# STRESS MEASUREMENT TECHNICS

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| 1 | Course Title: | STRESS MEASUREMENT TECHNICS |
| 2 | Course Code: | MAK4425 |
| 3 | Type of Course: | Optional |
| 4 | Level of Course: | First Cycle |
| 5 | Year of Study: | 4 |
| 6 | Semester: | 7 |
| 7 | ECTS Credits Allocated: | 3.00 |
| 8 | Theoretical (hour/week): | 2.00 |
| 9 | Practice (hour/week): | 0.00 |
| 10 | Laboratory (hour/week): | 0 |
| 11 | Prerequisites: | None |
| 12 | Language: | Turkish |
| 13 | Mode of Delivery: | Face to face |
| 14 | Course Coordinator: | Dr. Ögr. Üyesi KENAN TÜFEKÇİ |
| 15 | Course Lecturers: | |
| 16 | Contact information of the Course Coordinator: | Dr. Öğr.Üy. Kenan TÜFEKCİ<br>Uludag Üniv. Müh. Fak. Makine Müh. Böl.<br>tel: 0 224 2942794<br>email: kenantufekci@uludag.edu.tr |
| 17 | Website: | |
| 18 | Objective of the Course: | Experimental stress analysis has an important place for many engineering branches, especially mechanical engineering, as it includes techniques that engineers can use to estimate the stress and strain distributions that will occur in materials due to different loading conditions. The stability and strength conditions of structural elements and machine parts under the effect of load can be evaluated in a healthy way by using these techniques. Thus, experimental stress analysis is the most important tool used in the design and analysis of machines and structures.<br>The aim of the Stress Measurement Techniques course, which is an introduction to experimental stress analysis, is to help students consolidate the stress, strain and damage concepts they have learned in the strength course, understand experimental stress analysis techniques and improve their ability to apply them in real engineering designs. At the end of this course, students will learn what experimental stress analysis is and why it is necessary, the common experimental stress analysis techniques such as Moire, Optical Sensor, Photoelasticity and surface coating techniques, and the electrical strain gauge techniques and the measuring devices used will be learned in detail. . Therefore, the experiments to be done by the student have an important place in the teaching and understanding of this course. The students who take the course will develop experiments for the load cases including tensile, compression, bending, torsion and their combination, which they learned theoretically in the strength course, will make real measurements with measurement elements such as strainage, lvdt, encoder, load cell, and will compare the results with theoretical results.<br>Contribution will also be provided for students to develop their ability to take part in teamwork and lead when necessary, to prepare a written report and to present the results of the analysis verbally. In addition, they will make a literature search and learn about the new stress measurement techniques that have emerged as a result of the rapid developments in experimental stress analysis. |

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| **19** | Contribution of the Course to Professional Development: | It provides the basis for structural engineering applications. | |
| **20** | Learning Outcomes: | | |
| | | **1** | Understanding of Normal and Shear Stress, calculate them in uniaxial condition. |
| | | **2** | Comprehend the stress condition at any point and ability of transformation of stress. |
| | | **3** | Be able to determine Shear stresses caused axial and torsinal load. |
| | | **4** | Be able to calculate principle stresses in symmetrical sections |
| | | **5** | Be able to analyse combined stresses |
| | | **6** | Be able to stress analyse thin and thick wall pressure tank. |
| | | **7** | Comprehend the theory of strain-gage and configuration of wheatstone bridges. |
| | | **8** | Be able to determine principle strain and stresses obtained from strain-gages. |
| | | **9** | |
| | | **10** | |
| **21** | Course Content: | | |

**Course Content:**

| Week | Theoretical | Practice |
|---|---|---|
| **1** | Definition of stress and strain; Analysis of the | |
| **2** | Analysis of the state of strain at a point: Principal strains and principal directions | |
| **3** | law<br>Electrical resistance type strain gauges: Strain gauge circuits, measurement recorders | |
| **4** | Failure criteria; Introduction to stress analysis: Strain measurement, strain gauge types, | |
| | type strain gauges, usage areas of strain gauges | |
| **5** | The concept of strain and strain transformations | |
| **6** | Derivation of Von-mises equation. | |
| **7** | Criteria of Tresca | |
| **8** | Analysis of damage directions in case of multi-axial stress for ductile materials | |
| **9** | Stress concentrations in discontinuous media | |
| **10** | Torsion of noncircular circles | |
| **11** | beam of constant strength | |
| **12** | Stresses in thin and thick hollow. | |

| Activites | Number | Duration (hour) | Total Work Load (hour) |
|---|---|---|---|
| Theoretical | 14 | 2.00 | 28.00 |
| Practicals/Labs | 0 | 0.00 | 0.00 |
| Self study and preperation | 0 | 0.00 | 0.00 |
| Homeworks | 1 | 5.00 | 5.00 |
| Projects | 0 | 0.00 | 0.00 |
| Field Studies | 0 | 0.00 | 0.00 |
| Midterm exams | 1 | 20.00 | 20.00 |
| Others | 0 | 0.00 | 0.00 |
| Final Exams | 1 | 30.00 | 30.00 |
| Total Work Load | | | 83.00 |
| Total work load/ 30 hr | | | 2.77 |
| ECTS Credit of the Course | | | 3.00 |

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| **13** | Comparation of analitical and numerical solution I. | |
| **14** | Comparation of analitical and numerical solution II | |

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| **22** | Textbooks, References and/or Other Materials: | Strength of Materials, Ferdinand Beer , Russel Johnston. |
| **23** | Assesment | |

| **TERM LEARNING ACTIVITIES** | **NUMBER** | **WEIGHT** |
|---|---|---|
| Midterm Exam | 1 | 40.00 |
| Quiz | 0 | 0.00 |
| Home work-project | 0 | 0.00 |
| Final Exam | 1 | 60.00 |
| Total | 2 | 100.00 |
| Contribution of Term (Year) Learning Activities to Success Grade | | 40.00 |
| Contribution of Final Exam to Success Grade | | 60.00 |
| Total | | 100.00 |
| Measurement and Evaluation Techniques Used in the Course | | Mid-term and Final exam. |

**24 ECTS / WORK LOAD TABLE**

**25 CONTRIBUTION OF LEARNING OUTCOMES TO PROGRAMME QUALIFICATIONS**

| | **PQ1** | **PQ2** | **PQ3** | **PQ4** | **PQ5** | **PQ6** | **PQ7** | **PQ8** | **PQ9** | **PQ10** | **PQ11** | **PQ12** | **PQ13** | **PQ14** | **PQ15** | **PQ16** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ÖK1** | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK2** | 4 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK3** | 3 | 3 | 4 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK5** | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK6** | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK7** | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ÖK8** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**LO: Learning Objectives PQ: Program Qualifications**

| **Contribution Level:** | **1 very low** | **2 low** | **3 Medium** | **4 High** | **5 Very High** |
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