bending.	
Deflection of beams	April2018
Relationship between loading, S.F. ,B.M., slope and deflection	
methods of determining beam deflection for different types of loading , integration method	
Moment area method (Macaulay's method)	
Statically Indeterminate Beams	May2018
Column ,Buckling	
	Final Exams
18. Practical Topics (If there is any): It is a separate multi subject Labs. with its own credit hours	
19. Examinations: An Example shown below	

Ministry of Higher Education and Scientific research

Final Examinations 2015-2016/1st Attempt

Salahaddin University -Hawler		Subject : Strength Of Materials
Collage of Engineering		Time: 3 hrs
Mechanical Engineering Dept.		2nd Year Students
Date: 4- 6-2016		Lecturer: Shereen A.A-Rahman

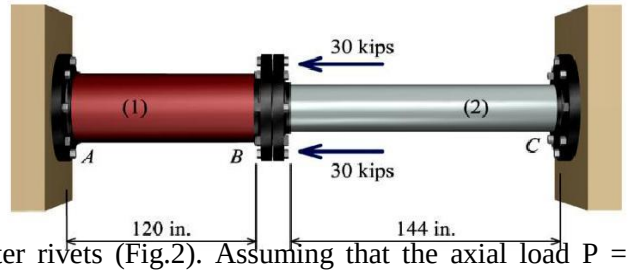
Q 1/ 15 Marks

A steel [E = 30,000 ksi, $\alpha = 6.6 \times 10^{-6}$/°F] pipe (1) with a cross sectional area of $A_1 = 5.60$ in.^{2} is connected at flange B to an aluminum alloy [E = 10,000 ksi, $\alpha = 12.5 \times 10^{-6}$/°F] pipe (2) with a cross sectional area of $A_2 = 4.40$ in.^{2}. The assembly (shown in Fig.1) is connected to rigid supports at A and C. It is initially unstressed at a temperature of 90°F.

(a) At what temperature will the normal stress in steel pipe (1) be reduced to zero?

(b) Determine the normal stresses in steel pipe and aluminum pipe when the temperature reaches (–10°F).

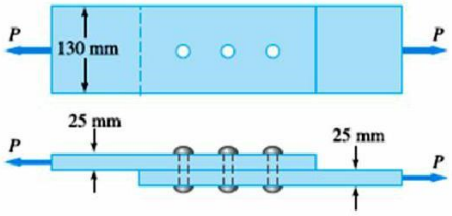
Fig.1



Q 2/ 10 Marks

The lap joint is connected by three 20-mm-diameter rivets (Fig.2). Assuming that the axial load P = 50 kN is distributed equally among the three rivets, find (a) the shear stress in a rivet; (b) the bearing stress between a plate and a rivet; and (c) the maximum average tensile stress in each plate.

Fig.2



Q3 /20 Marks

A tubular steel [G = 80 GPa] shaft is being designed to transmit 150 kW at 30 Hz. The maximum shear stress in the shaft must not exceed 80 MPa and the angle of twist is not to exceed 6° in a 4-m length. Determine the minimum permissible outside diameter if the ratio of the inside diameter to the outside diameter is 0.80.

Q 4/ 30 Marks

For the simply supported beam shown, determine the principal stresses and the maximum shear stress acting at point H, as shown on Figs.5.a and Fig.5.b. Show these stresses on an appropriate sketch.

Fig.4.a

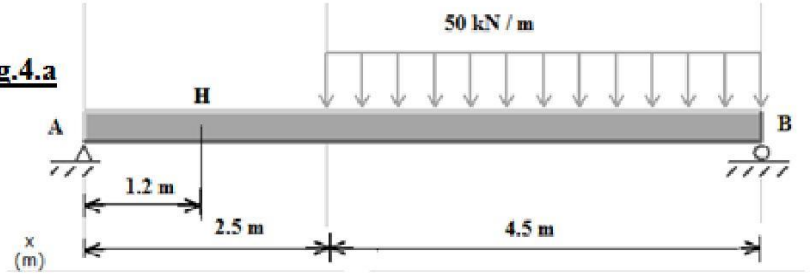
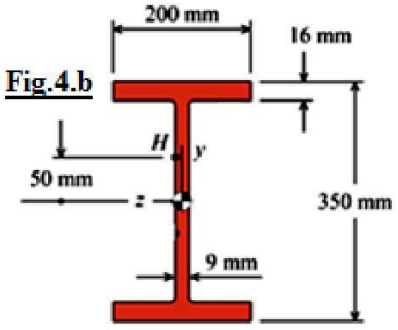


Fig.4.b



Q 5 / 25 Marks

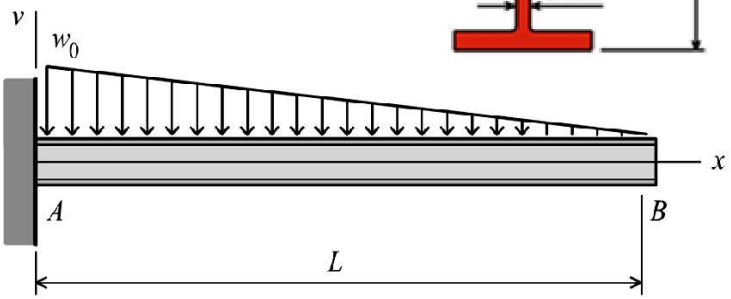
For the loading shown in Fig .5, use the double integration method to determine

(a) the equation of the elastic curve

(b) the deflection at the free end

(c) the slope at the free end.

Assume that EI is constant.



20. Extra notes:

20. Extra notes:

21. Peer review :