



RELIABILITY GROUP NEWSLETTER

JULY 1973 Vol. XVIII·Issue 3

Editor: Paul Gottfried

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Editor's Notes

We welcome aboard the Newsletter's new Associate Editor, Mrs. Naomi J. McAfee. Naomi's initial responsibilities will include Chapter News and all other chapter-contributed material, beginning with the next (October) issue.

Naomi's biography, as a member of the group who joined the G-R Administrative Committee in January, appears elsewhere in this issue in the "Meet Your AdCom" feature. She can be reached at the Westinghouse Electric Corporation, Defense and Electronic Systems Center, Box 746, M/S 138, Baltimore, Maryland 21203.

"Material for the October issue must be in the Editor's hands by August 31. Chapter material may be sent directly to the Associate Editor."

Chapter chairmen

Baltimore	Mr. Thomas T. Jackson Amecom Division Litton Systems, Inc. 5115 Calvert Road College Park, Md. 20740	New Jersey Coast	Mr. Weldon V. Lane 57 Throckmorton Avenue W. Long Beach, N.J. 07764
Binghamton	Mr. Joseph J. Rexford 20 Merrill Street Binghamton, N.Y. 13905	New York - Long Island	Dr. Martin L. Shooman 12 Broadfield Place Glen Cove, N.Y. 11542
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Canaveral/Daytona	Mr. Jack R. Lykins 285 Carissa Drive Satellite Beach, Fla. 32935	Philadelphia	Mr. Irving Hyams 134 East Cheltenham Ave. Philadelphia, Penna. 19120
Chicago	Mr. Charles W.N. Thompson 240 Randolph Street Chicago, Ill. 60022	San Francisco	Mr. Gilmore Bowers 766 Berkley Avenue Menlo Park, Calif. 94025
Connecticut	Mr. J. R. Breton 320 Ocean Avenue New London, Conn. 06320	Twin Cities	Mr. Stephen J. Pech 109 East Golden Lake Lane Circle Pines, Minn. 55014
Florida West Coast	Mr. Robert P. Dalton 2170 College Drive Clearwater, Fla. 33516	Washington	Mr. Peter J. Mulligan 2500 N. Van Dorn Alexandria, Va.
Los Angeles	Mr. Robert B. Babin 26822 Hawhurst Drive Palos Verdes, Calif. 90274		
Mohawk Valley	Mr. George Kasouf 1513 Bette Road Utica, N.Y. 13502		

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Chapter news

Baltimore

The last meeting of the 1972-73 season was held on May 21, when Edward Fisher of the Chesapeake and Potomac Telephone Company spoke on "The Picturephone: Past and Future." A short film introduced the subject and a pair of operating picture phones were set up in the meeting room to illustrate their design and use.

The following officers were elected to serve during the 1973-74 term:

Chairman	Thomas T. Jackson Amecom Division Litton Systems, Inc. 5115 Calvert Road College Park, Md. 20740
Vice Chairman	Frank P. Lee, Jr. Federal Aviation Administration c/o Radiation Systems, Inc. 1755 Old Meadow Road McLean, Va. 22101
Secretary/Treasurer	Thomas A. Kurzmilller Westinghouse Electric Corp. P.O. Box 1897, M/S 661 Baltimore, Md. 21203

Boston

The Boston Chapter maintained its customary full schedule of meetings throughout the 1972-73 season:

October 19	"A Method of Assessing the Risk of Reliability Demonstration Testing", A.C. Spear, RCA Aerospace Systems Division
January 18	Tour of Budweiser Brewery plus "Stress Testing for Improved Reliability Performance with Computerized Test Methods", Wallace B. Haigh, Raytheon MSD
February 15	"A Synergistic Reliability and Maintainability Prediction Package", A.C. Spann, GTE Sylvania Eastern Division
March 15	"Safety and Health Standards -- Their Effect on Engineering and Reliability", Gerald M. Duwors, Assistant Regional Administrator, Technical Support, Occupational Safety and Health Administration (joint meeting with IEEE Boston Section and Standards Engineers Society)
April 26	Eleventh Annual Reliability Spring Semester; 8 papers plus keynote and banquet addresses.

