



**ARAB ACADEMY FOR SCIENCE, TECHNOLOGY
AND MARITIME TRANSPORT**

**COLLEGE OF ENGINEERING
AND TECHNOLOGY**

(GRADUATE STUDIES)

Master of Science Programs

STATUS REPORT

NOVEMBER 2008

CONSTRUCTION AND BUILDING ENGINEERING

M.Sc. PROGRAMS

Program Detailed Structure

M.Sc. PROGRAM

(D) STRUCTURAL ENGINEERING

M.Sc. in Construction and Building Engineering

Program Structure

(D) Structural Engineering

M.Sc. in Construction and Building Engineering

(D) Structural Engineering

CORE COURSES:

Course Code	Course Title	Credit Hours
CB 740	Advanced Construction Materials	3
CB 741	Advanced Structural Analysis	3
Subtotal	2 Courses * 3 Credit Hours	6

ELECTIVE COURSES:

GROUP (1)

Course Code	Course Title	Credit Hours
CB 742	Experimental Methods in Civil Engineering	3
CB 743	Concrete Durability	3
CB 744	Fiber Reinforced Cementitious Composites	3
CB 745	Advanced Strength of Materials	3
CB 746	Advanced design of Reinforced Concrete Structures	3
CB 747	Advanced Prestressed Concrete	3
CB 748	Repair of Concrete Structures	3
CB 749	Bridge Structures	3
CB 740-S	Finite Element Method	3
CB 741-S	Theory of Elasticity	3
CB 742-S	Plastic Analysis and Design of Structures	3
CB 743-S	Earthquake Engineering	3
CB 744-S	Design of Special Metallic Structures	3
CB 745-S	Composite Structures	3
CB 746-S	Reliability in Civil Engineering	3
Subtotal	4 Courses * 3 Credit Hours	12

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M.Sc. in Construction and Building Engineering

Program Structure

(D) Structural Engineering

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ELECTIVE COURSES: GROUP (2)

Course Code	Course Title	Credit Hours
CB 710	Advanced Construction Engineering	3
CB 711	Value Engineering in the Construction Industry	3
CB 731	Advanced Geotechnical Engineering	3
CB 762	Design of Hydraulic Structures	3
CB 758	Highway Materials and Equipments	3
CB 723	Environmental Impact Assessment of Civil Engineering Projects	3
Subtotal	1 Course * 3 Credit Hours	3

RESEARCH THESIS:

Course Code	Course Title	Credit Hours
CB 701	Master's Research Thesis (Part 1)	6
CB 702	Master's Research Thesis (Part 2)	6
Subtotal	2 Parts * 6 Credit Hours	12

Total	36
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Courses

DETAILED STRUCTURE

Course Code : CB 740

Course Title : Advanced Construction Materials

Credit Hours : 3

Course Description

Properties and strength of light weight concrete, massive concrete, high strength concrete, hot weather concrete, high performance concrete. Waterproofing materials. Sound insulating materials, advances in concrete technology.

Course Objectives

To familiarize the students with properties, specifications and requirements for special purpose concretes as well as insulating materials.

Course Topics

- Properties and strength of light weight concrete
- Massive concrete, high strength concrete
- Hot weather concrete
- High performance concrete
- Waterproofing materials
- Sound insulating materials
- Advances in concrete technology

References

- Mehta, P.K., and Monterio, P.J.M., "*Concrete: Structure, Properties, and Materials*," Second Edition, Prentice-Hall, Englewood Cliffs, USA, 1994.
- Neville, A.M., "*Properties of Concrete*," Fourth Edition, Longman Scientific and Technical, England, 1996.
- Illston, J.M., "*Construction Materials: Their Nature and Behavior*," E. and F.N. Spon, 1994.
- American Concrete Institute, "*Manual of Concrete Practice*," Parts 1-5, Detroit, USA, 2003.
- ASTM standards, 2004.

Course Code : CB 741

Course Title : Advanced Structural Analysis

Credit Hours : 3

Course Description

Matrix analysis of two-dimensional frames by the stiffness method. Force and displacement methods; formulation of different types of element flexibility, stiffness matrices. Temperature effects. Shear deformation in beams. Non-linear structural analysis. Computer applications.

Course Objectives

To present the methods of matrix analysis to the students with emphasis on application to determinate and indeterminate problems.

