1. Providing students with a formal treatment of probability theory.
2. Equipping students with essential tools for statistical analysis.
3. Fostering understanding through real-world statistical applications.
4. Develop skills in presenting quantitative data using appropriate diagrams, tabulations.
5. Use appropriate statistical methods in the analysis of simple datasets.
6. Instill the belief that Statistics is important for scientific research.

Course Content:

Unit – I
Probability and theorems in Probability **(8 Contact hours)**
Probability introduction through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem and Independent Events.

Unit – II
Probability Distributions: **(10 Contact hours)**

Discrete distributions: Bernoulli, Binomial, Poisson, Negative Binomial, Geometric and hyper geometric distributions (Find their mean, variance and problems). Continuous distributions: Uniform, Exponential, Normal, Beta and Gamma distributions.

Unit – III
Moment Generating functions **(10 Contact hours)**
Functions of Random Variables, Correlation coefficient and Bivariate Normal Distribution. Probability Inequalities and Generating Functions, Moment Generating Function, Characteristic Function, Cumulant Generating Function, Probability Generating Function.

Unit – IV
Order Statistics and Central Limit theorem **(08 Contact hours)**
Order Statistics, Convergence of Sequence of Random Variables, Weak Law of Large Numbers, Strong Law of Large Numbers, Central Limit Theorem.

Unit - V
Sampling Theory: **(12 Contact hours)**
Definition of population, sampling, statistics and parameters. Types of sampling, Expected values of sample mean and variance, sampling distribution, standard error, sampling distribution of mean and sampling distribution of variance. Sampling -Distributions (t, F and Chi-square), confidence interval and interval estimation.

Unit – VI
Large Sample Tests: **(12 Contact hours)**
Definition of Null and alternative hypothesis, critical region. Type I and Type II errors, power of the test, one tail, two tail tests, Tests for the single mean, two means, single proportion and two proportions using Z-test and t-test, t-test and F-test for significance of difference variance.

Learning resources

Text book:
1 William W. Hines and Douglas C. Montgomery, '*Probability and Statistics in Engineering*', Willy Publications, 4th Edition.

Reference Books:
1. Sheldon Ross, '*A First Course in Probability*', Pearson Publications, 9th Edition.
2. Athanasios Papoulis and S. Unnikrishna Pillai, '*Probability, Random Variables and Stochastic Processes*', TMH, 4th Edition,.

Web resources:
1. https://nptel.ac.in/courses/117105085/
2. https://nptel.ac.in/courses/111106112/
3. https://nptel.ac.in/courses/111102111/
4. RGUKT Course Content

Course outcomes: At the end of the course, the student will be able to

CO 1	Apply Probability theory via Bayes Rule.
CO 2	Describe the properties of Discrete and Continuous distributions.
CO 3	Apply problem-solving techniques to solving real-world events.
CO 4	Apply selected probability distributions to solve problems.
CO 5	Develop problem-solving techniques needed to accurately calculate probabilities.

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Course code	Course Name	Course Category	L-T-P	Credits
20CS2103	Formal Languages and Automata Theory	PCC	3-0-0	3

Course Learning Objectives:

1. **To understand and design Finite State Machines and applications.**
2. **To Understand about Regular Expressions and its applications.**
3. **Understanding of formal grammars and their applications.**
4. **Understanding various other formal languages and their designing models.**
5. **To understand Decidability and Undecidability of various problems in the theoretical computer science.**

UNIT I: Introduction to Automata **(6 Contact hours)**

Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non-deterministic finite automaton, transition diagrams and Language recognizers.

UNIT II: Finite Automata **(9 Contact hours)**

NFA with Ɛ-transitions - Significance, acceptance of languages. Conversions and Equivalence: Equivalence between NFA with and without Ɛ transitions, NFA to DFA conversion, minimization of FSM, equivalence between two FSM's, Finite Automata with output- Moore and Mealy machines, Equivalence between Moore and Mealy.

UNIT III: Regular Languages **(6 Contact hours)**

Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, Closure properties of regular sets (Proofs not required).

UNIT IV: Grammars **(9 Contact hours)**

Regular grammars: Right linear and left linear grammars, Equivalence between regular linear grammar and FA, Inter conversion, Context free grammar, derivation trees, and sentential forms. Right most and leftmost derivation of strings.

Context Free Grammars: Ambiguity in context free grammars. Minimization of Context Free Grammars. Chomsky Normal Form, Greibach Normal Form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (Proofs omitted).

UNIT V: Push Down Automata **(7 Contact hours)**

Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, Inter conversion. (Proofs not required). Introduction to DCFL and DPDA.

UNIT VI: Turing Machine & Computability Theory (8 Hrs)

Recursive and Recursively enumerable languages, and Church's Hypothesis. Turing Machine: Introduction, Components of Turing Machine, Description of Turing Machine, Elements of TM, Language accepted by a TM, Role of TMs, Design of TMs, Universal Turing Machine, Undecidability of Post Correspondence problem.