Publicity Chairman John Grund advises that Chapter Vice Chairman Donald Simpson is to be credited with lining up the meeting schedule and appointing the various committee chairmen.

The March 21 meeting featured a talk on "Application of Reliability Concepts to Industrial Power Distribution Systems" by Charles R. Heising of General Electric. Myron A. Wilson of General Electric spoke on "Application of Failure Modes and Effects Analysis on an Oil Industry Production System" on April 26, the last meeting of the season. Average attendance for the six meetings was 27.

The officers for the 1973-74 season will be Irving Hyams, Chairman; John Davaro, Vice Chairman; and Charles R. Heising, Secretary.

Washington

Donald L. Costello of Bradford Computer and Systems, Inc., presented "A Gaze Through the Haze of the Ways of Bayes" at the March 14 meeting. On May 23, the Chapter heard William A. MacCrehan, Jr., of Westinghouse Electric Corp., discuss "A Gambler's Kit for Component Part Screening." The Chapter continued its custom of presenting certificates for outstanding Reliability-related exhibits at local Science Fairs; an award was made to David Salzman for his exhibit on "Integrated Circuits" at the Prince Georges' Area Science Fair. Mr. Salzman is a student at John Hanson Junior High School.

Officers elected for the 1973-74 season are: Peter J. Mulligan, Chairman; V.W. Pennanen, Executive Vice Chairman; W.M. Redler, Program Vice Chairman; and C.F. Veraa, Secretary. These officers along with the two most recent available Past Chairmen, W.E. Wallace, Jr., and V.E. Gardner, constitute the Executive Committee of the Chapter.

Section 6.1 of the G-R By-laws provides: "A slate of nominees for members-at-large vacancies shall be prepared by the Nominating Committee. Recommendations for such nominees shall be solicited by a letter to the Chairmen of all Sub-Groups and Standing Committees. In addition, the Chairman of the Nominating Committee shall cause to be published and distributed to the entire group membership a call for nominations. A nominating petition carrying a minimum of 25 names of Group Members, excluding students, shall automatically place that nominee on the slate to be presented to the 'AdCom'."

Six vacancies will be created by the expiration of the three-year terms (as of the end of 1973) of the following:

Term Expires 12/31/73

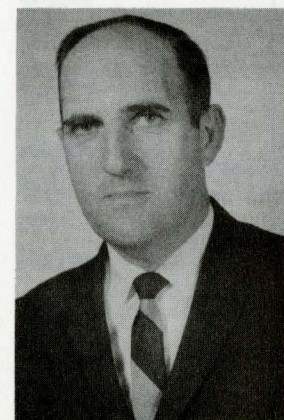
- G. H. Ebel
- R. A. Evans
- R. E. Kuehn
- *V. R. Monshaw
- M. P. Smith
- J. W. Thomas

*Has served two consecutive terms and is not eligible for re-election until after a lapse of one year.

The Nominating Petition may be forwarded to the following no later than September 1, 1973:

V. R. Monshaw
Chairman, Nominating Committee
RCA - MS 81
Box 800
Princeton, New Jersey 08540

MEET YOUR AdCom



David F. Barber is Chief, Reliability Branch, RADC, responsible for Air Force programs on reliability and maintainability (R&M) techniques, R&M support of Air Force electronic systems, development of reliable microelectronic devices, physics of failure studies, system and cost effectiveness investigations, and implementation and operation of the DOD Reliability Analysis Center. RADC positions have covered areas of radio-meteorology, electronic warfare, intelligence, display techniques, reliability, and maintainability.

Mr. Barber received an A. B. degree in Mathematics from Hamilton College. After spending the years 1943-1947 as a Weather Officer, with service predominantly in the Pacific, he returned to the U.S. and studied at M.I.T., where he received an S.M. degree in 1951. He has almost 30 years of federal government service, including positions at Watson Laboratories, AF Cambridge Research Laboratories, and, since 1951, Rome Air Development Center.