Course Topics

- Matrix analysis of two-dimensional frames by the stiffness method
- Force and displacement methods
- Formulation of element flexibility and stiffness matrices.
- Temperature effects
- Shear deformation in beams
- Non-linear Structural analysis
- Computer applications

References

- Wang, C.K., "*Indeterminate Structural Analysis*," Prentice-Hall, Englewood Cliffs, USA, 1984.
- Charles, A., "*Structural Analysis*," Second Edition, Prentice-Hall, Englewood Cliffs, USA, 1990.
- Ghali, A., and A.M. Neville, "*Structural Analysis*," McGraw-Hill, New York, USA, 1986.
- Wang, C.K., "*Matrix Methods of Structural Analysis*," International Text Book Company, PA, USA, 1970.
- Arbabi, F., "*Structural Analysis and Behavior*," McGraw-Hill, New York, USA, 1991.
- Ghali, A., "*Concrete Structures: Stresses and Deformations*," Chapman and Hall, London, 1986.
- Nelson, J.K., and J.C. McCormack, "*Structural Analysis: Using Classical and Matrix Methods*," Third Edition, John Wiley and Sons, 2003.

Course Code : CB 742

Course Title : Experimental Methods in Civil Engineering

Credit Hours : 3

Course Description

Probability distribution of random variables, data analysis, sampling distribution of means and variances, influence about one mean, difference between two means, comparison of more than two means (ANOVA), randomization block design, factorial design, fractional factorial design.

Course Objectives

To understand the concepts of statistical analysis of data, design experimental programs, and learn the different methods of analyzing data.

Course Topics

- Probability distribution of random variables
- Data analysis and sampling distribution of means and variances
- Influence about one mean, difference between two means, comparison of more than two means (ANOVA)
- Randomization block design, factorial design
- Fractional factorial design

References

- Crandall, K.C., and R.W. Seabloom, "*Engineering Fundamentals; in Measurements, Probability, Statistics, and Dimensions*," McGraw-Hill, New York, 1970.
- Mason, R.F., J. Gunst, and L. Hess, "*Statistical Design and Analysis of Experiments: with Applications to Engineering and Science*," Wiley, New York, 1989.
- Wayne, L., "*Accelerated Testing: Statistical Models, Test Plans and Data Analyses*," New York, Wiley, 1990.
- Shelemyahu, Z., "*Introduction to Reliability Analysis: Probability Models and Statistical Methods*," Springer-Verlag, New York, USA, 1992.
- Montgomery, D.C., G.R. Runger, and N.F. Hubele, "*Engineering Statistics*," Wiley, New York, 1998.

Course Code : CB 743

Course Title : Concrete Durability

Credit Hours : 3

Course Description

Design of concrete mixtures for durability, permeability of concrete and factors affecting it, organic and inorganic acid attack of concrete, effect on sulfates on concrete, effect of chlorides on the durability of concrete, effect of sea water on concrete, corrosion of steel reinforcement and its protection.

Course Objectives

To introduce the students with the long-term properties of concrete materials, prevention of deterioration, and sustainability for long term.

Course Topics

- Design of concrete mixtures for durability
- Permeability of concrete and factors affecting it
- Organic and inorganic acid attack of concrete
- Effect of sulfates on concrete
- Effect of chlorides on the durability of concrete
- Effect of sea water on concrete
- Corrosion of steel reinforcement and its protection

References

- Mehta, P.K., and Monterio, P.J.M., "Concrete: *Structure, Properties, and Materials*," Second Edition, Prentice-Hall, Englewood Cliffs, USA, 1994.
- Neville, A.M., "Properties of Concrete," Third Edition, Longman Scientific and Technical, England, 1983.
- Illston, J.M., "Construction Materials: *Their Nature and Behavior*," E. and F.N. Spon, 1994.
- American Concrete Institute, "Manual of Concrete Practice," Parts 1-5, Detroit, USA, 1995.
- ASTM standards, 2004.
- Ulm, F.J., "Creep, Shrinkage, and Durability Mechanics of Concrete and Other Quasi Brittle Materials," Pergamon Press Inc., 2001.

