

**COMMONWEALTH GRADUATE ENGINEERING PROGRAM
TELEVISED COURSE PLANNING SHEET
UNIVERSITY OF VIRGINIA**

Course _____ MAE 641 / APMA 641 – Engineering Mathematics I _____ Semester _____ Fall 2007 _____

Instructor _____ Professor William W. Roberts, Jr. _____ Phone No. _____ 434 924 6216 _____

Office Address _____ Mechanical Engineering Building _____ Room 328 _____

_____ School of Engineering and Applied Science _____ University of Virginia _____

E-Mail Address _____ wwr@virginia.edu _____

Very important to get the following information asap so that off-grounds sites can place book orders with publishers:

Textbook(s): (Student to purchase)

Applied Partial Differential Equations by Richard Haberman (Prentice Hall 4th Edition or latest Edition)

Advanced Engineering Mathematics by Michael Greenberg (Prentice Hall 2nd Edition or latest Edition)

Reference(s):

<http://toolkit.itc.virginia.edu>

menu option: select Fall, 2007

menu option: search APMA641-1

<http://www.mae.virginia.edu/faculty/roberts.htm>

<http://www.mae.virginia.edu/research/mcml.html>

Computer Needs:

Computer Capability ___Yes, whatever PC or other computer workstation the student would have available to use ___

Software required? ___One or more mathematics software packages and graphics capabilities_____ Provided? _____

Other _____Access to the WEB and ability to download information from the University of Virginia's WEB toolkit _

Please attach a copy of your course syllabus, biographical sketch, and any other information we might need to prepare for this course.

ENGINEERING MATHEMATICS I [3]
MAE 641 / APMA 641 Fall, 2007

Professor: William W. Roberts, Jr.
MEC - 328 (434) 924-6216 wwr@virginia.edu

Class Times (in Room THN A - 119): Tu Th 1530 - 1645

Professor's Office Hours (MEC - 328): Tu Th 0845 - 0915 1400 - 1500
Tu Th 1700 - 1730 or By Appointment

Text: "Applied Partial Differential Equations" by Richard Haberman (4th Ed.)

Text: "Advanced Engineering Mathematics" by Michael D. Greenberg (2nd Ed.)

Prerequisites: Graduate Standing and APMA 111, 212, and 213 or equivalents

Objectives of Study: Review of ordinary differential equations, matrices, linear algebraic equations, eigenvalues, and eigenvectors, and scalar and vector field theory. Partial differential equations that govern physical phenomena in science and engineering. Solution of initial-value, boundary-value problems by separation of variables, superposition, Fourier series, and eigenfunction expansions. Sturm-Liouville theory. Particular focus on the heat, potential, and wave equations in rectangular, cylindrical, and spherical coordinates. Development of analytical skills and expertise. Introduction to numerical methods for partial differential equations, if time allows.

Course Coverage: The course will review selected concepts and techniques in the Greenberg Text's Part I - Ordinary Differential Equations, Part II - Linear Algebra, and Part III - Scalar and Vector Field Theory. The course will focus upon and cover important fundamental concepts and techniques in the Greenberg Text's Part IV - Fourier Methods and Partial Differential Equations and in the Haberman Text's Chapters 1, 2, 3, 4, 5, 6, 7, and 8 centered on Applied Partial Differential Equations.

Homework: Each student is expected to do all the homework. Indeed, doing the homework problems is important for the student in part because mathematics is largely learned by doing (as well as studying) and in part because a number of the problems on the tests and the final examination are expected to be similar to the homework problems. Homework is not pledged. Each student is expected to work on his/her own to the greatest extent practical; however collaboration with his/her peers is educational and acceptable. Homework may or may not be collected; if collected, randomly selected problems will be graded. One or more computer projects may be assigned.

In-Class Questions And Interactions With The Professor Encouraged: In-class questions on lecture material and interactions with the professor are encouraged.

Final Letter Grade: The final letter grade will be based on: the Tests and Computer Projects (if assigned) and Homework (collected/graded) - 60% and Final Exam - 40%.