Mr. Barber is a member of IEEE and IEEE Group on Reliability. He has served on many panels, workshops, technical committees on reliability, maintainability, microelectronics, and system effectiveness. He was co-chairman of the Third Annual Symposium on the Physics of Failure in Electronics, and General Chairman of the 1973 Reliability Physics Symposium, and has presented papers on reliability management, microelectronics, and the RADC Reliability Analysis Center at national and international symposia. He was chairman of Task Group II, USAF Weapon System Effectiveness Industry Advisory Committee. He is also a member of the Management Committee of the Annual Symposium on Reliability and the Board of Directors of the IEEE Reliability Physics Symposium. Mr. Barber is married to the former Elizabeth Ziemann of Rome, New York. They have three children, David, Jr., 22; Nancy, 15; and Pamela, 12.



Naomi J. McAfee is Manager, Quality and Reliability Assurance Programs of the Westinghouse Electric Corporation Defense and Electronic Systems Center. Mrs. McAfee received her B.S. degree in Physics from Western Kentucky University in 1956. After graduation, she joined Westinghouse as a Mathematician in the Reliability Engineering Section. She currently is responsible for directing the reliability, quality, maintainability and safety engineering activities for all Aerospace and Electronic Systems Division Programs. Prior to this assignment, she was Manager, Reliability, Maintainability and Safety Engineering. She has had extensive experience in planning and directing the reliability and maintainability efforts for such programs as the Environmental Measurements Experiment for the Application Technology Satellite, AN/AWG-10 Airborne Missile Control System and Special Support Equipment and the AN/SPG-59 radar for the Typhon Weapon System.

Mrs. McAfee is a senior member of the Institute of Electrical and Electronics Engineers (IEEE), the American Society for Quality Control (ASQC) and the Society of Women Engineers. She has served as Executive Secretary of ASQC and is currently President of the Society of Women Engineers. She is listed in "Who's Who of American Women", "Who's Who in the South", and "Two Thousand Women of Distinction".

Mrs. McAfee has published numerous papers and is co-editor of the Reliability Training Text.

AdCom NOMINATIONS SOLICITED

Employment Notices

The Newsletter accepts both "Help Wanted" and Position Wanted" Notices on a no-charge basis, subject to the following rules:

- Notices will appear in two successive issues unless cancellation notice is received before editorial deadlines.
- Text for each notice will be limited to ten lines plus identification, with a maximum of 45 characters and spaces per line.
- Notices may be open or blind, but blind "Help Wanted" notices should identify the type of business and the general geographic location of the vacancy.
- Submittals of "Position Wanted" notices should include IEEE membership number.
- "Help Wanted" notices must fall in the "Equal Opportunity - M&F" category. Agreement to this requirement will be considered to be implied by the submittal of the notice and need not appear in the text.

POSITION WANTED

18 yrs exper. in Product Assurance activities incl. program mgmt., Q.A., Q.C., failure reporting & reliability programs pertaining to component parts including IC's for commercial and military equipment. Coordinated & controlled quality of purchased items for mass production of communications equipment & effected yield improvements in the end products through process analyses and implementation of corrective measures. BSEE, MBA.

Reply to Box 3, c/o Editor
Paul Gottfried
9251 Three Oaks Drive
Silver Spring, Md. 20901

HELP WANTED

Manager of Quality Assurance--Senior level with extensive electronics and/or display products experience to implement QA program. Responsible for vendor part qualification and application; components engineer; production QC; product reliability, specifications and failure analysis. Should be presently performing at this level with minimum of 8 years experience. Should have extensive QA experience to plan, implement and engineer such a program. Midwestern Computer Display Manufacture.

Reply to Box 4, c/o Editor
Paul Gottfried
9251 Three Oaks Drive
Silver Spring, Maryland 20901

Components Engineer--Engineering level reporting to quality assurance manager technical responsibility for component specification, reliability and application; qualified parts list; non standard parts control and parts vendor qualification; component quality control test plans and component failure analysis. Should presently be performing at this level with minimum of 5 years experience. Should have in addition electronics design and QA experience. Midwestern Computer Display Manufacture.

