COURSE STRUCTURE AND SYLLABI OF M. Tech. PROGRAMME

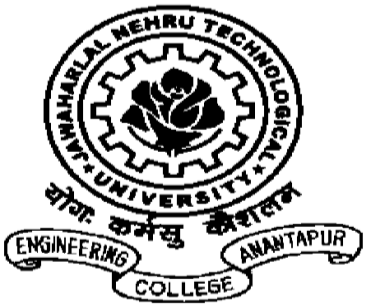
in

RELIABILITY ENGINEERING

(An Interdisciplinary Course)

(From Academic Year 2015-16)

Board of Studies meeting during 25th & 26th April 2015



Department of Electrical Engineering
JNTUA College of Engineering (Autonomous)

INFORMATION ON THE COURSE

1.0 Details about the Course.

1.1 Name of the Course (s)

Name of Degree/ Diploma	Name of Specialization	Intake (Full/Part time) to be started	Year of Starting	Duration (Total)	Name of Degree & Branch eligible for admission
M. Tech.	Reliability Engineering	18 Regular + 07 Sponsored	2009	2 Years	Any Branch B. Tech/B. E

1.2 Course Structure and scheme of evaluation (Semester-wise)

Name of the Subject	Hrs./Week			Evaluation (Marks)		
	L	P	C	Internal	External	Total
I-SEMESTER						
1. 15D24101 System Reliability Concepts	4	-	4	40	60	100
2.15D24102 Life Testing & Reliability	4	-	4	40	60	100
Estimation	4	-	4	40	60	100
3. 15D24103 Statistical Quality Control	4	-	4	40	60	100
4. 15D24104 Stochastic Processes						
5.Elective-I	4	-	4	40	60	100
15D24105 Software Reliability	4	-	4	40	60	100
15D24106 Reliability in Engineering Design						
6. Elective-II	4	-	4	40	60	100
15D24107 Information Security	4	-	4	40	60	100
15D22102 Advanced Digital Signal Processing						
RE Any other Elective Subject offered by any other Engineering Department with prior permission from Chairman BoS, and CAC of the college	-	4	2	40	60	100
7. 15D24108 Reliability Tools Lab						
II-SEMESTER						
1. 15D24201 Six Sigma Concepts	4	-	4	40	60	100
2. 15D24202 Risk Assessment and Management	4	-	4	40	60	100
3. 15D24203 Maintenance Engg & Management	4	-	4	40	60	100
4. 15D24204 Reliable & Fault Tolerant Computing	4	-	4	40	60	100
5. Elective-I						
15D24205 Reliability Optimization	4	-	4	40	60	100
15D24206 Monte Carlo Simulation	4	-	4	40	60	100
6. Elective-II						
15D21201 Power System Reliability	4	-	4	40	60	100
15D22203 Intelligent Algorithms	4	-	4	40	60	100
RE Any other Elective Subject offered by any other Engineering Department with prior permission from Chairman BoS, and CAC of the college						
7. 15D54201 Research Methodology(Audit Course)						
8. 15D24207 Reliability Testing Lab	2	-	0			
	-	4	2	40	60	100
III SEMESTER	**T**	**P**	**C**			
15D24301 Seminar - I	-	4	2			
IV SEMESTER	**T**	**P**	**C**			
15D24401 Seminar - II	-	4	2			
III & IV SEMESTERS						
15D24302 Project Work	-	-	44			

15D24101 SYSTEM RELIABILITY CONCEPTS

UNIT-I: Basic Probability Theory
Basic concepts – Rules for combining Probabilities of events – Failure Density and Distribution functions – Bernoulli's trials – Binomial distribution – Expected value and standard deviation for binomial distribution – Examples.

UNIT-II: Network Modeling and Reliability Evaluation
Basic concepts – Evaluation of network Reliability / Unreliability – Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability / Unreliability using conditional probability method – Paths based and Cutset based approach – complete event tree and reduced event tree methods - Examples.

UNIT-III: Time Dependent Probability
Basic concepts – Reliability functions f(t), F(t), R(t), h(t) – Relationship between these functions – Baths tubs curve – Exponential failure density and distribution functions - Expected value and standard deviation of Exponential distribution – Measures of reliability – MTTF, MTTR, MTBF – Evaluation of network reliability / Unreliability of simple Series, Parallel, Series-Parallel systems - Partially redundant systems - Evaluation of reliability measure – MTTF for series and parallel systems – Examples.

UNIT-IV: Discrete Markov Chains & Continuous Markov Processes
Basic concepts – Stochastic transitional Probability matrix – time dependent probability evaluation – Limiting State Probability evaluation – Absorbing states – Markov Processes-Modelling concepts – State space diagrams – time dependent reliability evaluation of single component repairable model – Evaluation of Limiting State Probabilities of one, two component repairable models – Frequency and duration concepts – Frequency balance approach - Examples.

UNIT-V: Multi Component & Approximate System Reliability Evaluation
Recursive relation for evaluation of equivalent transitional rates, cumulative probability and cumulative frequency and 'n' component repairable model - Series systems, Parallel systems, Basic reliability indices – Cutset approach – Examples.

