Course Description

5th Semester:

Title: Probability Theory and Random Processes **Code: 18B11MA511**

L-T-P scheme: 3-1-0 **Credit: 4**

Prerequisite: Students must have already studied course, “Mathematics-I” and should have the Knowledge of Differential & Integral Calculus.

Objective: Objective of this course is to provide a foundation in the theory and applications of probability and stochastic processes and an understanding of the mathematical techniques relating to random processes in the areas of signal processing, detection, estimation, and communication. Topics include the axioms of probability, random variables, and distribution functions; functions and sequences of random variables; stochastic processes; and representations of random processes.

Learning Outcomes:

Course Outcome	**Description**
CO1	Construct sample spaces of random experiments; identify and specify events, and perform set operations on events; compute probabilities by counting; evaluate conditional probability, and apply Bayes’ theorem to simple situations.
CO2	Express random variables by using CDFs, PMFs; calculate moments related to random variables; understand the concept of inequalities and probabilistic limits. Understand the axiomatic approach of probability theory and intrinsic need of (functions of) random variables for the analysis of random phenomena.
CO3	Compute probability distributions and correlation measures of bivariate random variables; obtain marginal and conditional distributions of random variables; find probabilities for outcomes of various events related to an uncertain phenomenon using appropriate probability distributions as models.
CO4	Conduct hypotheses tests concerning population parameters based on sample data; perform and interpret chi-square test of goodness-of-fit and test of independence; find the equation of regression line and second degree curve, and to predict the value of one variable based on the value of the other variable.
CO5	Identify and classify random processes and determine covariance and spectral density of stationary and ergodic random processes; demonstrate specific applications to Gaussian process.
CO6	Students are able to provide the theories associated with the random variable and random process. The course particularly provides the student with an ability to apply to real-world problems in the communication and physical systems.

Course Contents:

Unit-1: Random experiments, sample space and events. Three basic approaches to probability, conditional probability, total probability theorem, Bayes’ theorem of Probability of causes, Bayes’ theorem of future events, total independence, mutual independence and pair wise independence.

Unit-2: One dimensional random variables (discrete and continuous) and their distributions, bivariate distributions, joint, marginal and conditional distributions, characteristic function.

Unit-3: Covariance and correlation of random variables. Some special probability distributions: Binomial, Poisson, probability distributions. Negative Binomial, Geometric and Normal probability distributions. Fitting of probability distributions.

Unit-4: Concept of reliability: Reliability function, Hazard rate function, Mean time to failure, cumulative and average failure rate, Conditional reliability and failure rates, residual MTTF, some special failure rate distributions- exponential distribution and the Weibull distribution, reliability of systems- series configuration and some deductions, parallel-series configuration, series -parallel configuration.

Unit-5: Introduction and description of random processes, average values of random processes, stationary processes and computation of their averages, autocorrelation function and its properties, Cross correlation and its properties. Power spectral density function and its properties. Ergodicity of a random process, Poisson processes.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Probability Theory and Random Processes (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

1. T. Veerarajan ,Probability, Statistics and Random Processes, Tata McGraw Hill.
2. J.J. Aunon & V. Chandrasekhar, Introduction to Probability and Random Processes, Mc- Graw Hill International Ed.
3. A. Papoulis & S.U. Pillai, Probability, Random Varibles and Stochastic Processes, Mc-Graw Hill.
4. H. Stark, and J.M. Woods, Probability and Random Processes with Applications to Signal Processing, Pearson Education.

Title: Theory of Computation **Code:** 18B11C511

L-T-P scheme: 3-1-0 **Credit: 4**

Prerequisite:
Students must have already studied for the course Set algebra, elementary formal logic, constructing proofs, recurrence relations.

Objective:

1. To give an overview of the theoretical foundations of computer science from the perspective of formal languages
2. To illustrate finite state machines to solve problems in computing
3. To explain the hierarchy of problems arising in the computer sciences.
4. To familiarize Regular grammars, context frees grammar.

Learning Outcomes:

Course Outcome	Description
CO1	Students will demonstrate knowledge of basic mathematical models of computation and describe how they relate to formal languages.
CO2	To Design Finite Automata's for different Regular Expressions and Languages
CO3	To Construct grammar for various languages and applying normal forms and push down automata
CO4	To solve various problems of Turing Machines and types of TM

Course Content:

UNIT – I
Mathematical Concepts: Review definitions and notations for sets, relations and functions. Basic concepts and definitions Set operations; partition of a set, Equivalence relations; Properties on relation on set; Proving Equivalences about Sets. Central concepts of Automata Theory.

UNIT – II
FINITE AUTOMATA (FA): Introduction, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.

UNIT – II
REGULAR EXPRESSIONS (RE): Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions.
REGULAR GRAMMARS: Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular -Pumping lemma, applications, Closure properties of regular languages.

UNIT - IV
CONTEXT FREE GRAMMER (CFG): Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG's, Minimization of CFG's, CNF, GNF, Pumping Lemma for CFL's, Enumeration of Properties of CFL (Proof's omitted).

UNIT – V

PUSHDOWN AUTOMATA: Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA.

UNIT VI

TURING MACHINES (TM): Formal definition and behaviour, Languages of a TM, TM as accepters, and TM as a computer of integer functions, Types of TMs.