Reply to Box 5, c/o Editor
Paul Gottfried
9251 Three Oaks Drive
Silver Spring, Maryland 20901

RELIABILITY PHYSICS

Symposium Thumbnail Summary

The 1973 Reliability Physics Symposium, held in Las Vegas, Nevada April 5-7, marked the beginning of its second decade. The symposium is dedicated to the exchange of ideas and knowledge on solid-state device failure mechanisms and their control. By considering the fundamental physical and chemical processes that lead to device degradation, attendees of this conference are provided the basic tools for coping with the rapid advances being made in solid-state technology.

The 1973 program put together by H. Nigh, BTL, attracted a record attendance of 548 engineers and scientists. Featured were six full technical paper sessions, two failure analysis workshops and an evening panel discussion on hybrid device reliability. B/Gen (Ret.) S.S. Hunn, Director, Systems Research and Development Service, FAA, keyed the meeting with a chronology of their long range automation program. The objective of this program is to increase the capability of the FAA Air Traffic Control network to handle the rapidly expanding traffic. He repeatedly emphasized the overriding importance of passenger safety and long, uninterrupted periods of reliable system operation without maintenance slow-downs.

Aside from the two workshops, a complete technical session was devoted to failure analysis techniques and procedures. Workshop I was a teaching session outlining proven methods as well as latest techniques for isolating and identifying specific types of failures including package hermeticity, wire bonds, overstress, oxide defects and surface inversion. Of particular interest was the quasi-quantitative determination of the nature of the overstress condition (voltage level & pulse duration) that lead to failure described by J. Smith, RADC. The basic operation, advantages, and limitations of the various electron analysis techniques such as SEM, electron probe (EMP) Auger (AES), ion microprobe, and ion microprobe mass analyzer (INMA) were described in Workshop II. Significant developments described in the related technical papers include: 1) a pulse laser technique which enables fast, accurate cutting of metalization stripes to isolate oxide and other faults; 2) the use of computerized test procedures for zeroing in on the defective area of MOS/LSI circuits; and 3) a non-contacting method of testing thin film circuit interconnections using electron beam probes.

Topics covered in other technical sessions included metalization and bonding, hybrid circuits and passive components, MOS interface properties, design and process control for reliability, and microwave and optoelectronic devices. Two areas given strong emphasis were plastic encapsulated devices and inprocess screening and testing techniques. The use of "novolac" cured epoxy and tri-metal gold interconnect metalization either alone or together are reported to offer reliability advantages over previous systems. C. Adams, Honeywell-Bull (France) reported that gold interconnect wires in plastic-encapsulated integrated circuits exhibit grain growth and rupture under axial tensile stress at elevated temperatures. To minimize this mode, the encapsulant should apply a net compressive force on the bonding wire over the entire device operating temperature range. A quantitative method for correlating plastic encapsulated device accelerated temperature-humidity conditions to normal use conditions was described by D.S. Peck, BTL. Considering electrolytic corrosion failures, he concluded that the acceleration factor between an 85°C, 85% RH Biased test condition and average use condition was approximately 2×10^5 .

1973 Product Liability Prevention CONFERENCE

PLP-73, the fourth annual conference of its kind, will take place August 22-24 at Newark College of Engineering with 21 professional societies and trade organizations as co-sponsors. G-R is among the charter sponsors of the conference, which is chaired by G-R Vice President Richard M. Jacobs.

The keynote address will be delivered by Richard O. Simpson, Chairman of the new Consumer Product Safety Commission. Following Mr. Simpson, some 40 invited speakers will identify current product safety and liability situations and point to engineering, legal, insurance and administrative solutions. The schedule includes six extended tutorial workshops on such fundamental liability prevention procedures as organization, design review, contracts and disclaimers, and labels and advertising. A wind-up session will consist of a panel discussion on "Preparing for Product Recall."