Text Book:

1. System Reliability Concepts by V. Sankar, Himalaya Publishing House, 2015.

Reference Books:

1. Reliability Evaluation of Engineering Systems by Roy Billinton and Ronald N. Allan, Reprinted in India B. S. Publications, 2007.
2. Reliability Engineering by E. Balagurusamy, Tata McGraw Hill, 2003.
3. Reliability and Maintainability Engineering by Charles E. Ebeling, Tata McGraw Hill, 2000.
4. Probability concepts in Electric Power system – G.J.Anders- 1st edition –1990 – John wiley & sons.

15D24102 LIFE TESTING & RELIABILITY ESTIMATION

UNIT-I

Probability Distribution Functions - Discrete distributions - Uniform distribution, Marginal Distribution, Negative binomial distribution and Geometric distribution. Continuous distribution - Exponential distribution, double exponential, Rayleigh distribution, Weibull distribution, Gamma distribution, Beta distribution, Pareto distribution, Normal distribution and lognormal distribution - Sampling distribution - Correlation – The concept of Correlation, measuring correlation - Auto and cross correlation functions – Properties.

UNIT-II

Interval Estimation - Unbiased Estimators, Interval Estimates (Confidence Intervals), Prediction Intervals, Central Limit Theorem, Parametric Bootstrap Estimation - Parameter estimation - Unbiased estimators - Point estimators - Properties of point estimators - Maximum likelyhood estimation - Bayes estimation - Mean Square estimation - Linear mean square estimation - Examples.

UNIT-III Reliability Life Testing Methods

Reliability Life Testing - Test time calculations, Burn-in testing, Acceptance testing, accelerated life testing and Experimental Design - Reliability Growth Testing - Growth process, Idealized growth curve and other growth modals. Goodness of Fit tests - Chi-square goodness of fit test, Bartlett's test for the exponential distribution, Mann's test for the weibull distribution, kolmogorov smirnov test for normal and lognormal distributions and tests for the power law process model.

UNIT-IV

Baye's testing and Testing Hypotheses - Terminology in Statistical Tests of Hypotheses, Hypothesis Tests: Means, Hypothesis Tests: Proportions, Hypothesis Tests for Difference between Two Means: Small Samples - Known, Hypothesis Test with Paired Samples, Hypothesis Tests: Variances, Hypothesis Tests for Independence, Homogenity, and Goodness of Fit.

UNIT- V

Non-Parametric Methods - Introduction, The Sign Test, Nonparametric Bootstrap Estimation, The Sign Test for Paired Data, The Wilcoxon Signed - Rank Test, Wilcoxon – Mann -Whitney (WMW) Rank Test for Two Samples, Spearman Rank Order Correlation Coefficient, Kendall's Rank Correlation Coefficient (t), Nonparametric Tests for Regression, Nonparametric Tests for ANOVA, Runs Test and Randomization Tests.

Reference Books:

1. E Balagurusamy, Reliability Engineering, Tata McGraw-Hill.
2. S. K. Sinha, Reliability and Life Testing, Wiley Eastern Ltd., 1986.
3. Charles E. Ebeling, Reliability and Maintainability Engineering, Tata McGraw-Hill.
4. Ronald Deep, Probability and Statistics, Elsevier Publishers.

15D24103 STATISTICAL QUALITY CONTROL

UNIT-I: QUALITY CONTROL

Quality, quality control, factors affecting quality, methods of control, chance causes and assignable causes. Quality control and Quality assurance, Quality Costs, Organization for quality, Quality circles, and Statistical process control.

UNIT-II: CONTROL CHARTS

Statistical process control –Control charts for variables and attributes. Process and machine capabilities. 6 sigma concept.

UNIT-III: ACCEPTANCE SAMPLING:

Types of sampling, sampling inspection, inspection by Attributes and Variables, Role of acceptance sampling , Procedure for sampling inspection, single, double, multiple sequential sampling plans, O.C. Curves, quality indices for acceptance sampling plans , acceptance sampling by attributes, AQL , LTPD , AOQL – Sampling plans.

UNIT-IV: TOTAL QUALITY MANAGEMENT

Quality management system, Definition of TQM, Principles of TQM, Organizational structure of TQM, Total quality control, Total employee involvement, Bench marking –Principles and Procedures, ISO9000 and quality management system. ISO9000 series, quality audits.

UNIT-V: TOOLS AND TECHNIQUES FOR TQM

Ishikawa diagrams, Pareto diagrams, Histograms, Scatter diagrams, Process Flow Diagram, Check Sheet, Stratification, Quality Function Deployment- House of quality, procedure to carry out QFD, Failure Mode and Effects Analysis, Fault tree analysis, Poka-Yoke, Continuous Process Improvement – Kaizen, PDCA Cycle. House Keeping – 5S principles.

REFERENCE BOOKS

1. Jain K.C. & Chitale. A.K., Quality Assurance and TQM- Khanna Publisher, 1998.
2. Sharma S.C., Inspection, Quality control and Reliability- Khanna Publishers, 1998.
3. Srinath L.S., Reliability Engineering – Affiliated East West Press, 1975.
4. Juran.J.M. & Frank.M.Gryna - Quality Planning and Analysis TMH, 1995.
5. Egene L., Grant and Others, Statistical Quality Control – McGraw Hill, 1988.