Course Code : CB 744

Course Title : Fiber Reinforced Cementitious Composites

Credit Hours : 3

Course Description

Fiber reinforcement of cement based matrices; continuous and discontinuous fibers and meshes. Fiber reinforced concrete and Ferro-cement. Behavior and mechanical properties. Mechanics of fiber reinforcement. High strength, high performance fiber composites. Fiber reinforced plastic reinforcement.

Course Objectives

To introduce the students to different properties of FRC, their behavior and application. New Developments of FRP are to be targeted.

Course Topics

- Fiber reinforcement of cement-based matrices
- Continuous and discontinuous fibers and meshes
- Fiber reinforced concrete and ferro-cement
- Behavior and mechanical properties
- Mechanics of fiber reinforcement
- High strength high performance fiber composites
- Fiber reinforced plastic reinforcement

References

- Shah, S.P., and G.B. Batson, "*Fiber Reinforced Concrete, Properties and Applications*," American Concrete Institute, Detroit, USA, 1987.
- Nanni, A., "*Fiber Reinforced Plastic Reinforcement for Concrete Structures: Properties and Applications*," Elsevier Publishers, New York, 1993.
- Banthia, N., C. Macdonald, and P. Tatnall, "*Structural Applications of Fiber Reinforced Concrete*," American Concrete Institute, Farmington Hills, MI, 1999.
- Stevens, D.J., "*Testing of Fiber Reinforced Concrete*," American Concrete Institute, Farmington Hills, MI, 1995.
- *Manual of Concrete Practice*, American Concrete Institute, Farmington Hills, MI, 1995.
- Stang, H., "*Mechanics of Fiber Reinforced Concrete: Materials Design for Structural Applications*," Research Studies Press, 2005.

Course Code : CB 745

Course Title : Advanced Strength of Materials

Credit Hours : 3

Course Description

General theory of torsion, nonsymmetrical bending, transverse shear, thin-walled beams, beams on elastic foundations, thick-walled cylinders. Basic contact mechanics. Failure criteria of solids.

Course Objectives

To familiarize the students with the behavior of the materials under various advanced types of loadings as well as failure mechanisms of structure.

Course Topics

- General theory of torsion
- Nonsymmetrical bending
- Transverse shear
- Thin-walled beams, beams on elastic foundations
- Thick-walled cylinders
- Basic contact mechanics
- Failure criteria of solids

References

- Bickford, W.B., “*Advanced Mechanics of Materials*,” Addison-Wesley, CA, USA, 1998.
- Cook, R.D., “*Advanced Mechanics of Materials*,” Prentice-Hall, NJ, 1999.
- Popov, E.P., “*Mechanics of Materials*,” Second Edition, Prentice-Hall, Englewood Cliffs, USA, 1976.
- Gere, J.M., and S.P. Timoshenko, “*Mechanics of Materials*,” Third Edition, PWS-Kent Publishers, Boston, USA, 1990.

Course Code : CB 746

Course Title : Advanced Design of Reinforced Concrete Structures

Credit Hours : 3

Course Description

Inelastic behavior of reinforced concrete beams and columns. Combined bending, shear and torsion in beams. Behavior of beams, columns, and walls under seismically induced load reversals. Analysis and design of connections.

Course Objectives

To introduce the students to the advanced design concepts of the reinforced concrete structures.

Course Topics

- Inelastic behavior of reinforced concrete beams and columns
- Combined bending
- Shear and torsion in beams
- Behavior of beams, columns, and walls under seismically induced load reversals
- Analysis and design of connections

References

- Kong, F.K., and R.H. Evans, "*Reinforced and Prestressed Concrete*," Chapman and Hall, London, 1987.
- Wang, C.K., and C.G. Salmon, "*Reinforced Concrete Design*," Fourth Edition, Harpor and Row Publishers, NY, 1998.
- Park, R., and T. Paulay, "*Reinforced Concrete Structures*," Wiley, 1990.
- *Building Code Requirements for Reinforced Concrete*, ACI 318-04.
- *Egyptian Code of Practice for Reinforced Concrete*, 2004.
- McCormack, J.C., and J.K. Nelson, "*Design of Reinforced Concrete*," Sixth Edition, John Wiley and Sons, 2004.