Registration and program information may be obtained from the PLP-73 Secretary, Newark College of Engineering, 323 High Street, Newark, New Jersey 07102.

RELIABILITY PHYSICS SYMPOSIUM THUMBNAIL SUMMARY (Continued)

Typical of the screen test techniques described are:

- . A linearity test for resistors to detect abnormal non-linearities that signal latent defects,
- . Use of the field oxide test transistor on MOS wafers as a vehicle to determine the extent of lateral charge spreading,
- . Reflectivity measurement to establish condition of surfaces for bonding, die attach, soldering, etc.,
- . A dynamic thermal resistance measurement for IMPATT diodes using pulse techniques.

General Chairman of the highly successful 1973 event was David F. Barber, RADC. H. Nigh, BTL, serving as Program Chairman, was responsible for putting together the entire technical program. Proceedings may be procured from IEEE Headquarters (request catalogue 73CHO 755-9-PHY) at \$9 per copy to IEEE members and \$12 to non-members.

IEEE Central American CONVENTION FIRST Canadian Reliability SYMPOSIUM

The IV Convention of the Central American Section of IEEE will be held August 9-12 in San Salvador, the capital city of El Salvador. Based on the success obtained by last year's Convention, this coming one promises to be a unique meeting both from the technical and social viewpoints.

Specific topics to be discussed during this three-day Conference have been chosen for their timeliness, relevancy and applicability to present and near-future problems at the level of developing nations. The aim of the Organizing Committee has been to give some exposure to areas of increasing concern that are not being widely presented elsewhere. Among the topics included: Television as Educational Tool; Promotion of Electrical Consumption in Rural Areas; Anti-Seismic Provision on Electrical Systems and Maximum Utilization of Prominently Hydro Generating Systems during long draughts.

Dr. Harold Chestnut, the Institute's President, has confirmed his participation. A good attendance is anticipated from Central and South American countries, Mexico, the United States, and Canada, as in past years.

It should be noted that this IEEE gathering offers a rare opportunity to visit the smallest and one of the most progressive countries in the American Continent. Members interested in attending should contact Ing. Carlos Molina, Apartado Postal 186, San Salvador, El Salvador, Central America. English is gladly and freely understood and accepted.

The First Canadian Reliability Symposium has been scheduled for May 11, 1974, at Carleton University, Ottawa, Ontario. Based on the theme of "Reliability - The Key to Future Survival", the Symposium will be hosted by the Ottawa Chapter of the Society of Reliability Engineers. Mr. Hans Reiche will be Acting Chairman.

A Call for Papers has been issued for the following topic areas:

- . Reliability Program Management, effective resource utilization and implementation.
- . Effective reliability design analysis techniques.
- . New device and material evaluation, cost effectiveness analysis techniques.
- . Integrated reliability information systems, software reliability.
- . Case histories of design verification, testing and system performance evaluation.

Interested authors should prepare an abstract of 300 to 800 words accompanied with a biography of 200 to 300 words. October 15, 1973 is the deadline for submission of abstract. Chosen authors will be notified and completed papers, suitable for reproduction, should be submitted by January 15, 1974. Two copies of the title, abstract and biography should be sent to The First Canadian Reliability Symposium, P.O. Box 1412, KANATA, Ontario, KOA 2CO, Canada, Attention: Bruce E. McMillan - Technical Programs.

COBOL COMPILER TESTING AGREEMENT

A new service for testing certain computer programs used by the Federal Government has been initiated by the Department of Defense under an agreement with the National Bureau of Standards, U.S. Department of Commerce. NBS has the central responsibility for assuring efficiency and effectiveness of federal computer usage under Public Law 89-306.

This is the first instance in which the Bureau has called on another agency in pursuing this responsibility. It is also the first major implementation of software quality control testing.