15D24104 STOCHASTIC PROCESSES

UNIT-I

Random Variables, Distribution Functions, Discrete Random Variables-Joint Probability Mass Functions, Continuous Random Variables-Joint Probability Density Functions, Conditional Distributions, Conditional Means and Conditional Variances, N-Variate Random Variables, Special Distributions-Examples, Functions of Random Variables, Expectation and Limit Theorems-Functions of One Random Variables-Functions of Two Random Variables-Functions of n Random Variables-Expectation-Moment Generating Functions-Characteristic Functions-The Laws of Large Number and the Central Limit Theorem-Examples.

UNIT-II

Stochastic Processes-Definitions-Expectations-Vector process-Gaussian process-Harmonic process-Stationary process-Scalar process, Vector process, Correlation length-Ergodic process-Statistical properties of time averages, Temporal density estimation-Poisson process-
Compound Poisson process-Markov process-Examples.

UNIT-III

Stochastic Calculus-Modes of convergence-Stochastic differentiation-Statistical properties of derivative process, Spectral analysis of derivative processes. Stochastic integration-Statistical properties of stochastic integrals, Integration of weakly stationary processes, Riemann–Stieltjes integrals. Itô calculus-Brownian motion, Itô and Stratonovich integrals, Itô and Stratonovich differential equations, Itô's lemma, Moment equations-Examples.

UNIT-IV

FokkerPlanck–Kolmogorov Equation-Chapman–Kolmogorov equation Derivation of the FPK equation-Derivation using Itô's lemma-Solutions of FPK equations for linear systems-Short-time solution-Improvement of the short-time solution. Path integral solution-Markov chain representation of path integral. Exact stationary solutions- Examples. Kolmogorov Backward Equation-Derivation of the backward equation-Reliability formulation-First-passage time probability.

UNIT-V

Structural Reliability-Modes of failure-Level crossing-Single level crossing, Method of counting process, Higher order statistics of level crossing, Dual level crossing, Local minima and maxima, Envelope processes-Vector process-First-passage reliability based on level crossing-First-passage time probability – general approach-Example of SDOF linear oscillators, Common safe domains, Structural fatigue-S-N model, Rainflow counting, Linear damage model, Time-domain analysis of fatigue damage-Dirlik's formula for fatigue prediction, Case studies of fatigue prediction-Examples.

REFERENCE BOOKS:

1. Jian-Qiao Sun, Stochastic Dynamics and Control, Elsevies Publishers.
2. Papoulis, Probability, Random Variables, and Stochastic Processes, McGraw-Hill.
3. Hwei P. Hsu, Probability, Random Variables, and Random Processes, Schaum's Outline Series, McGraw-Hill.

15D24105 SOFTWARE RELIABILITY

UNIT-I: Introduction and Operational Profile

The Need for Reliable Software, Software Reliability Engineering Concepts, Basic definitions, Software practitioners biggest problem, software reliability engineering approach, software reliability engineering process, defining the product, Reliability concepts, software reliability and hardware reliability, developing operational profiles, applying operational profiles, learning operations and run concepts.

UNIT-II: Software Reliability Concepts

Defining failure for the product, common measure for all associated systems, setting system failure intensity objectives, determining develop software failure intensity objectives, software reliability strategies, failures, faults and errors, availability, system and component reliabilities and failure intensities, predicting basic failure intensity.

UNIT-III: Software Reliability Modeling Survey

Introduction, Historical Perspective and Implementation, Exponential Failure Time Class of Models, Weibull and Gamma Failure Time Class of Models, Infinite Failure Category Models, Bayesian Models, Model Relationship, Software Reliability Prediction in Early Phases of the Life Cycle, software reliability growth modeling.

UNIT-IV: Software Metrics for Reliability Assessment

Introduction, Static Program Complexity, Dynamic Program Complexity, Software Complexity and Software Quality, Software Reliability Modeling.

UNIT-V: Software Testing and Reliability

Introduction, Overview of Software Testing, Operational profiles, Time/Structure Based Software Reliability Estimation, Benefits and approaches of SRE, SRE during requirements phase, SRE during implementation phase, SRE during Maintenance phase.

Text Books

1. Handbook of Software Reliability Engineering Edited by Michael R. Lyu, published by IEEE Computer Society Press and McGraw-Hill Book Company.
2. Software Reliability Engineering John D. Musa, second edition Tata McGraw-Hill.

Reference Books

1. Practical Reliability Engineering, Patric D. T. O connor 4th Edition, John Wesley & Sons, 2003.
2. Fault tolerance principles and Practice, Anderson and PA Lee, PHI, 1981.
3. Fault tolerant computing-Theory and Techniques, Pradhan D K (Ed.): Vol 1 and Vol 2, Prentice hall, 1986.
4. Reliability Engineering E. Balagurusamy, Tata McGrawHill, 1994.