Course Code : CB 747

Course Title : Advanced Prestressed Concrete

Credit Hours : 3

Course Description

Prestressing in statically indeterminate structures; design of prestressed concrete slabs; analysis and design of partially prestressed concrete beams; nonlinear analysis; analysis of members prestressed with unbonded tendons; prestressed compression members; special research and/or application related topics.

Course Objectives

To familiarize the students to concepts of analysis and design of indeterminate prestressed concrete structures.

Course Topics

- Prestressing in statically indeterminate structures
- Design of prestressed concrete slabs
- Analysis and design of partially prestressed concrete beams
- Nonlinear analysis
- Analysis of members prestressed with unbonded tendons
- Prestressed compression members
- Special research and/or application related topics

References

- Lin, T.Y., and N.H. Burns, "*Design of Prestressed Concrete Structures*," Wiley, NY, USA, 1981.
- *PCI Design Handbook*, Precast and Prestressed concrete, Precast-Prestressed Institute, Chicago, 1999.
- Naaman, A.E., "*Prestressed Concrete Analysis and Design: Fundamentals*," McGraw Hill Publishers, NY, 1982.
- *Building Code Requirements for Reinforced Concrete*, ACI 318-83.
- Kong, F.K., and R.H. Evans, "*Reinforced and Prestressed Concrete*," Chapman and Hall, London, 1987.
- Hilal, M., "*Fundamentals of Reinforced and Prestressed Concrete*," J. Macro Publishers, Cairo, 1971.
- Gerwick, B., "*Construction of Prestressed Concrete Structures*," Second Edition, Wiley, NY, 1993.
- Nawy, E.G., "*Prestressed Concrete: A Fundamental Approach*," Fourth Edition, Prentice Hall, 2002.

Course Code : CB 748

Course Title : Repair of Concrete Structures

Credit Hours : 3

Course Description

Concrete behavior: embedded metal corrosion, disintegration mechanics, moisture effects, load effects, concrete evaluation, surface repair, strengthening and stabilization, protection.

Course Objectives

To introduce the students to different causes and methods of repair in reinforced concrete structures.

Course Topics

- Concrete behavior
- Embedded metal corrosion
- Disintegration mechanics
- Moisture effects and load effects
- Concrete evaluation
- Surface repair
- Strengthening and stabilization
- Protection

References

- Son, L.H., and G.C.S. Yuen, "*Building Maintenance Technology*," MacMillan Press, London, 1993.
- Mailvaganam, N.P., "*Repair and Protection of Concrete Structures*," CRC Press, Florida, USA, 1991.
- Krstulovic-Opara, N., "*SP-185 High Performance Fiber Reinforced Concrete in Infrastructure Repair and Retrofit*," American Concrete Institute, Farmington Hills, MI, USA, 2000.

Course Code : CB 749

Course Title : Bridge Structures

Credit Hours : 3

Course Description

Advanced concepts and modern trends in design of bridges. Rehabilitation, repair, and retrofit of existing bridges. Use of relevant codes. Study of Alternative structural forms and materials for efficiency and economy. Design problems and reports.

Course Objectives

To present the modern approach of bridge design, analyses and health evaluation.

Course Topics

- Advanced concepts and modern trends in design of bridges
- Rehabilitation, repair, and retrofit of existing bridges
- Use of relevant codes
- Study of Alternative structural forms and materials for efficiency and economy
- Design problems and reports

References

- Bakht, B., and L.G. Jaeger, "*Bridge Analysis Simplified*," McGraw-Hill, NY, USA, 1985.
- Rockey, K., and H.R. Evans, "*The Design of Steel Bridges*," Granada Publishers, London, 1981.
- Heins, C., and R. Lawric, "*Design of Modern Highway Concrete Bridges*," Krieger Publication Company, Florida, 1992.
- Liu, T.C., "*Strength Evaluation of Existing Concrete Bridges*," American Concrete Institute, Detroit, 1985.
- Jagadeesh, T.R., and M.A. Jyaram, "*Design of Bridge Structures*," Prentice Hall of India, 2004

Course Code : CB 740-S

Course Title : Finite Element Method

Credit Hours : 3

Course Description

Introduction to the finite element method; Formulation of various finite element stiffness in one, two, and three dimensions; presentation of the principles of modeling and analysis of civil engineering problems using linear, planar, plate, and solid elements; application of the finite element principles to practical problems; introduction to a typical finite element software package.

