



The School of Mechanical and Nuclear Engineering

9 ECSA Short Courses in Reliability Engineering

- The School of Mechanical and Nuclear Engineering has identified short learning courses to address Plant Reliability.
- These courses focus on Reliability and its applications for plant availability.
- The aim is to reach the Engineer in practice; especially Production and Maintenance Engineers.
- Modules will contain the applicable theory to integrate into practical problems.
- The objective is to test the attendee's understanding and application of the underlying content.
- Relevant practical reliability improvement case studies test the understanding and ability to utilize and apply the theory and problem solving tools through a project.

Basic Reliability Concepts

Advanced Reliability Concepts

Maintenance Optimisation

Computers in Reliability Engineering and Maintenance

Condition Monitoring

Incident Investigation or Root Cause Analysis

Modern Reliability Management Techniques

Systems Engineering

Reliability Management

Method of Presentation

- Duration for 9 courses: Maximum 2 years
- Distance/contact module via e-learning, enables the learner to participate in well-structured self-study learning activities prior to and after attending the contact lecture session.

Presentation of a course

- 8 week to complete each course
- 1 week compulsory class
- 7 weeks via e-learning
- Assessment on the last day of the eight weeks

Costing model

- Market research – R10 000 for 3 day Reliability course at other institutions
- Our offer
 - R65 900 (excl VAT) for all 9 courses over 2 year period or
 - R13 500 (excl VAT) per single course
 - Includes study material and handbook
 - Excludes accommodation, travel and meals

Reliability Engineering Programme Outcomes

Module 1: Basic Reliability Concepts

- The Importance of Reliability
- Definitions: Reliability, Availability, Maintainability, Component, System, Failure, etc
- Acronyms: LCC, DCF, FRACAS, KPI, MTBF, MTTF, MFOP, MTTR, MDT, FTA, RCA, RTF, FMEA, FMECA, RBD, RCM, TPM, etc
- Basic Statistics: Probability, Distribution Theory, Sampling, Limits of Confidence, the Failure Probability Density Function, Interpretation of Statistical Tables, Linear Regression, Analysis of Variance, Design of Experiments, Taguchi Methods
- Component Reliability
- Weibull Analysis of Components
- The Bathtub curve: Infant Mortality Failures, Random Failures and Wearout Failures
- Reasons for Infant Mortality
- Reasons for Random Failures,
- Types of Wearout Failures
- Examples and Case Studies
- PROJECT: Research or Case Study in some aspect of Component Reliability

Module 2: Advanced Reliability Concept

- System Reliability. The Reliability Block Diagram. System Reliability Prediction
- Maintainability
- Design for Reliability and Maintainability
- Availability. Availability as the synthesis of Reliability and Maintainability
- System Availability. The Availability Block Diagram
- Availability Optimisation. The necessity of Life Cycle Costing (also see Module 7)
- Use of Excel in Availability Studies
- Ways to Increase Availability
- Functions and Failure Modes
- Failure Modes and Effects Analysis
- Failure Modes and Effects Criticality Analysis
- Fault Tree Analysis. The relationship between Fault Tree Analysis and the Reliability Block Diagram
- Simulation. Markov Simulation vs Monte Carlo Simulation
- Laplace Analysis of Maintained Systems
- Examples and Case Studies
- PROJECT: Research Report or Case Study in some aspect of System Reliability

Module 3: Maintenance Optimisation

- Why we maintain – Maintenance as an essential function of Reliability Management
- The Maintenance Paradigm: Know your Plant, Keep it Good as New
- The History of Maintenance: Run to Failure, Scheduled Maintenance based on Failure History, Predictive or Condition-Based Maintenance based on proxies for failure
- Maintenance Policy Documentation. Semantics in Maintenance Management
- Reliability Centred Maintenance (RCM)
- Total Productive Maintenance (TPM)
- Maintenance Management: Planning and Scheduling
- KPI's for Maintenance: The Importance of Wrench Time
- Shutdown, Outage or Turnaround Management: Project Management Principles
- Maintenance Auditing. Internal vs External Audits
- Recording, archiving and the proper use of data (e.g. job cards, failure feedback etc.)
- Examples and Case Studies
- PROJECT: Original Case Study in any of the above