RECURSIVE AND RECURSIVELY ENUMERABLE LANGUAGES (REL): Properties of recursive and recursively enumerable languages, Universal Turing machine, The Halting problem, Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy, Decidability.

Teaching Methodology:

Teaching in this course is designed to engage the students in active and experimental learning by taking a problem solving and design oriented approach with special emphasis on real world applications. Students are expected to carry out lot of design and programming.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Theory of Computation (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. K. L. P Mishra, N. Chandrashekaran (2003), Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.
2. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman (2007), Introduction to Automata Theory Languages and Computation, 3rdedition, Pearson Education, India.

Reference Books:

1. Papadimitriou, Elements of the Theory of Computation, Prentice-Hall, 1998
2. Peter Dehning, Jack B. Dennis, “Machines, Languages and Computation”, Second Edition, Prentice-Hall, 1978
3. Harry R. Lewis, Christos H. Papadimitriou, "Elements of the theory of computation", Second Edition, Prentice-Hall, 1998

Title of Course: Minor Project-1 **Course Code: 18B91CI591**
Course Credits: 2

Course Learning Outcome:

After successful completion of this course student will be able to:

Course Outcome	**Description**
CO1	Acquire practical knowledge within the chosen area of technology for project development
CO2	Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach
CO3	Contribute as an individual or in a team in development of technical projects
CO4	Develop effective communication skills for presentation of project related activities

Syllabus:

A project to be developed based on one or more of the following concepts.

Introduction to Java 2 SDK Tool Set Object Oriented paradigm, arrays, collection objects, data types, variables, functions, Wrapper Class, Object Class Inheritance, Interfaces, Abstract Class, Inner Class Exception Handling, Customization of Exception classes Event Handling, Adapter Classes Introduction To Application Programming In Java2, Creating Window Application, Writing Console Application, Use of Utility and Math Packages Introduction To Swing, MVC Architecture, Swing AWT and JFC, Writing Swing Application, Swing Components, Changing Look and Feel of Application Enhancing Application Using Clipboard, Drag and Drop, I/O Stream Enhancement, Printing, Internationalization Garbage Collection and Application Cleanup Applet and Applet Security Network Programming, Sockets, URL Class, Internet Address Class Java database Programming, Java.Sql Package Study, JDBC, Different Types of Drivers of JDBC

Evaluation scheme:

Exam	**Marks**
P1	10 marks
P2	15 marks
P3	30 marks
Term paper	20 marks
Guide marks	25 marks (continuous evaluation-15, documentation-10)
Total	**100 marks**

Title: Open Source Software Lab **Code: 18B17CI507**

L-T-P scheme: 0-0-2 **Credit: 1**

This Lab will be based on the subject run in CSE-Elective -1

Title of Course: Advanced Programming Lab-II **Course Code: 18B17CI573**
L-T-P scheme: 1-0-1 **Course Credit: 2**

Prerequisite: Students must have already registered for the course, "OOP".

Objective:

1. Demonstrate basic problem-solving skills: analyzing problems, modeling a problem as a system of objects, creating algorithms, and implementing models and algorithms in an object-oriented computer language (classes, objects, methods with parameters, abstract classes, interfaces, inheritance and polymorphism).
2. To learn using advanced features of a Programming Language.
3. To learn working with different APIs and make faster, reusable and efficient programs.

Learning Outcomes: At the end of the course students should:

Course Outcome	Description
CO1	Possess an ability to apply mathematical foundations, algorithmic principles, and computer science theory to the modeling and design of computer-based systems.
CO2	Be able to deconstruct problems to develop algorithms and eventually program code.
CO3	Develop substantial Java programs, when appropriate reusing previously created classes, writing programs requiring three or more classes.
CO4	Demonstrate ability to define the computing requirements of a problem and to design appropriate solutions based on established design principles and with an understanding of the tradeoffs involved in design choices.
CO5	Diligently leverage sound development principles to implement computer-based and software systems of varying complexity, and to evaluate such systems.

Course Contents:

Unit-1: Relooking classes, methods, objects, relationships, polymorphism, overriding and other object-oriented concepts.

Unit-2: Object oriented analysis and design, making inheritance-based designs, containership, abstract classes and interfaces.

Unit-3: Exception handling, polymorphic nature of exceptions, Multithreading, Race condition, Synchronization.

Unit-4: Introduction to design patterns, intents and class diagrams, singleton, factory, template, adapter pattern etc.

Unit-5: Project based on team work. The project may be menu-driven and should provide a design-oriented solution to a well-defined problem. The students should be able to identify the nature of the problem and perform object-oriented analysis followed by creating design solutions by identifying an appropriate design pattern. The code should justify the designs created.

References:

1. Horstmann, "CoreJava", Addison Wesley.
2. Urma, Fusco and Mycroft, "Java 8 In ACTION", Manning Publications, 1st edition, 2015.

3. Herbert Schieldt, “The Complete Reference: Java”, TMH.
4. John Hunt, Alexander g. McManus,“Key Java: Advanced Tips and Techniques”, Springer, 1998.
5. Y.Daniel Liang**, “**Introduction to Java programming”, Comprehensive Version (9th Edition)
6. Cay S. Horstmann and Gary Cornell, “Core Java, Vol.2 Advanced Features” (8th Edition).

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	
P-2		15 Marks	
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	