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William W. Roberts, Jr. - Biographical Sketch
Commonwealth Professor of Engineering and Applied Science
Director of Applied Mathematics

William W. Roberts, Jr. is the Commonwealth Professor of Engineering and Applied Science and the Director of Applied Mathematics in the School of Engineering and Applied Science at the University of Virginia. Professor Roberts, a native of Huntington, West Virginia, earned his S.B. in mathematics from the Massachusetts Institute of Technology in 1964 and his Ph.D. in applied mathematics from the Massachusetts Institute of Technology in 1969. Professor Roberts came to the School of Engineering and Applied Science at the University of Virginia as an assistant professor in 1969. In 1974, he was promoted to associate professor; in 1982, he became full professor; in 1992, he was appointed to the Commonwealth Professor Chair of Engineering and Applied Science; and in 2004, he was appointed as Director of Applied Mathematics.

Professor Roberts is the Director of the School's Mathematical-Computational Modeling Laboratory [MCML]. His professional work is focused on: the formulation of scientific and engineering problems in mathematical terms; the identification, isolation, and study of the dominant physical processes and fundamental dynamical mechanisms present; and the solution of the mathematical equations in the models thus formulated through analytical and computational approaches. Professor Roberts has authored or co-authored more than 100 refereed journal publications, books, national and international conference papers, annual review articles, and technical reports. His work has application in various fields and spans a broad realm of phenomena and events observed in nature and the experimental laboratory, including shock waves, nonlinear wave phenomena, rarefied & hypersonic gas flows, industrial prototype technologies for fiber processing operations, two phase gas-fiber flows, fibrous assemblies and their compression and decompression, the interstellar medium, and the structure & dynamics of galaxies. Professor Roberts received the 1990 NCR-University Stakeholder Innovation Award for his scientific work on 'mathematical modeling-computer algorithm development' in the area of fiber production processing and was nominated as "Virginia's Outstanding Scientist" in 1991. Involved with more than forty research projects, he has presented over 200 technical lectures and colloquia throughout the U.S., Switzerland, England, Australia, Italy, France, The Netherlands, Sweden, Germany, Poland, Canada, Japan, Finland, Greece, and Scotland.

Professor Roberts has carried out consulting work for industrial firms and has held visiting positions at: the State Univ. of New York, the Institut des Hautes Etudes Scientifiques in France, the University of Groningen in The Netherlands, the Stockholms Observatorium in Sweden, the Massachusetts Institute of Technology, the University of Leiden in The Netherlands, the Kitt Peak National Observatory, the IBM T.J. Watson Research Center, the NASA Langley Research Center, the National Radio Astronomy Observatory, and the NASA Ames Research Center. Among these visiting appointments were honorary awards of NORDITA Guest Professorship in 1974-75 and National Research Council Senior Research Associateship in 1989.

Professor Roberts received the 1980 Distinguished Teaching Award from the University of Virginia's Office of Afro-American Affairs and the University of Virginia's Engineering School 2005 Instructor of the Year Award for Distance Learning. He has served on numerous committees both within and outside the University and as referee and reviewer of proposals and papers for more than 15 national funding agencies and national and international journals. Among his professional memberships during his career are the Am. Assoc. for the Adv. of Science, the Am. Astronomical Society, the Am. Inst. of Physics, the International Astronomical Union, Sigma Xi, the Soc. for Indust. & Appl. Mathematics, the Fiber Society, and the Virginia Academy of Science. He is listed in Marquis Who's Who in America, Who's Who in Am. Education, and Who's Who in Sci. & Engr. (<http://www.mae.virginia.edu/faculty/roberts.htm>)

Academic Rank:

Commonwealth Professor of Engineering and Applied Science
 Director, Mathematical-Computational Modeling Laboratory
 Director of Applied Mathematics

Born / Marital Status:

Huntington, West Virginia, 1942 Wife: Linda Two sons: Will and Dave

Education:

S.B. (mathematics) Massachusetts Institute of Technology, 1964
 Ph.D. (applied mathematics) Massachusetts Institute of Technology, 1969

Professional Experience / Positions / Appointments :