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15D24106 RELIABILITY IN ENGINEERING DESIGN

UNIT-I: **Failure Mode and Effect Analysis (FMEA)**
Basic Principles and General Fundamentals of FMEA Methodology- FMEA according to VDA 86- Example of a Design FMEA according to VDA 86- FMEA according to VDA 4.2- Example of a System FMEA Product according to VDA 4.2- Example of a System FMEA Process according to VDA 4.2.

UNIT-II: Fault Tree Analysis (FTA)
General Procedure of the FTA- Qualitative Fault Tree Analysis- Quantitative Fault Tree Analysis- Reliability Graph- Examples.

UNIT-III: Design of Experiments
Analysis of Variance Technique-Strategy of Experimental Design-t test-one and two sample test-F test-one factor at a time-power of analysis of variance tests-Orthogonal design. Completely Randomized design-Randomized Block Design-Latin Square Design-Graeco Latin Squares-Two Factor analysis of variance-Factorial Experiments. Three Factor Experiments-Factorial Experiments in a Regression setting-Incomplete Blocks Design.

UNIT-IV: Product Liability and Planning
History-Product Safety Law-Product Liability Law-Defenses-proof and the Expert Witness-Financial Loss- The future of product Liability- Prevention- Degree of Novelty of a Product, Product Life Cycle, Company Goals and Their Effect. Solution Finding Methods- Conventional Methods, Intuitive Methods, Discursive Methods, Methods for Combining Solutions- Examples.

UNIT-V: Product Development Process
General Problem Solving Process- Flow of Work During the Process of Designing- Activity Planning, Timing and Scheduling, Planning Project and Product Costs, Effective Organization Structures- Interdisciplinary Cooperation, Leadership and Team Behaviour.

REFERENCE BOOKS:

1. G. Haribaskaran, Probability, Queuing Theory & Reliability Engineering, Laxmi publications, Second Edition.
2. D. H. Besterfield, Glen H. Besterfield and M. Besterfield-Sacre, Total Quality Management, Pearson Publications, Third Edition.
3. E. Walpole, H. Myers and L. Myers, Probability and Statistics for engineering and Scientists, Pearson Publications, Eighth Edition.
4. Brend Bretsche, Reliability in Automotive and Mechanical Engineering, Springer Publications.
5. G. Pahl, W. Bietz, J. Feldhusen and K. H. Grote, Engineering Design a Systematic approach, Springer Publications, Third Edition.

15D24107 INFORMATION SECURITY

UNIT-I

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

UNIT-II

Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, Key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC.

UNIT-III

Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service. Email privacy: Pretty Good Privacy (PGP) and S/MIME.

UNIT-IV

IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management, Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET)

UNIT-V

Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3, Intruders, Viruses and related threats, Firewall Design principles, Trusted Systems, Intrusion Detection Systems

TEXT BOOKS:

1. Network Security Essentials (Applications and Standards); William Stallings, PEA.
2. Hack Proofing your network; Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W.Manzuik and Ryan Permeh, wiley Dreamtech,

REFERENCES:

1. Fundamentals of Network Security; Eric Maiwald, Dreamtech.
2. Network Security - Private Communication in a Public World; Charlie Kaufman,
3. Radia Perlman and Mike Speciner, PEA/PHI.
4. Cryptography and network Security, Stallings, 3e, PHI/PEA.
5. Principles of Information Security, Whitman, Thomson.
6. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
7. Introduction to Cryptography, Buchmann, Springer.

15D22102 ADVANCED DIGITAL SIGNAL PROCESSING

UNIT-I:

Short introduction, Analog to digital and Digital to Analog conversion, sampled and Hold circuit, Continuous time Fourier Transforms. Discrete-time signals and systems, Discrete-time Fourier transform- its properties and applications, Fast Fourier Transform (in time-domain and Frequency domain) , IDFT and its properties.

UNIT-II: z- Transforms

Definition and properties, Rational z-transforms, Region of convergence of a rational z- Transform, The inverse z- Transform, Z-Transform properties, Computation of the convolution sum of finite-length sequences, The transfer function.

Digital Filter Structures: Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

UNIT III: **IIR Digital Filter Design:**

Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter, IIR digital filter design using MATLAB, Computer aided design of IIR digital filters.

UNIT IV:FIR Digital Filter Design:

Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters, FIR digital filter design using MATLAB, Design of computationally efficient FIR digital filters.

UNIT V: Analysis of Finite word length effects:

The quantization process and errors, quantization of Fixed point numbers, Quantization of floating point numbers, Analysis of coefficient quantization effects, Analysis of arithmetic round off errors, Low sensitivity digital filters, Reduction of product round off errors using error feedback, Round off errors in FFT algorithms. The basic sample rate alteration devices, Multi rate structures for sampling rate conversion, Multistage design of decimator and interpolator, The Polyphase decomposition, Arbitrary-rate sampling rate converter, Nyquist Filters and some applications of digital signal processing.