Text Books:

Hopcroft, J D Ullman "Introduction to Automata and Language Theory", 3rd Edition, 2006
C. Papadimitrou and C. L. Lewis. Elements of Theory of Computation, Prentice-Hall, 1981.

Reference Books:

John.C.Martin, "Introduction to Languages and the Theory of Computation" McGraw-Hill Education, 01- May-2010.
Kamala Krithivasan, Rama.R, "Introduction to Formal Languages, Automata Theory and Computation", Pearson Education India, 01-Sep-2009

Web Resources

Indian Institute of Technology, Guwahati, " Formal Languages and Automata Theory", https://nptel.ac.in/courses/111103016/

Course outcomes: At the end of the course, the student will be able to

CO 1	Construct finite state diagrams while solving problems of computer science
CO 2	Ability to convert NFA to DFA and Epsilon NFA to DFA

Course Code	Course name	Course Category	L-T-P	Credits
20EC2110	**Digital Logic Design**	**ESC**	**3-0-0**	**3**

Course Learning Objectives:

1. To discuss the relevance of Digital Logic Design with Computer Science and Engineering course.
2. To discuss the concepts of Number systems and representations, combinational design, sequential designs and complete system design at gate-level abstraction in computer Design.
3. To discuss the important features of IC design like area, power and delay.

Course Content

Unit-I **(8Contact hours)**

Number systems-Representations-Conversions, error detection and error correction, Boolean constants and variables, basic gates: operation and truth tables, describing logic gates algebraically, evaluating logic circuit outputs, implementing circuits from Boolean expressions, universality of gates, Boolean theorems

Unit-II **(8 Contact hours)**

Combinational circuit minimization using Boolean laws and karnaugh maps, multilevel synthesis, logic levels and noise margins. Single bit adders and subtractors, parallel adders, multi-bit subtraction using adders, signed multiplier, unsigned multiplier

Unit-III **(6 Contact hours)**

Decoders, Encoders, Multiplexers, Demultiplexers. Realization of various functions using Decoders, Multiplexers. Priority encoders ,IC 74x148

Unit-IV **(7 Contact hours)**

Bistable elements, Latches and Flip-flops : S-R latch, D latch, J - K Flipflop, D Flipflop, master/slave flip-flop, edge triggered J-K flip-flop with asynchronous inputs, T flip-flops. Excitation tables, Characteristic tables, Characteristic equations

Unit-V **(8Contact hours)**

Frequency division and counting. Design and analysis of synchronous counters, asynchronous counters. State diagrams for D-flipflop, T-Flip flop, J-K Flip flop, Mealy machines and Moore machines.

Unit-VI **(8Contact hours)**

Design and display of mobile number using synchronous and asynchronous counters, design and display of digital clock using synchronous and asynchronous counters.

Learning Resources:

Text books:

1. Ronald J Tocci, Neal S.Widmer, Gregory L.Moss,'Digital systems' Pearson 10th edition.
2. Stephen Brown, Zvonko Vranesic,'Fundamentals of Digital Logic with Verilog Design', TMH, 2nd edition

Reference books

1. John F.Wakerly, 'Digital Design' , Pearson 4th edition

Web Resources

1. Prof. Shankar Balachandran, NPTEL-IIT Madras, *'Digital Circuits & Systems'*
   URL: https://nptel.ac.in/courses/117106114/
2. Prof. S Srinivasan, NPTEL-IIT Madras, 'Digital Circuits and Systems'
   URL: https://nptel.ac.in/courses/117106086/

Course Outcomes

At the end of the course, the student will be able to

CO 1	Apply the knowledge of simplification in obtaining optimal digital circuits
CO 2	Employ Boolean algebra to describe the function of logic circuits
CO 3	Design circuits which represent digital logic expressions. Specifically, design a gate-level digital circuit to implement a given Boolean function
CO 4	Study and examine the SSI, MSI, LSI and Programmable elements
CO 5	Analyse the operation of synchronous and asynchronous state machines

Course code	Course name	Course category	L-T-P	Credits
20CS2101	Design & Analysis of Algorithms	PCC	3-1-0	4

Course Learning Objectives:

5. Interpret the fundamental needs of algorithms in problem solving
6. Classify the different algorithm design techniques for problem solving
7. Develop algorithms for various computing problems
8. Analyze the time and space complexity of various algorithms

Course Content

Unit I **(8 Contact Hours)**

Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation, Probabilistic analysis, Amortized analysis. Analysis of Insertion Sort & Heap Sort.

