

MANSOURA UNIVERSITY  
FACULTY OF ENGINEERING

Department of Mechanical Design and Production Engineering

Second Year.  
First Term, Final Exam.

Time allowed: 3 Hs.  
Jan 2013.

Methods of Experimental Stress Analysis

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Answer the following Questions:

1- Write an engineering brief describing in the following subjects:

- Meaning and benefits of Experimental stress analysis.
- Stress-strain relationship.
- Elastic-plastic behavior of the body material against the external forces.
- Electrical-strain gauge measurements systems and its applications in practice.
- Brittle-coating method of stress analysis.

2- a- layout and in details discuss the difference between the plane, circular and reflection polariscopes which are using in the photoelastic experimental analysis.

b- Draw the arrangement of the optical elements in the circular polariscope and explain the function of each element.

3- Describe in details the application of the following techniques:

a- The technique of Two-dimensional Photoelasticity which apply to dynamic loading conditions.

b- Frozen-stresses technique and discuss its advantages.

4- a- With illustrative sketch, describe the main uses of GFP in practical problems.

b- Give an example to illustrate the practically use of GFP in real-time photoelasticity.

5- An engineering component made of mild steel has been experimentally treated by photoelastic-coating technique. The coating thickness is 2mm. and its strain fringe value is  $1515 \mu\epsilon/\text{fringe}$ . The component subjected to normal load  $P$  and in dark field stress region the fringe order of 12 is found at the point of interest. The load is then removed and a electrical-resistance strain gauges is mounted at the same loaded location. The same loaded is reapplied, and it is found that the indicated strain is  $300 \mu\epsilon$ . Determine the principal strains and stresses in the steel component if the modulus of elasticity and poisson`s ratio are  $2 \times 10^6 \text{ N/mt}^2$  and 0.3 respectively.

Prof. Dr. A.A.Fattah

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Reminder:

- Carefully read the given questions and take your time in thinking then write proper answers according to the engineering formatting systems.
- Give an individual answer for each Question in an individual page.
- Don't leave the examination hall before answering all the above questions.