Text Books:

1. S.K. Mitra**, Digital Signal Processing**-, Tata McGraw-Hill, Third Edition, 2006.

2. B.P. Lathi, **Principle of Signal Processing and Linear Systems**-, Oxford International Student Version, 2009

3. M. Mondal and A Asif, **Continuous and Discrete Time Signals and Systems**, Cambridge, 2007

References:

1. Li Tan, **Digital Signal Processing- Fundamentals and Applications**-, Indian reprint, Elsevier, 2008.

2. Alan V. Oppenheim, Ronald W. Schafer, and John R.Buck, **Discrete- Time Signal Processing**-, Pearson Edu, 2008.

15D24108 RELIABILITY TOOLS LAB

CYCLE-I: DEMO EXPERIMENTS

1. **MATLAB Commands and Examples**
2. **Built-in functions**

RELIABILITY SOFTWARE MODULES

3. **SPARE Software package**
4. **Failure Mode Software Package**
5. **FMEA-RPN Software package**
6. **SPC Software package**

CYCLE-II: TESTING PROGRAMS

1. **Characteristics of Binomial and Poisson distributions**
2. **Characteristics of Exponential and Weibull distributions**
3. **Characteristics of Normal and Log-Normal distributions**
4. **Determination of MTTF for series and parallel systems**
5. **Evaluation of Limiting State Probabilities (LSPs)**
6. **Evaluation of basic probability indices for series and parallel systems**
7. **Parametric Boot-Strap estimation and finding best parameters**
8. **Chi-Square Goodness of Fit**
9. **Determination of Covariance, Correlation and Cross-Correlation coefficients**
10. **Neural Network design to Block box models**
11. **Testing of sampling methods**
12. **Characteristics of Histogram, Scatter diagram, Process Flow diagram and Pareto diagram**

15D24201 SIX SIGMA CONCEPTS

UNIT-I:

Introduction to Six-Sigma-Probabilistic models-Six Sigma measures-Yield-DPMO-Quality level-Reliability function using Six-Sigma-MTTF using Six Sigma-Maintenance free operating period- Availability using Six-Sigma-Point availability-Achieved availability-Operational Availability-Examples.

UNIT-II:

The Elements of Six Sigma and their Determination-The Quality Measurement Techniques: SQC, Six Sigma, Cp and Cpk- The Statistical quality control (SQC) methods-The relationship of control charts and six sigma-The process capability index (Cp)-Six sigma approach-Six sigma and the 1.5 σ shift-The Cpk Approach Versus Six Sigma-Cpk and process average shift-Negative Cpk-Choosing six sigma or Cpk-Setting the process capability index-Examples.

UNIT-III:

Calculating Defects Using Normal Distribution-Relationship between *z* and Cpk-Example defect calculations and Cpk-Attribute processes and reject analysis for six sigma-Quick visual check for normality-Checking for normality using chi-square tests-Example of x^2 goodness of fit to normal distribution test-Transformation data into normal distributions-The use of statistical software for normality analysis-Examples.

UNIT-IV:

Basic QC and Six Sigma Tools-The 7 QC Tools-Process Flowchart and Process Mapping-Quality Function Deployment (QFD)- Six Sigma and Design of Experiments (DoE)-DoE Definitions and Expectations-DoE objectives and expectations- DoE Techniques-Steps in conducting a successful DoE-experiment - Types of DoE using orthogonal arrays-Two-level orthogonal arrays-Three-level orthogonal arrays- The Taguchi design-The DoE Analysis Tool Set - Orthogonal array L9 saturated design- Bonding process optimization- Examples.

UNIT-V:

Introduction - Product Life Cycle and the Six Sigma Design-Quality Issues-Changes in product design-Changing traditional design communications and supplier involvement-Design process communications needs-Examples.

REFERENCE BOOKS:

1. U Dinesh Kumar, Crocker, Chitra and Harithe Saranga, Reliability and Six Sigma, Springer Publishers.
2. Sung H. Park, Six Sigma for Quality and Productivity Promotion, Asian Productivity Organization
3. Sammy G. Shina, Six Sigma for Electronics Design and Manufacturing, McGraw-Hill.

15D24202 RISK ASSESSMENT AND MANAGEMENT

UNIT- I:

Basic concepts of Risk-Analysis-Process-planning and Assessment-Risk treatment-Risk analysis methods-Coarse Risk Analysis-Job Safety Analysis-FMEA-Hazard and Operability Studies-SWIFT-Bayesian networks.

UNIT-II:

Human Reliability-Human Errors-Characteristics-Modes of Error detection-Human and Technical reliability-Task Performance-Human Reliability Assessment techniques-Technique for Human error Rate Prediction (THERP)-Human performance data-Human Reliability Enhancement. Human error in maintenance-System Life Cycle-Reasons for maintenance error-Reducing human errors-Prediction techniques-Markov model-Fault Tree Analysis-Examples.

UNIT-III:

Terotechnology-Definitions-System-Process-Programmes-Total Productive maintenance-Strategies-Training Programmes-for project operation managers-maintenance supervisors.

UNIT-IV:

Risk management-Objectives-Definitions-Process-Risk Identification and Approaches-Risk Statement-Risk Prioritization-Borda Algorithm-Value function approach-Ranking-Risk events-Additive value model-Formulations-Incorporating uncertainty-models-Progress monitoring. Spare Parts Management-Inventory Control-Functional Classifications-Advantages-Features-Economic order quantity and its model-Inventory Control approaches-Multi item Inventory control-Classifications-Man power resource and Spares requirement planning-Flow chart-Examples.