Naval Underwater Ordnance Station, Newport, Rhode Island, Summer 1964
 Massachusetts Institute of Technology, Cambridge, Massachusetts
 Teaching Assistant, 1964-66; Research Assistant, 1966-68; MIT Lincoln Laboratory,
 Sum. 1965; Postdoctoral Research Associate, Oct. 1968-Feb. 1969; Visiting Scientist,
 Sum. 1971; Visiting Associate Professor, Feb.-July 1975
 The RAND Corporation, Santa Monica, California, Summer 1966
 University of Virginia, Charlottesville, Virginia: School of Engineering and Applied Science
 Department of Applied Mathematics, Institute of Applied Mathematics & Mechanics, and
 Department of Mechanical and Aerospace Engineering
 Assistant Professor, 1969-74; Associate Professor, 1974-82; Professor, 1982-92
 Director, Mathematical-Computational Modeling Laboratory [MCML], 1990--
 Commonwealth Professor of Engineering and Applied Science, 1992--
 Director of Applied Mathematics, 2004--

Professional Societies and Synergistic Activities (during professional career):

American Association For The Advancement Of Science (A.A.A.S.), American Astronomical Society (A.A.S.), American Institute for Aeronautics and Astronautics (A.I.A.A.), American Institute of Physics (A.I.P.), Division for Planetary Sciences (D.P.S.), Division on Dynamical Astronomy [Executive Committee, 1976-77, 1983-84] (D.D.A.), International Astronomical Union (I.A.U.), Marquis Who's Who in America, Who's Who in American Education, Who's Who in Science and Engineering, and Who's Who in Technology, Sigma Xi, Society for Industrial and Applied Mathematics (S.I.A.M.), The Fiber Society, Virginia Academy of Science

Scientific Work includes:

- (1) Refereed Journal Publications - 34
- (2) Published Books [Including Ph.D. Dissertation] - 5
- (3) Encyclopedia And Annual Review Book Publications - 2 [2 invited reviews]
- (4) Published Papers In International Conference Proceedings - 34 [14 invited reviews]
- (5) Other Papers Presented At International Conferences - 7 [4 invited reviews]
- (6) Papers Presented At National Meetings - 32
- (7) Technical Reports - 17
- (8) Invited Lectures, Seminars, and Colloquia - > 200

Awards, Honors:

Sesquicentennial Associateship, Center for Advanced Studies, University of Virginia, 1974-75
 Distinguished Teaching Award, Office of Afro-Am. Affairs, Univ. of Va., 1980
 Sesquicentennial Associateship, Center for Advanced Studies, University of Virginia, 1980-81
 Sesquicentennial Associateship, Center for Advanced Studies, University of Virginia, 1988-89
 National Research Council Senior Research Associateship, 1988-89
 NCR-University Stakeholder Innovation Award, 1990
 Nomination as "Virginia's Outstanding Scientist," 1991
 Appointment to the Commonwealth Professor Chair of Engineering and Applied Science, 1992
 Sesquicentennial Associateship, Center for Advanced Studies, University of Virginia, 1994-95
 Nomination for the Raven Society Faculty Award, University of Virginia, 2001
 Engineering School 2005 Instructor of the Year Award for Distance Learning, UVa., 2005

Research Activities (during professional career):

Principal Investigator or Co-Principal Investigator on grants from Amoco, Du Pont, Hercules, NASA, NSF, 3M Company, U.S. Army, VCIT, and other sources, totaling over \$2,500,000.

Other Professional Experience / Positions:

Visiting Scientist, Dept. of Earth & Space Sciences, SUNY, Stony Brook, NY, Summer 1972
Visiting Scientist, Institut des Hautes Etudes Scientifiques, Bures-Sur-Yvette, France, 1974
Visiting Scientist, Kapteyn Astronomical Institute, University of Groningen, Netherlands, 1974
NORDITA Guest Professor, Stockholms Observatorium, Saltsjobaden, Sweden, 1974-1975
Visiting Scientist, Huygens Laboratorium, University of Leiden, The Netherlands, 1975
Visiting Scientist, Kitt Peak National Observatory, Tucson, Arizona, Summer 1976
Visiting Scientist, IBM T. J. Watson Research Center, Yorktown Heights, New York, 1980
Visiting Scientist, ICASE, NASA Langley Research Center, Hampton, Virginia, 1980-1981
Consultant, Union Carbide Corporation, Oak Ridge, Tennessee, 1981
Consultant, E. I. Du Pont de Nemours & Co., Inc., Richmond, Virginia, 1986-1992
Member, Virginia Institute for Theoretical Astronomy (V.I.T.A.), 1987--
Visiting Scientist, National Radio Astronomy Observatory, Charlottesville, Virginia, 1988
National Research Council Senior Res. Assoc., NASA/Ames Res. Ctr., Moffett Field, CA, 1989
Consultant, Amoco Fabrics and Fibers Company, Atlanta, Georgia, 1991-1993
President, Computational Modeling Technologies, Inc., 1991--
Consultant, Owens Corning, Granville, OH and Prentice-Hall, Upper Saddle River, NJ, 1997

Graduate Advisees, Post-Doctoral Research Associates and Collaborators:

J. M. Huntley, W. W. van Osdol, F. H. Levinson, R. A. Marschall, B. LoBracco, Jr., D. A. Cook, D. S. Adler, L. P. Anderson, Jr., A. C. Smith, W. S. Russell, P. A. Berger, J. G. Vaver, L. D. Wibberly, V. Milione, A. H. Rots, H. C. D. Visser, G. D. van Albada, M. A. Hausman, G. R. Stewart, N. B. Beil

Selected Publications (Five Most Closely-Related Publications):

Roberts, W. W., Jr., "Virtual Prototyping of Textile Technologies: Critical Competitive Advantage for Industry," TIWC78: Textiles And The Information Society, Vol. 2 (Textile Institute, Manchester, U.K., 1997), pp. 275-286.

Beil, N. B. and Roberts, W. W., Jr., "Modeling and Computer Simulation of the Compressional Behavior of Fiber Assemblies. Part I: Comparison to van Wyk's Theory," Textile Research Journal, 72, No. 4 (2002), pp 341-351.

Beil, N. B. and Roberts, W. W., Jr., "Modeling and Computer Simulation of the Compressional Behavior of Fiber Assemblies. Part II: Hysteresis, Crimp, and Orientation Effects," Textile Research J., 72, No. 5 (2002), pp. 375-382.

Roberts, W. W., Jr., and Beil, N. B., "Fibrous Assemblies: Modeling/Computer Simulation of Compressional Behavior," INTEDEC 2003 - Fibrous Assemblies at the Design and Engineering Interface (ISBN No. 0-9546162-0-0, Heriot-Watt University, Edinburgh, U. K., 2003).

Roberts, W. W., Jr., and Beil, N. B., "Fibrous assemblies: modeling/computer simulation of compressional behavior," International Journal of Clothing Science and Technology, Vol. 16, No. 1/2 (2004), pp. 108 - 118.

Other Significant Publications:

Roberts, W. W., Jr., and Hausman, M. A., "Hypersonic, Stratified Gas Flows Past An Obstacle: Direct Simulation Monte Carlo Calculations," Journal of Computational Physics, Vol. 77 (1988), pp. 283 - 317.

Smith, A.C., and Roberts, W. W., Jr., "Computational Modeling of Fiber Formation in Polypropylene Spunbonding with Crystallization: Comparison with Experiments," International Nonwovens Journal, Vol. 6 (1994), pp. 31-41.

Smith, A.C., and Roberts, W. W., Jr., "Straightening of Crimped and Hooked Fibers in Converging Transport Ducts: Computational Modeling," Textile Research Journal, Vol. 64, No. 6 (1994), pp. 335-344.

Roberts, W. W., Jr., "Industrial Fiber Processing and Machine Design: Mathematical Modeling, Computer Simulation, and Virtual Prototyping Textile Research Journal, Vol. 66, No. 4 (1996), pp. 195-200.

Wibberly, L. D. and Roberts, W. W., Jr., "Modeling the Diffusive Transport of Bulk Fiber Mass in a Card," Textile Research Journal, Vol. 67, No. 4 (1997), pp. 296-308.