Federal Information Processing Standard (FIPS 21) adapts COBOL as a mandatory standard for use by government activities. Compilers must be tested to see if they conform to the COBOL standard. The testing program will be known as the Federal COBOL Compiler Testing Service (FCCTS). The existing DOD Central COBOL Compiler Testing Facility, operated by the Department of the Navy, has expanded its mission to assume the added responsibility for operation of the government-wide testing service.

The testing service will provide a major facility to Federal data processing installations for validating a compiler against required levels of the Federal COBOL Standard. The National Bureau of Standards has the responsibility for interpretation of the standard. The testing service is a significant step in reducing redundant testing of COBOL compilers and improving compatibility and interchangeability of COBOL programs, as well as improving the quality of COBOL compilers used by Federal ADP installations. Requests for cost reimbursable COBOL compiler validations may be submitted to the FCCTS by government contractors wishing to have a compiler validated for their own purposes; vendors wishing to have a compiler validated in response to a Government RFP; Government Agencies involved in a procurement; or Government Agencies wishing to validate a compiler already in use.

Further information is available from the Office of Technical Information and Publications, NBS, or the Director, Federal COBOL Compiler Testing Service, ADPESO, Department of the Navy.

MAINTAINABILITY

Questionnaire

The Advisory Committee to the IEEE Reliability Professional Group is seeking guidance to direct its activities to improve its dissemination of information and to serve as a catalytic function in the field of reliability and its companion field of maintainability.

As an aid to this process, your cooperation in completing the attached questionnaire regarding your organizational activities in the maintainability/maintenance field would be appreciated. Through the information obtained, it is expected that better insight toward structuring future symposium sessions devoted to the field may be obtained and technology development promoted.

B. L. Retterer
Chairman
Maintainability Committee

MAINTAINABILITY QUESTIONNAIRE

1. Please list key individuals in your organization who are concerned with maintainability techniques or standards development.

<u>Name</u>	<u>Title</u>	<u>Address</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

2. Please identify current projects within your organization that you consider contribute to maintainability state-of-the-art advancement. (Attach project abstract if possible.)

<u>Project Title</u>	<u>Objective</u>	<u>Sponsoring Agency</u>	<u>Completion Date</u>	<u>Principal Investigator</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. Please identify areas within the maintainability/maintenance field which you feel require new or improved standards.

Please return questionnaire to: B. L. Retterer
ARINC Research Corporation
2551 Riva Road
Annapolis, Md. 21401

conferences

- July 23-26 1973 IEEE Conference on Nuclear and Space Radiation Effects (G-NS Radiation Effects Committee, Utah State University), Logan, Utah

- August 9-12 IV Convention, IEEE Central American Section, San Salvador, El Salvador

- August 12-18 1973 (Fifth) Pan American Congress of Mechanical, Electrical & Allied Engineering Branches, Bogota, Colombia

- August 13-17 1973 Intersociety Energy Conversion Engineering Conference (G-AES, G-ED, AIAA, ACS, AIChE, ANS, ASME, SAE), University of Pennsylvania, Philadelphia, Pennsylvania

- August 14-16 Conference on Microwave Semiconductor Devices, Circuits, and Applications (Cornell University, ONR, G-CT, G-ED, G-MTT, Ithaca Section), Cornell University, Ithaca, New York

- August 22-24

PLP-73: 1973 Product Liability Prevention Conference (G-R, Newark College of Engineering, numerous others), Newark College of Engineering, Newark, New Jersey

- September 10-12 IEEE Fifth International Congress of Instrumentation in Aerospace Simulation Facilities, California Institute of Technology, Pasadena, California

- September 24-27 1973 Intersociety Transportation Conference (IEEE, AEA, AIAA, AIIE, ASME, EIC, ORSA, SAE, SNAME, TIMS), Brown Palace Hotel, Denver, Colorado

- September 24-28 Reliability Engineering Seminar, Centre for Management and Industrial Development, CBO International N.V., Rotterdam, Netherlands

- September 25-28

1973 IEEE International Conference on Engineering in the Ocean Environment (Oceanography Coordinating Committee, Seattle Section), Washington Plaza Hotel, Seattle, Washington