Unit II **(10 Contact Hours)**

Divide and conquer: General Method, solving of recurrence relations – Substitution Method, Recursion Tree Method, Masters Method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication,

Unit III **(10 Contact Hours)**

Greedy method: General method, applications-Job sequencing with deadlines, 0/1 knapsack problem, Minimum cost spanning trees, Disjoint Sets- disjoint set operations, union and find algorithms, spanning trees, connected components and bi-connected components, Single source shortest path problem.

Unit IV **(10 Contact Hours)**

Dynamic Programming: General method, applications-Matrix chain multiplication, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem, Reliability design.

Unit V **(12 Contact Hours)**

Backtracking: General method, applications-n-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles.

Branch and Bound: General method, applications - Travelling sales person problem, 0/1 knapsack problem- LC Branch and Bound solution, FIFO Branch and Bound solution.

Unit VI **(10 Contact Hours)**

String Matching: Naive string matching, Tries, Rabin Karp Algorithm, KMP algorithm, Boyer moore Algorithm.

NP-Hard and NP-Complete problems: Basic concepts, non deterministic algorithms, NP - Hard and NP Complete classes, Reducibility.

Learning resources

Text Books:

- Thomas H.Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein , "Introduction to Algorithms".

Reference Books:

3. SatrajSahni and Rajasekharam, *"Fundamentals of Computer Algorithms"*,
4. Galgotia publications pvt. Ltd.
5. ParagHimanshu Dave, HimanshuBhalchandraDave, *"Design and Analysis algorithms"*,Publisher: Pearson.
6. R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, McGraw Hill "*Introduction to Design and Analysis of Algorithms A strategic approach"*
7. Allen Weiss "*Data structures and Algorithm Analysis in C++"*, Second edition,
8. Pearson education.
9. Aho, Ullman and Hopcroft "*Design and Analysis of algorithms*" Pearson education.

Web Resources

1.https://www.oreilly.com/library/view/design-and-analysis/9788177585957/
2.https://www.tutorialspoint.com/design_and_analysis_of_algorithms
3.https://www.amazon.in/Design-Analysis-Algorithms-V-Muniswamy/dp/9380026730

Course outcomes: At the end of the course, the student will be able to

CO 1	Synthesize efficient **algorithms** in common engineering **design** situations.
CO 2	Major techniques for **algorithm design** and **analysis** are introduced through the study of various **algorithms**.

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Course code	Course name	Course Category	L-T-P	Credits
20CS2102	Database Management Systems	PCC	3-0-0	3

Course Learning Objectives:

1. To Understand the role of a database management system in an organization.
2. To Understand the basics of ER Diagram, Relational model, Relational Algebra and Relational Calculus.
1. To Understand basic database concepts, including the structure and operation of the relational data model.
2. To Construct simple and moderately advanced database queries using Structured Query Language (SQL).
3. To Understand and successfully apply logical database design principles, including E-R diagrams and database normalization.
4. To Understand the concept of a database transaction and related database facilities and indexing techniques.

Course Content:

Unit I **(8Contacts hours)**

Introduction to database systems, File System vs. Database Systems, Database system structure, Views of data in a database system, Data models and Database languages.
Introduction to Entity-Relationship data model, Elements of an ER model, Constructing ER diagrams, Modelling of constraints, Reduction of ER diagrams to relational tables.

Unit II **(6 Contact hours)**

Basics of relational model, ER diagrams to relational design, Relational algebra: Simple operations and extended operations, writing relational algebra expressions for queries, Introduction to tuple relational calculus and writing basic queries using tuple calculus

Unit III **(9 Contact Hours)**

Basic structure of SQL queries, Writing simple queries, Complex queries and nested Subqueries in SQL, Aggregate functions in SQL, Effect of NULL values on result, Defining a Relational Schema, View definitions and constraints, types of keys.

Unit IV **(7 Contact hours)**

Features of Good Relational Designs, Atomic Domains and First Normal Form, Problems encountered in bad schema design, Motivation for normal forms, Dependency theory-functional dependencies, Armstrong's Axioms for FD, Closure of a set of FD's, Minimal Cover, Definition of 1NF, 2NF, 3NF and BCNF, Decomposition and desirable properties of them.

Unit V **(6Contact hours)**

Storing data in disk and files and the memory hierarchy, RAID, File organization and indexes, ISAM Tree, B+ Tree, Linear Hashing and Extendible Hashing

Unit VI **(9 Hours)**

Transaction concept, ACID properties, Concurrency in a DBMS, Serializability and Recoverability, Concurrency control Protocols (lock-based and time-stamp based)

Text Books

A. Silberschatatz, H. F. Korth and S. Sudarshan, Database System Concepts, 5/e, McGraw Hill,2006
R. Ramakrishnan and J. Gehrke, Database System Concepts, 3/e, McGraw Hill, 2003

Wilfried Lemahieu, Seppe Vanden Broucke and Bart baesens Principles of Database Management Systems, 1/e Cambridge 2018