UNIT-V:

Verification and Validation-Basic concepts-Management-Planning-Requirements-Systems approaches-Managing Plan-Effectiveness measures-Risk management-Flow Chart-Communication Structures-Internal and Independent information flows. Life Cycle Analysis-Traceability Analysis-Interface Analysis-Phase dependent analysis-Testing-Hierarchy of test documents.

REFERENCE BOOKS:

1. Terje Aven, Risk Analysis Assessing Uncertainties beyond Expected Values and Probabilities, John Wiley and Sons Publication.
2. Sue Cox and Robin Tait, Safety, Reliability and Risk Management: an integrated approach, Second edition, Butterworth-Heinemann Publications.
3. B. S. Dhillon, Engineering Maintenance A Modern Approach, CRC Press.
4. A. K. Gupta, Reliability, Maintenance and Safety Engineering, University Science Press.
5. Analytical Methods for Risk Management A Systems Engineering Perspective, Paul R. Garvey, CRC Press.
6. Marcus S. Fisher, Software Verification and Validation an Engineering and Scientific Approach, Springer Publishers.

15D24203 MAINTENANCE ENGINEERING AND MANAGEMENT

UNIT-I:
Maintenance engineering objectives-Basic principles and approaches-Types of maintenance-Specifications and functions-Systems approach-performance indices-planning and control-Strategy.

UNIT-II:
Maintenance management and control-functions and organization-critical maintenance-effective elements-project control methods-control indices - Maintainability-Concepts-tasks-modeling and allocation-prediction-FMECA-reliability and maintainability trade off-Design for maintainability-design methods. .

UNIT-III:
Preventive maintenance-elements and principle-measures-mathematical models-Advantages and disadvantages - Corrective maintenance-types-measures-mathematical models-effective failure rate equations - Reliability Centered Maintenance-goals and principles-components-predictive testing and Inspection techniques-effective measurement indicators-Advantages.

UNIT-IV:
Quality in Maintenance-Processes-Control Charts-Post maintenance testing-Maintenance Safety-maintenance tasks-improving safety-personnel safety.

UNIT-V:
Maintenance costing-factors-budget type and approaches-labor cost estimation-material cost estimation-cost estimation model-cost related indices-economic analysis-Convex and Concave costs-profit and life cycle cost trade offs.

REFERENCS BOOKS:

1. A. K. Gupta, Reliability, Maintenance and Safety Engineering,
2. B. S. Dhillon, Engineering Maintenance A Modern Approach, CRC Press.
3. Charles E. Ebeling, Reliability and Maintainability Engineering, Tata McGraw Hill, 2000.

15D24204 RELIABLE & FAULT TOLERANT COMPUTING

UNIT-I:

Introduction - Definitions - Organization and Intended Use - Means to Achieve Dependable Software - Fault Avoidance or Prevention - Fault Removal - Fault/Failure Forecasting - Fault Tolerance - Types of Recovery - Backward Recovery - Forward Recovery - Software Fault Tolerance - Acceptance Tests - Single-Version Fault Tolerance – Wrappers - Software Rejuvenation - Data Diversity - Software Implemented Hardware Fault Tolerance (SIHFT) - *N*-Version Programming - Consistent Comparison Problem – Version - Independence - Recovery Block Approach - Basic Principles - Success Probability Calculation - Distributed Recovery Blocks - Preconditions, Post Conditions, and Assertions - Exception-Handling - Requirements from Exception-Handlers - Basics of Exceptions and Exception-Handling - Language Support.

UNIT-II:

Checkpointing - Checkpointing Nontrivial - Checkpoint Level - Optimal Checkpointing – An Analytical Model - Time Between Checkpoints - A First-Order Approximation – Optimal Checkpoint Placement - Time Between Checkpoints - A More Accurate Model – Reducing Overhead - Reducing Latency - Cache-Aided Rollback Error Recovery (CARER) - Checkpointing in Distributed Systems - The Domino Effect and Livelock - A Coordinated Checkpointing Algorithm - Time-Based Synchronization - Diskless Checkpointing - Message Logging - Checkpointing in Shared-Memory Systems - Other Uses of Checkpointing.

UNIT-III:

Fault Detection Methods – Fault Models – Basic Models – Process Models – Theoretical and Experimental Modeling – Static Process Models – Linear Dynamic Process Models – Signal Models - Harmonic Oscillations – Signal Oscillations – Superposition – Amplitude Modulation – Frequency and Phase Modulation – Beating (Libreation) – Characteristics – Stochastic Signals – Fault Detection with Limit Checking – Limit Checking of Absolute Values – Trend Checking –Examples.

UNIT-IV:

Fault Diagnosis with Classification Methods – Simple Pattern Classification Methods – Bayes Classification – Geometric Classifiers – Polynomial Classification – Decision Trees – Fault Tolerant Systems – Fault Tolerant Design – Basic Redundant Structures – Degradation Steps – Fault Tolerant Components and Control – Fault Tolerant Sensors – Fault Tolerant Actuators – Communication – Fault Tolerant Control Systems - Examples.