Module 4: Computers in Reliability Engineering and Maintenance

- System Availability Design, etc: Availability Workbench Training (Lecturer to be proposed by AngloGold-Ashanti?)
- Alternative: RAM Commander Training (Lecturer from software company – proposed by E A Bradley)
- FRACAS (Failure Reporting and Corrective Action System) (Lecturer from software company – proposed by E A Bradley)
- CMMS (Computerised Maintenance Management Systems) Review of systems on the market (Proposed Lecturer: Jan Myburg – 012 667 3691 or 082 921 7164)
- The SAP CMMS system (Proposed Lecturer: Jan Myburg – 012 667 3691 or 082 921 7164)
- Exercises and Case Studies
- PROJECT: Original Research or Case Study in FRACAS or a CMMS

Module 5: Condition Monitoring

- The rationale of Condition Monitoring
- Vibration Monitoring – Theory and Applications
- Oil Analysis – Theory and Applications (with specific reference to Total Fluids Management)
- Thermography – Theory and Applications
- Examples and Case Studies
- PROJECT: Investigation on some topic within the Condition Monitoring Field

Module 6: Incident Investigation or Root Cause Analysis (RCA)

- The relationship of RCA to Reliability and Maintenance
- The Importance of Human Reliability. Human Reliability Assessment Techniques
- Cases from around the world: Challenger, Chernobyl, Piper Alpha, various mining disasters etc
- Generic conclusions from the above studies: Operator Errors, Maintenance Errors, Design Errors, Management Errors, etc
- Defect elimination
- Failure mechanisms
- RCA Techniques:
 - The Fives Why's - history of its use and its limitations
 - Kepner Tregoe and its clones – difficulties and advantages
 - The Ishikawa Fishbone Diagram – uses and limitations
 - The Asset Methodology – A nuclear engineering technique of universal applicability
 - The use of Fault Trees in Incident Investigation
 - RCA Apollo method
 - Examples and Case Studies
- PROJECT: Analysis of a mining incident

Module 7: Modern Reliability Management Techniques

- Configuration Management. History. Traditional CM vs CMII. How to apply CM to an existing system (Suggested Lecturer: Carol Cotty - 011 807 5733)
- Getting your point across: The Essentials of Good Report Writing for budget justification etc. Why technical people must improve their communication skills (Suggested Lecturer: E A Bradley)
- ISO 55 000 – The Standard for Asset Management in the 21st Century (Suggested Lecturer – Jan Myburg – 012 667 3691 or 082 921 7164)
- ISO 9000, 14 000 and 18 000: The interface with R&M (Reliability and Maintenance) (Lecturer to be proposed by NW University)
- Systems Engineering and its relationship to Reliability Engineering (Lecturer to be proposed by NW university)
- Hazard and Operability Studies (HAZOP Studies) Suggested Lecturer: Eugene Pininski – 011 800 5882 or 083 650 6049)
- Lubrication and Tribology Fundamentals
- Examples and Case Studies
- PROJECT: Research Report or Case Study in any of the above fields

Module 8: Systems Engineering

- The Systems Engineering Concept
- Managing the Systems Engineering Process. Coordination of the various disciplines
- Design for Reliability
- Design for Maintainability
- Design for Operability
- Design for Logistic Support
- Inventory Optimisation
- Master Data
- Project Management and Control
- Mechanical System Design. Reliability by Design
- Control and Instrumentation Design. Reliability evaluation
- Electrical System Design. Reliability Evaluation
- Examples and Case Studies
- Production optimization (with specific reference to Theory of Constraints)
- PROJECT in Systems Engineering

Module 9: Reliability Management

- The Business of Reliability Management
- Project Management
- Reliability Solution Action Planning and Implementation
- Engagement Skills Training

- Change Management (ADKAR Process)
- Business Case Development
- Financial Management
 - Income Statements
 - Balance Sheets
 - Return on Assets
 - Return on Equity
 - Share Price Performance
 - Life Cycle Costing: History. Discounted Cash Flow. Calculating the Discount Rate.
Prioritisation of Alternatives. Internal Rate of Return vs Net Present Value
- Project in Reliability Management