INSTITUTE OF APPLIED MECHANICS
UNIVERSITY OF MISKOLC
3515 MISKOLC-EGYETEMVÁROS

9th February 2015

MM/23/2015.

NOTICE

for the Group G1MME of MSc students at the Faculty of Mechanical Engineering
Requirements of the subject **ELASTICITY** (GEMET310M-A)
in the spring semester of the academic year 2014-2015

This subject is a compulsory course. The most important information concerning the subject is given below under the various key words.

AIMS

The main objectives of this graduate course are to provide the students with an introduction to the theory of elasticity and to develop their ability to pursue studies in the field of finite element method. Emphasis is placed on fundamental concepts, principles and methodologies and on how to apply them to solutions of engineering problems.

INSTRUCTION

There are two classes a week during the fourteen-week term-time. A weekly timetable shows when, where and what lessons - formal lecture or practical-class - are given.

Monday	8^{00}-9^{50} a.m.	Room A/1 12.	(formal lecture)
Thursday	9^{00}-9^{50} a.m.	Room A/1 12.	(practical-class)

We remark that the location of the classes might change. If this is the case the students will be informed about the new location in time.

CALENDAR

February 9	Monday	Teaching begins
April 3-7	Friday-Tuesday	Easter Holiday
May 1	Friday	Holiday (Labour Day)
May 15	Friday	Teaching ends
May 18 - June 26	Monday-Friday	Examination period

PRECONDITIONS

Familiarity with fundamental concepts and principles of mechanics of materials, a solid mathematical background in vector algebra and analysis and a good command of English are required for effective and productive work.

SCHEDULE

Week 1: *Mathematical preliminaries.*
Scalars and Vectors, Tensor Product. Identity Tensor. Zero Tensor. Transpose of Tensor. Symmetric and Skew Tensors. Tensors of Higher Order. Tensor functions.

Week 2: *Geometry of Deformation.*
Deformation Gradient. The Strain Tensor Concept. Principal Axes and Strains. Independent Compatibility Conditions. Examples.

Week 3: *The Idea of Stress.*
The Stress Vector Concept. Cauchy's Theorem. Stress Tensors. Equations of motion. Principal Axes and Stresses. Examples.

Week 4: *Hook's Law.*
Isotropy and Anisotropy. Physical Interpretation of the Elastic Constants. The Strain Energy Concept. Primal Equation System.

Week 5: *Principle of Virtual Work.*
Kinematically Admissible Displacements, Strains and Stresses. Statically Admissible Stresses and Strains. Primal and Dual Forms of the Principle.

Week 6: *Principle of Minimum Potential Energy and Maximum Complementary Energy.*
Quadratic Functions with Symmetric Coefficients. Proofs of the Principles. Reciprocal Theorems of Betti and Rayleigh. First midterm exam.

Week 7: *Applications in Structural Mechanics.*
The Timoshenko Beam. Beams on Elastic foundations. Examples.

Week 8: *Torsion of Prismatic Members.*
Solid Cross Sections. Assumptions. Stress Function. Compatibility Conditions. Boundary Conditions. Torsional Rigidity. Solutions.

Week 9: *Torsion of Thin-Walled Members.*
Closed Cross Sections. Open Cross Sections. Influence of Restrained Warping.

Week 10: *Two Dimensional Problems of Elasticity I.*
Plain Strain. Equations in Cylindrical Coordinates. Cylindrical Shell Under Internal and External Pressure.

Week 11: *Two Dimensional Problems of Elasticity II.*
Rotating Shaft. Rotating Hollow Shaft. Analytical and Graphical Solutions.

Week 12: *Two Dimensional Problems of Elasticity III.*
Plane Stress. Generalised Plane Stress. Comparison of Plane Strain and Plane Stress. Rotating Disk. The second midterm exam.

Week 13: *Classical Plate Theory*
Kirchhoff's Assumption. Differential Equation of the Problem. Boundary Conditions. Stress and Moment Resultants. Rectangular Plate Problems. Solutions to Cylindrical Plates

Week 14: *Stability of equilibrium.* Bifurcation Problems with Finite Degrees of Freedom. A Snap-Through Buckling Problem. Column Buckling with Solutions.

Textbook(s)

1. Herbert Reismann – Peter S. Pawlik: Elasticity: Theory and Applications, John Wiley and Sons, New York-Toronto, 1980.
2. Timoshenko, S. P. – Goodier, J. N.: Theory of Elasticity, Third Edition, McGraw-Hill, 1976.

Warning: The notations used in the book(s) may, however, be different from those used in the classes.

Requirements

Students are requested to learn the materials of the lectures and practical classes in a satisfactory manner. For the sake of effective and systematic work regular attendance of the classes is compulsory. Two midterm exams are to be taken during the semester. The maximum score attainable by solving all problems in a 50 minute midterm exam is 40. The minimum score for a midterm exam is 16. The minimum score for the whole semester is 32. The midterm exams failed can be repeated in the last week.

If a student does not achieve the minimum prescribed he/she does not get the signature, i.e., has no right to enter for the final exam. One can make up for the signature at the beginning of the examination period. The conditions are however harder: the performance should be at least 50% (20 points).

There is a final examination in Elasticity at the end of the semester – it should be taken in the examination period. This exam is a 50 minute long written test. The mark given to a student depends on the performance provided in the final exam. The course is graded on a five grade scale: excellent (5), good (4), fair (3), pass (2), fail (1):

Score	0-19	20-23	24-27	28-31	32-40
Mark	fail	pass	fair	good	excellent

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