UNIT-V:

Hardware Fault Tolerance – Voters - Variations on *N*-Modular Redundancy - Duplex Systems - Fault-Tolerance Processor-Level Techniques - Watchdog Processor - Simultaneous Multithreading for Fault Tolerance - Byzantine Failures - Byzantine Agreement with Message Authentication – Examples.

REFERENCE BOOKS:

1. Laura L. Pullum, Software fault Tolerance Techniques and Implementation, Artech House Publishers.
2. Israel Koren and C. Mani Krishna, Fault Tolerant Systems, Morgan Kaufmann Publishers is an imprint of Elsevier.
3. Rolf Isermann, Fault-Diagnosis Systems An Introduction from Fault Detection to Fault Tolerance, Springer Publishers.

15D24205 RELIABILITY OPTIMIZATION

UNIT-1:
Partially redundant systems-Standby redundant systems-redundancy concepts-perfect switching-imperfect switching-standby redundancy calculations-Component versus unit redundancy-Weakest-Link Technique-Mixed Redundancy-Redundancy Optimization-Double Failures and Redundancy.

UNIT-II:
Systems Model-Statement of the various optimization problems- Heuristic Methods applied to optimal systems reliability-A heuristic method : Sharma And Venkateswran's Approach, Aggrawal's Approach, Mishra's Approach, Ushakov's Approach, Nakagawa and Nakashima's Approach.

UNIT-III:
Dynamic programming applied to optimal systems reliability-Basic dynamic programming approach-Dynamic programming approach using Lagrange multipliers-The discrete maximum principle applied to optimal systems reliability-Sequential unconstrained minimization technique(SUMT) applied to optimal systems reliability-Generalized reduced gradient method(GRG) applied to optimal Systems reliability.

UNIT-IV:
Method of Lagrange multipliers-single constraint problem-single linear constraint problem-two linear constraint problem-Generalized Lagrangian function method applied to optimal systems reliability-Generalized Lagrangian problem-computational procedures- KUHN-TUCKER conditions in optimal systems reliability and for the two linear constraint problem-
The geometric programming applied to optimal systems reliability- Examples.

UNIT-V:
Integer programming applied to optimal systems reliability-Introduction-The partial Enumeration method-The Gomory Cutting plane method-The branch and bound method-The Geoffrion Implicit Enumeration method-Parametric method-Linear programming-Separable Programming Methods-Examples.

REFERENCE BOOKS:
1. F. A. Tillman, C. V. Hwang & W. Kuo, Optimization of Systems Reliability, Marcel Dekker Inc.
2. S. S Rao, Engineering Optimization Theory and Practice, New Age International Publications, Third edition.
3. E. Balagurusamy, Reliability Engineering, Tata McGraw-Hill Publishing Company Limited.
4. J. K. Sharma, Operations Research Theory and Appliactions, Macmillan Publications, 4th Edition.

15D24206 MONTE CARLO SIMULATION

UNIT-I:

Basic concepts-Features-Efficiency-Convergence Characteristics-Random number generation-Linear Congruential generators-Random variate generation-Inverse Transform method-Tabulating technique- Generating random numbers from discrete distributions- Binomial Distribution- Poisson Distribution-Geometric Distribution-Negative Binomial Distribution-Hypergeometric Distribution-Monte Carlo Integration-The Hit or Miss, The Sample-Mean Monte Carlo Methods-Efficiency of Monte Carlo Method-Comparison.

UNIT-II:

Generating random functions from continuous distributions - Exponential Distribution - Gamma Distribution - Beta Distribution - Normal Distribution - Lognormal Distribution - Cauchy Distribution - Weibul Distribution - Chi-Square Distribution-Procedures and Algorithms.

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UNIT-III:

Variance Reduction Techniques-Importance Sampling-Correlated Sampling-Control Variates-Stratified Sampling-Antithetic Variates-Partition of the Region-Reducing the Dimensionality-Conditional Monte Carlo-Random Quadrature Method-Biased Estimators-Weighted Monte Carlo Integration.

UNIT-IV:

Discrete event simulation-Poisson process-Time-dependent Poisson process-Poisson processes in the plane-Markov chains-Discrete-time Markov chains-Continuous-time Markov chains-Regenerative analysis- Markov chains-Bayesian statistics- The Metropolis–Hastings (MH) algorithm- Regenerative Simulation-Point Estimators and Confidence Intervals-Examples of Regenerative Processes-Variance Reduction Techniques- Examples.

UNIT-V:

Monte Carlo Optimization-Random search Algorithms-Efficiency of Random Search Algorithms-Local and Integral Properties of Optimum Trial Random search Algorithm- Global Optimization-A Closed form Solution -Examples.

REFERENCE BOOKS:

1. Roy Billinton and Wenyuan Li, Reliability Assessment of Electric Power Systems Using Monte Carlo Methods, Plenum Press, New York.
2. Reuven Y. Rubinstein, Simulation and The Monte Carlo Method, John Wiley & Sons publishers.
3. J. S. Dagpunar, Simulation and Monte Carlo, John Wiley & Sons Publishers.