Course Objectives

To introduce the students to the concepts and methods of finite element analysis of structures.

Course Topics

- Introduction to the finite element method
- Formulation of various finite element stiffness in one, two, and three dimensions
- Presentation of the principles of modeling and analysis of civil structures
- Application to practical problems
- Introduction to a typical finite element software package

References

- Rockey, K., *"The Finite Element Method: A basic Introduction,"* Wiley, Née, USA, 1983.
- Bickford, W., *"A first Course in the Finite Element Method,"* Irwin Publishers, Illinois, 1994.
- Huebner, K., *"The Finite Element Method for Engineers,"* Wiley, NY, USA, 1995.
- Logan, D., *"A First Course in the Finite Element Method,"* PWS Publishing company, Boston, 1993.
- Zienkiewicz, O.C., and R.L. Taylor, *"Finite Element Method: Volume 2, Solid Mechanics,"* Fifth Edition, Butterworth-Heinemann, 2000.

Course Code : CB 741-S

Course Title : Theory of Elasticity

Credit Hours : 3

Course Description

Fundamentals of isotropic linear elasticity. Solution of plane elasticity problems. St. Venant bending and torsion. Basic three-dimensional solutions.

Course Objectives

To introduce the students to the concepts and methodologies of elasticity theory.

Course Topics

- Fundamentals of isotropic linear elasticity
- Solution of plane elasticity problems
- St. Venant bending and torsion
- Basic three-dimensional solutions

References

- Novozhilov, V., "*Foundations of the Nonlinear Theory of Elasticity*," Dover Publications, Née, USA, 1999.
- Reismann, H., "*Elasticity: Theory and Applications*," Krieger Publications Company, Florida, USA, 1991.
- Saada, A., "*Elasticity: Theory and Applications*," Krieger Publications Company, Florida, USA, 1993.
- Timoshenko, S., "*Theory of Elasticity*," McGraw-Hill, New York, USA, 1978.

Course Code : CB 742-S

Course Title : Plastic Analysis and Design of Structures

Credit Hours : 3

Course Description

Plastic analysis of structural frames. Rules of practice for the plastic design of steel and reinforced concrete structures. Design problems and reports.

Course Objectives

To introduce the students to the concepts and methodologies of limit state analysis and design of structures.

Course Topics

- Plastic analysis of structural frames
- Rules of practice for the plastic design of steel and reinforced concrete structures
- Design problems and reports

References

- *Manual of Steel Construction*, Ninth Edition, American Institute of Steel Construction, USA, 2004.
- Moy, S., "*Plastic Methods for Steel and Concrete Structures*," Wiley, NY, 1981.
- Disque, R.O., "*Applied Plastic Design in Steel*," Van Nostrand Reinhold, 1978.
- Jirasek, M., and Z.P. Bazant, "*Inelastic Analysis of Structures*," John Wiley and Sons, 2001.
- *Load and Resistance Factor Design Manual (LRFD)*, Third Edition, American Institute of Steel Construction, AISC 325-01, 2005.

Course Code : CB 743-S

Course Title : Earthquake Engineering

Credit Hours : 3

Course Description

Development of a rational basis for design of earthquake resistant design. Engineering characterization of earthquakes; dynamics of inelastic systems; response of inelastic structures; structural system design considerations; modeling and analysis of buildings; performance-based design; an advanced seismic design topic of choice, time permitting. Application of relevant design specifications.

Course Objectives

To introduce the students to the design of structures that would sustain dynamic loading (earthquake forces).

Course Topics

- Engineering characterization of earthquakes
- Dynamics of inelastic systems; response of inelastic structures
- Structural system design considerations
- Modeling and analysis of buildings
- Performance-based design
- Application of relevant design specifications

References

- Chopra, A.K., "*Dynamics of Structures: Theory and Applications to Earthquake Engineering*," Prentice-Hall, USA, 2000.
- Paz, M., "*Structural Dynamics: Theory and Computation*," Second Edition, Van Nostrand Reinhold, NY, 1985.
- Ghosh, S., "*Earthquake-Resistant Concrete Structures*," American Concrete Institute, Detroit, USA, 1991.
- Ambrose, J., "*Simplified Building Design for Wind and Earthquake Forces*," Wiley, NY, 1995.
- Fanella, D., "*Design of Low-Rise Concrete buildings for Earthquake Forces*," Portland Cement Association, Illinois, USA, 1997.
- Naeim, F., "*The Seismic Design Handbook*," Kluwer Academic Publishers, Second Edition, 2001

Course Code : CB 744-S

Course Title : Design of Special Metallic Structures

Credit Hours : 3

Course Description

Design of special steel structures (towers, masts, tanks, etc), torsion of open and box members. Design of tall buildings. Behavior of steel and aluminum structural members is studied with reference to their code design procedures.

