Thin Specialization in Engineering Systems Reliability

1. **School/Center:** Reliability Engineering Centre
2. **Name of the Thin Specialization:** Engineering Systems Reliability
3. **Brief Description:** UG students with various engineering backgrounds need to design, manufacture, operate and maintain engineering systems/services. Reliability engineering focuses on identification of weaker components/processes in a system and the methods of improvement so that the system becomes more reliable, safer and easily maintainable. Reliability engineering tools are structured, systematic, and objective approaches for quantitative and qualitative performance analysis. This specialization will help students to understand these tools, life testing, field failure data collection and analysis methods. This thin specialization is designed with generic approach so that students from all disciplines get benefited.
4. **Number of Subjects needed to earn the Thin Specialization (3-4 subjects):** 4
5. **Minimum Credits needed to earn the Thin Specialization (10-14 credits):** 12
6. **Structure:**

COMPONENT- I: MANDATORY REQUIREMENT (2 credit FOUNDATION COURSE)

TABLE-I

Sub no. (if it exists)	Name	LTP	Credits	Offering Semester Autumn/ Spring/Both	Existing Or To Be Proposed
1.	Introduction to Reliability Engineering	2-0-0	2	Both	New, Uploaded in ERP for approval

B. COMPONENT- II TWO SUBJECTS (3/4 credits each) FROM TABLE-II

TABLE-II

Sub no. (if it exists)	Name	LTP	Credits	Offering Semester Autumn/ Spring/Both	Existing Or To Be Proposed	Pre-Requisite (if any) Subject/s of Table I or Table-II only
RE60003	Reliability Estimation and Life Testing	3-1-0	4	Autumn	Existing	None
RE60011	Probabilistic Risk Assessment	3-1-0	4	Autumn	Existing	None
RE60024	Software Reliability	3-0-0	3	Spring	Existing	None
RE60018	Fault Diagnosis and Predictive Maintenance	3-0-0	3	Spring	Existing	None
RE60002	Reliability Design	3-1-0	4	Spring	Existing	None

C. COMPONENT- III PROJECT/DESIGN/TERM PAPER (4 credits) OR ONE (4 credit) SUBJECT

TABLE-III *

Sub no. (if it exists)	Name	LTP	Credits	Offering Semester Autumn/ Spring/Both	Existing Or To Be Proposed	Pre-Requisite (if any) Subject/s of Table-II only
1.	Project on System Reliability/Risk Analysis	0-0-6	4	Both	New, Uploaded in ERP for approval	

7. **Additional Remarks, if any:**

   NIL

HOC/HOS/Chairman

Detailed Syllabus

Table I:

SUBJECT NO-RE******, SUBJECT NAME- INTRODUCTION TO RELIABILITY ENGINEERING
LTP- 2-0-0, CRD- 2

SYLLABUS :-

Basic Definitions of reliability and maintainability terms. Failure rates such as constant, increasing and decreasing hazard rates. Reliability Block Diagram, Series, parallel, series-parallel, standby and k-out-of-modeling. Reliability prediction and estimation, Life Testing. The concepts of availability, maintainability, safety, and probabilistic risk of engineering products. Basic concepts of software reliability.

Table II:

SUBJECT NO-RE60003, SUBJECT NAME- RELIABILITY ESTIMATION & LIFE TESTING
LTP- 3-1-0,CRD- 4

SYLLABUS :-

Parameter Estimation, Regression analysis. Interval Estimation procedure for exponential, Gamma, Weibull, Log-normal and Fatigue life models. Point and interval reliability estimation. Testing reliability hypotheses for mean of distribution. Tests for Weibull, distribution, Reliability testing procedure, types of tests, accelerated life tests-parametric and nonparametric methods. Continuously increasing stress tests.

SUBJECT NO-RE60011, SUBJECT NAME- PROBABILISTIC RISK ASSESSMENT
LTP- 3-1-0, CRD- 4

SYLLABUS :-

Concept of risk, objective and scope of risk assessment, probabilistic risk, risk perception and acceptability, Quantitative aspects of risk. Three levels of risk quantification, PRA management, preliminary hazard analysis, HAZOP and HAZAN, FMEA and FMECA analysis, Fault tree Analysis. Digraph and other approaches. Computation of Hazard probability, unavailability and other parameters using fault tree methodology. Monte Carlo Simulation technique, Event tree analysis, identification of initiating events, sequence and scenario development, system analysis, external events and dependent failures and quantification, Accident-consequence Analysis, uncertainty analysis, sensitivity analysis and importance measures, Bayesian approaches. Human Reliability Analysis.

SUBJECT NO-RE60024, SUBJECT NAME- SOFTWARE RELIABILITY
LTP- 3-0-0, CRD- 3

SYLLABUS :-

Definition, errors-their cause and consequence, basic design principle of reliable software, requirements, objectives, and specifications, system architecture, program structure design, design practices, module design and coding, programming style. Software testing principles, module testing, functions and system testing, debugging, programming languages and reliability, computer architecture and reliability, proving program correctness, reliability models, software support systems.

SUBJECT NO-RE60018, SUBJECT NAME- FAULT DIAGNOSIS & PREDICTIVE MAINTENANCE
LTP- 3-0-0, CRD- 3

SYLLABUS :-

Determining health of machines through parameter monitoring. Performance and auxiliary variables, vibration parameters, time and frequency domain signals, vibration identification and diagnostic tables, vibration standards, vibration monitoring instruments. Temperature monitoring, thermography, tem-plugs, thermo-paints. Lubrication monitoring, SOAP, wear particles analysis, ferrography, ferrographical analyzer. Noise-sound monitoring sound measurement, magnetic tape recorders, sound level meters and analyzers, sound level data processing.

SUBJECT NO-RE60002, SUBJECT NAME- RELIABILITY DESIGN
LTP- 3-1-0, CRD- 4

SYLLABUS :-

Functional Designs, design simplifications, de-rating and human factors and optimal design selection. Allocation problem, reliability, redundancy and optimal reliability and redundancy allocation. Failure and repair rate allocation. Various design problems and their relevant solution techniques. Optimal maintenance strategies. Spare parts provisioning and policies. Optimal manpower planning.

Table III:

SUBJECT NO-RE*****, SUBJECT NAME- MICRO SPECIALIZATION PROJECT

LTP- 0-0-6, CRD – 4

Possible areas:

1. Accelerated Life Testing on components and products
2. Fault Diagnosis of Engineering Systems
3. Reliability Prediction of products
4. Failure data analysis and reliability estimation
5. Software reliability and quality
6. Risk analysis of engineering systems