Instructor: Bruce S. Kang  
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Office Hour: 9:30 - 10:45 am, T and Th  
Grading: Homework 15%  
Special Project 30%  
Mid-term Exam 25%  
Final Exam 30%  
100%  
Grading Scale: A(85-100); B(70-85); C(60-70); D(45-60); F(0-45)  
Course Content: Due to the rapid advancement in the field of experimental stress analysis in recent years. This course will put more emphasis on lecturing various experimental methods for stress analysis including latest experimental technology. However, some “basic” lab. experiments will still be demonstrated in class and lab (e.g. tensile test, impact test, stress analyses and applications using strain gages, LVDT, accelerometer, load cells, photoelasticity, etc.). A tentative outline of the course is given in the attached table. The availability of lab. equipment and space may impose changes to this program.  
Course Requirements:  
1. Attendance: Regular attendance is required.  
2. Homework: Mandatory; -25% per day if late. The homework assignments will be closely related to experimental method being taught. It should be treated as a “virtual lab report”. The homework should be presented in a neat, professional style.  
3. Special Project: Each student may choose one of the special projects listed in the "Special Project Outline", or the student can choose his/her own (upon approval of the instructor). The special projects are either literature review or actual lab. project, and should be started as early as possible. A thorough, comprehensive report and project presentation by the student are expected at the end of the semester.  
4. Exams: Required; makeup only under special circumstances. There will be mid-term and final exam. Average of mid-term and final exam grade must be above 50 (out of 100), otherwise, the student can not have above B final grade.  
5. Statement on Social Justice:  
WVU is committed to social justice. The instructor of this course concurs with WVU’s commitment and expects to maintain a positive learning environment based upon open communication and mutual respect and nondiscrimination. Our University does not discriminate on the basis of race, sex, age disability, veteran status, religion, sexual orientation, color, or national origin. Any suggestions as to how to further such a positive and open environment will be appreciated and given serious consideration. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise us and make appropriate arrangements with Disability Services (293-6700).
MAE 648  EXPERIMENTAL STRESS ANALYSIS

Course Outline  Fall 2011

I. Classroom Lecture

1. Mechanics of Materials, Fundamental of Elasticity and Fracture Mechanics (lecture notes, Ch. 3 and Ch. 4, self study Ch. 1 and Ch. 2)

2. Operation of Basic Instruments (classroom demo.)

3. Electrical-Resistance Strain Gage (Ch. 5.4, Ch. 6.4, Ch. 9, Ch. 10, Ch. 11, Ch. 12.1, 12.2 and 12.3) and other sensors (Ch. 5)

4. PC-based data acquisition system and LabVIEW software (Ch. 8, self study Ch. 7)

5. Optical Methods Applied to Experimental Stress Analysis (Ch. 13, 14, 15, 16, and 17)

6. Digital Image Analysis (applied to stress analysis) (lecture notes)

7. NDT/NDE and Defect Detection (lecture notes)

8. Indentation Methods (lecture notes)

II. Lab. Demonstration

(Basic Lab. Exercises)
Lab #1 Strain Gage Preparation, Load Cell Calibration, LVDT Calibration, Clip Gage Calibration

Lab #2 Tension and Impact Tests

Lab #3 Beam Bending and Combined Loading Tests

Lab #4 Hardness Test

(Optical Methods)
Lab #5 Photoelasticity

Lab #6 Moire Method (Geometric Moire, Shadow Moire and Projection Moire)

Lab #7 General Laser Interferometry (two-beam interferometry, phase-shift interferometry)

Lab #8 Digital Image Correlation (DIC) Method

III. Special Project Presentation (at end of semester)

IV. Mid-term and Final Exam
(1) Review and case study of a selected advanced experimental technology for deformation, stress/strain, material characterization, …etc. measurement.

(2) Sensors for stress analysis and/or NDT/NDE

(3)** Video Image Analysis (related to experimental stress analysis)

(4)** Impact Bar Demonstration (Stress Wave Analysis) and Dynamic Material Properties Measurement

(5)** Laser Interferometric Method for Stress Analysis

(6) (Advanced) Composite Material Property/Strength measurement

(7) Residual Stress Measurement and Analysis

(8)** ECP Model 210 Rectilinear Control System Demonstration (rigid bodies, linear drives, gearing and belts, coupled discrete vibration with actuator and sensor feedback control)

(9) Fiber Optics (alignment, collimation, coupling, sensor(s)) for stress analysis and/or NDT/NDE

(10)** Indentation Tests (for material properties measurement, i.e. Young’s modulus, yield Strength, etc.)

(11)** Indentation Fracture Toughness Test (Micro Victor Indentation)

(12)** Spectroscopy (for NDT, NDE, or stress analysis)

(13)** DIC

(14)** (Exploratory) Implementation of Digital Light Field Photography for deformation measurement

(15)** Integration of CAD/CAE/Prototyping/Finite Element Modeling/Exp Verification

(16) Others

* Tentative list, the instructor will provide adequate technical, instrumentation, and materials support to ensure the selected lab project can be carried out. Student’s feedback and participation are essential for a successful special lab project.

** Equipment and supporting facility are available.