CONFERENCES (Continued)

- September 30-October 4 11th Electrical Electronics Insulation Conference, Palmer House, Chicago, Illinois
- October 1-3 International Electrical, Electronics Conference and Exposition (Canadian Region), Automotive Building, Exhibition Park, Toronto, Canada
- November 12-14 44th National ORSA Meeting, Town & Country Hotel, San Diego, California
- November 13-16 Third Symposium on Reliability in Electronics (Scientific Society for Telecommunication), Hungarian Academy of Sciences, Budapest, Hungary
- 1974
- January 29-31 1974 Annual Reliability and Maintainability Symposium (G-R, ASQC, ASME, AIIE, ASM, AIAA, IES), Biltmore Hotel, Los Angeles, California
- April 1-5 1974 IEEE Power Engineering Society Underground Transmission and Distribution Conference, Convention Center, Dallas, Texas
- April 2-4 12th Reliability Physics Symposium (G-R, G-ED), Las Vegas, Nevada
- April 21-24 1974 IEEE International Symposium on Circuit Theory, Sir Francis Drake Hotel, San Francisco, California
- April 22-26 1974 European Conference on Electrotechnics (EUROCON) (Region 8), R.A.I. Congress Centre, Amsterdam, The Netherlands

short COURSES

Newsletter policy with respect to short-course announcements, as established by the AdCom, is to provide publication for information only. No endorsement is implied, and no check on course content or instructor qualifications has been accomplished.

University of Houston

Reliability Technology Theory and Practice: August 27-31. Five days, \$250. Contact: Professor E. J. Henley, University of Houston, Houston, Texas 77004.

Massachusetts Institute of Technology

Optimal Control and Estimation Methods for Engineering Design: August 6-17. Ten days (cost information not provided). Contact: Professor J. Austin, Director, Special Summer Programs, Room E19-356, M.I.T., Cambridge, Massachusetts 02139.

The George Washington University

Configuration Management: August 15-17. Three days, \$230. Contact: Continuing Engineering Education Program, The George Washington University, Washington, D. C. 20006.

New Techniques for Cost Reduction in Acceptance Sampling: August 21-23. Three days, \$230.

System Safety: September 17-21. Five days, \$425.

Working Statistics: September 19-21. Three days, \$225.

Operations Research: September 24-26. Three days, \$225.

publications

From the National Bureau of Standards, available through the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402:

Frequency Stability Specification and Measurement: High Frequency and Microwave Signals, NBS Tech Note 632, SD Catalog No. C13.46:632, 70 pages, \$0.65.

Methods of Measurement for Semiconductor Materials, Process Control, and Devices (Quarterly Report July 1-September 30, 1972), NBS Tech Note 754, SD Catalog No. C13.36:754, 55 pages, \$0.80.

Tabulation of Voluntary Standards and Certification Programs for Consumer Products, NBS Tech Note 762, SD Catalog No. C13.46:762, 119 pages, \$1.25.

An Index of U.S. Voluntary Engineering Standards-Supplement 1, NBS Special Publication 329 Supplement 1, SD Catalog No. C13.10:329 Suppl. 1, 459 pages, \$8.25.

Metric Conversion Card - (Reissue), NBS Special Publication 365 (a wallet card), SD Catalog No. C13.10:365, \$0.10.

Electrical Engineering Units and Constants, NBS Special Publication 368 (a wallet card -- supersedes NBS Misc. Publ. 268), SD Catalog No. C13.10:368, \$0.10.

From the IEEE Press, 345 East 47th Street, New York, N.Y. 10017:

Laser Theory, edited by Frank S. Barnes of the University of Colorado. A compendium of the principal resource papers on the various aspects of the theory of lasers. 480 pages; Member Edition (paperbound) \$7.50; clothbound edition \$14.95 (\$11.20 for IEEE members).

From IEEE:

IEEE Std. 91-1973, Graphic Symbols for Logic Diagrams (ANSI Y 32.14-1973), \$6.00.