Course Objectives

To introduce the students to the design concepts of special steel structures.

Course Topics

- Design of special steel structures (towers, masts, tanks, etc)
- Torsion of open and box members
- Behavior of steel and aluminum structural members
- Code design procedures

References

- Johnston, B.G., F.J. Lin, and T.V. Galambos, "*Basic Steel Design*," Third Edition, Prentice-Hall, Englewood Cliffs, USA, 1986.
- American Institute of Steel Construction, "*Manual of Steel Construction*," Ninth Edition, 2001.
- *Egyptian code* requirements for steel structures.
- Cooper, S.E., and A.C. Chen, "*Designing Steel Structures: Methods and Cases*," Prentice-Hall, Englewood Cliffs, USA, 1985.
- Salmon, C.G., and R.P. Johnson, "*Steel Structures: Design and Behavior*," Second Edition, Harper and Row, 1980.

Course Code : CB 745-S

Course Title : Composite Structures

Credit Hours : 3

Course Description

Full interaction of simple and continuous composite beams, types of connections, partial interaction theory of simple and continuous beams, effect of slip and uplift at the interface concrete slab-steel beams, analysis of composite columns.

Course Objectives

To familiarize the students with the advanced concepts of design and analysis of composite structures.

Course Topics

- Full interaction of simple and continuous composite beams
- Types of connections
- Partial interaction theory of simple and continuous beams
- Effect of slip and uplift at the interface concrete slab-steel beams
- Analysis of composite columns

References

- Johnson, R.P., "*Composite Structures of Steel and Concrete, Volume 1: Beams, Slabs, Columns, and Frames for Buildings*," Second Edition, Blackwell Scientific Publications, London, 1994.
- Narayanan, R., "*Steel-Concrete Composite Structures*," Elsevier Applied Science, NY, 1988.
- Kalamkarov, A., "*Analysis, Design, and Optimization of Composite Structures*," John Wiley and Sons, England, 1997.
- Wang, C.K., and C.G. Salmon, "*Reinforced Concrete Design*," Fourth Edition, Harpor and Row Publishers, NY, 1985.
- Kollár, L.P., and G.S. Springer, "*Mechanics of Composite Structures*," Cambridge University Press, 2003.

Course Code : CB 746-S

Course Title : Reliability in Civil Engineering

Credit Hours : 3

Course Description

The role of risk and probability in Civil Engineering is described and basic probability concepts are presented. Probability distribution functions commonly used to model and analyze Civil Engineering problems are discussed. Methods for estimating parameters and determining distribution models from observational data are introduced. Monte Carlo simulation methods are practiced. Detailed examples of the application of probabilistic methods to structural, transportation, hydrological, and environmental system design are presented throughout the course.

Course Objectives

This course aims to introduce civil engineers to studying reliability and its applications in different fields of civil engineering. A variety of related problems that may evolve in the site is studied and explained.

Course Topics

- Fundamental Concepts related to structural reliability
- Probabilistic treatment of civil engineering systems
- Sample statistics, parameter estimation, and confidence intervals
- Test if a distribution fits sampled data
- Regression analysis

References

- Ang, A.H-S., and W.H. Tang (1975), "*Probability Concepts in Engineering Planning and Design, Basic Principles*", Vol. I. Wiley, NY.
- Andrews J. D., and T. R. Moss (2000), "*Reliability and Risk Assessment*", Second Edition, Professional Engineering Publishing, London.
- Modarres, M. (1993), "*Reliability and Risk Analysis: What Every Engineer Should Know About Reliability and Risk Analysis*", Marcel Dekker, Inc., NY.
- Ushakov, A., and R. A. Harrison (1994), "*Handbook of Reliability Engineering*", Wiley, NY.