15D21201 POWER SYSTEM RELIABILITY

UNIT-I : Generating System Reliability Analysis – I
Generation system model – Capacity outage probability tables – Recursive relation for capacitive model building – Sequential addition method – Unit removal – Evaluation of loss of load and energy indices – Examples.

UNIT-II : Generating System Reliability Analysis – II
Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units – 2-level daily load representation - Merging generation and load models – Examples.

UNIT-III : Bulk Power System Reliability Evaluation
Basic configuration – Conditional probability approach – System and load point reliability indices – Weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.

UNIT-IV : Distribution System Reliability Analysis – I (Radial Configuration)
Basic Techniques – Radial networks – Evaluation of Basic reliability indices, performance indices - Load point and system reliability indices – Customer oriented, loss and energy oriented indices – Examples.

UNIT-V : Distribution System Reliability Analysis - II (Parallel Configuration)
Basic techniques – Inclusion of bus bar failures, scheduled maintenance – Temporary and transient failures – Weather effects – Common mode failures – Evaluation of various indices – Examples.

Text Books:

1. Roy Billinton and Ronald N. Allan, Reliability Evaluation of Power Systems, Plenum Press, New York and London, 2nd Edition, 1996.
2. J. Endrenyi , Reliability Modeling in Electric Power Systems, John Wiley & Sons, 1st Edition, 1978.

15D22203 INTELLIGENT ALGORITHMS

UNIT I: Introduction and motivation. Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule - based systems, the AI approach. Knowledge representation. Expert systems. Data Pre - Processing: Scaling, Fourier transformation, principal - component analysis and wavelet transformations.

UNIT II

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch - Pitts neuron model, simple perceptron, Adaline and Madaline, Feed - forward Multilayer Perceptron. Learning and Training the neural network. Networks: Hopfield network, Self - organizing network and Recurrent network. Neural Network based controller, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab / Neural Network toolbox.

UNIT III

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other than GA search techniques like tabu search and ant - colony search techniques for solving optimization problems.

UNIT IV

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to Fuzzy logic modeling and control of a system. Fuzzification, inference and defuzzification. Fuzzy knowledge and rule bases.

UNIT V

Fuzzy modeling and control schemes for nonlinear systems. Self - organizing fuzzy logic control. Implementation of fuzzy logic controller using Matlab fuzzy - logic toolbox. Stability analysis of fuzzy control systems. Intelligent Control for SISO/MIMO Nonlinear Systems. Model Based Multivariable Fuzzy Controller.

Text Books

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition, 2003.
2. T.J.Ross, Fuzzy logic with Fuzzy Applications, Mc Graw Hill Inc, 1997.
3. David E Goldberg, Genetic Algorithms.

References

1. M.T.Hagan, H. B. Demuth and M. Beale, Neural Network Design, Indian reprint, 2008.
2. Fredric M.Ham and Ivica Kostanic, Principles of Neurocomputing for science and Engineering, McGraw Hill, 2001.
3. N.K. Bose and P.Liang, Neural Network Fundamentals with Graphs, Algorithms and Applications, Mc - Graw Hill, Inc. 1996.
4. Yung C. Shin and Chengying Xu, Intelligent System - Modeling, Optimization and Control, CRC Press, 2009.
5. N.K.Sinha and Madan M Gupta, Soft computing & Intelligent Systems - Theory & Applications, Indian Edition, Elsevier, 2007.
6. John Yen and Reza Langari, Fuzzy logic Intelligence, Control, and Information, Pearson Education, Indian Edition, 2003.
7. Witold Pedrycz, Fuzzy Control and Fuzzy Systms, Overseas Press, Indian Edition, 2008.

15D54201 RESEARCH METHODOLOGY

(Audit Course)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.
Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.
Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text books:

1. **Research Methodology:Methods and Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.**
2. **Research Methodology: A Step by Step Guide for Beginners- Ranjit Kumar, Sage Publications (Available as pdf on internet)**
3. **Research Methodology and Statistical Tools – P.Narayana Reddy and G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.**

REFERENCES:

1. **Scientists must Write - Robert Barrass (Available as pdf on internet)**
2. **Crafting Your Research Future –Charles X. Ling and Quiang Yang (Available as pdf on internet)**

15D24207 RELIABILITY TESTING LAB

CYCLE-I: DEMO EXPERIMENTS

1. **MATLAB Commands and Examples**
2. **Built-in functions**

RELIABILITY SOFTWARE MODULES

3. **Reliability Centered Maintenance**
4. **RELTEST – Reliability Compliance and Determination Testing**

CYCLE-II: TESTING PROGRAMS

1. **Component and Unit Redundancy with Exponential Distribution**
2. **Chi-Square Goodness of Fit**
3. **Optimal Redundancy Calculations**
4. **Calculation of Correlation Co-efficient & Co-efficient of Co-variance**
5. **Control Charts for Variable to obtain the control limits and PCR**
6. **Method of Least Squares to fit the Regression Lines**
7. **ANOVA (Analysis of Variation)**
8. **MLE (Maximum Likely Hood Estimation) of Normal Distribution**
9. **Evaluation of Cumulative probability and Cumulative Frequency of Merged States**
10. **Analysis of Bi-Variant Method**