Reference Books

Ramez Elmasri, Shamkant B. Navathe , Fundamentals of Database (7th Edition), Paperback, 2007
Theorey T J, Database Modeling & Design, 2/e, Morgan Kaufmann Publishers, 1994.
H. GarciaMolina, J. D. Ullman and J. Widom, Database Systems The Complete Book, 1/e, Pearson Education, 2007

Web resources:

Department of CS&E, IIT M, "Introduction to Database Sytems and Design",
https://nptel.ac.in/courses/106106095/
Indian Institute of Technology, Kharagpur, " Database Management Systems",
https://nptel.ac.in/courses/106105175/

Course outcomes: At the end of the course, the student will be able to

CO 1	Demonstrate the basic elements of a relational database management system,
CO 2	Ability to identify the data models for relevant problems.

Course code	Course name	Course category	L-T-P	Credits
20CS2181	Design & Analysis of Algorithms Lab	PCC	0-0-3	1.5

Course Learning Objective:

1. This practical course should enable the students to
2. Lear how to analyze a problem and design the solution for the problem
3. Design and Implement efficient algorithms for a specified application
4. Strengthen the ability to identify and apply the suitable algorithm for a given real world problem.
5. To understand various graph algorithms

List of Experiments:

1. Lab No 1: Implementation and Analysis of Sorting Algorithms – Quick Sort, Merge Sort & Heap Sort
2. Lab No 2: Warshalls Algorithms – Applying to Topological Ordering of vertices in a given digraph and computing the transitive closure of given directed graph
3. Lab No 3: Implement 0/1 Knapsack Problem using Dynamic Programming
4. Lab No 4: Shortest Paths Algorithms : All Pair Shortest Path algorithms – Floyds Algorithm and other algorithms
5. Lab No 5: Implement any scheme to find the optimal solution for the Travelling Salesman Problem
6. Lab No 6: Implement Minimum Spanning Tree Algorithms – Prims Algorithms and Kruskal Algorithm
7. Lab No 7: Single Source Shortest Path Algorithms and other Graph Algorithms like connected components
8. Lab No 8: Implement the Sum of Subsets Problem
9. Lab No 9: Implementation of any scheme to solve the SUDOKU puzzle
10. Lab No 10: Implement N Queens Problem using the Back Trackin

Course Outcomes

At the end of the course, the student will be able to

CO 1	To analyze asymptotic notation and worst, average and best case analysis using suitable mathematical tools.
CO 2	To design efficient algorithms for computational problems using appropriate algorithmic paradigm.
CO 3	To understand different graph algorithms and traversal problems.
CO 4	To analyze the complexity of different class of problems.
CO 5	To explain the role of randomization and approximation in computation

Assessment Method

Course Nature		**Practical**		
Assessment Method				
Assessment Tool	Experiments	Record	Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	5%	10%	40%
End Semester Examination weightage (%)				60%

Course Nature		**Practical**		
Assessment Method				
Assessment Tool	Experiments	Record	Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	5%	10%	40%
End Semester Examination weightage (%)				60%

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Course Code	Course Name	Course Category	L-T-P	Credits
20EC2180	Digital Logic Design Lab	**ESC**	**0-0-3**	**1.5**

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Course Code	Course Name	Course Category	L-T-P	Credits
20EC2180	Digital Logic Design Lab	ESC	0-0-3	1.5

Course Learning Objectives:

1. To expose to the concept of Digital knowledge and its applications
2. To understand Combinational and Sequential circuits

3. To design a prototype digital logic design

List of Experiments

1. Familiarization with logic gate IC's and Arduino kits
2. Design of code converters and comparators (8-bit) on bread board
3. Adder related experiments: Half adder , full adder , half subtractor, full subtractor , ripple carry adder, BCD adder, carry look ahead adder using IC
4. Design of a binary multiplier and displaying its inputs and outputs on seven segment display unit
5. Familiarization with multiplexer, decoder, encoder. Design of Half adder, full adder, magnitude comparator and other examples using above familiarized components
6. Bi-stable multi-vibrator design. Design and verification of SR,JK,D,T latch/flip-flops. Verification and elimination of Race Around Condition
7. Flip-flop conversions and Design of frequency dividers
8. Design of synchronous counters (Up and Down) and displaying result on seven segment display unit
9. Design of Mod $n \leq 2^n$ counter design(total 8 states, design of mod6 and mod7 with clear
10. Design and IC verification of Decade counter
11. Cascading of counters
12. Synchronous counter design and displaying result on seven segment display unit
13. Random sequence
14. Ring counter/Johnson counter
15. Verification and analysis of ALU IC
16. Design of a digital clock in synchronous state machine design and in asynchronous state machine design
17. Design and submission of term project

Note:

1. All the above experiments (except few exceptional cases) are to be implemented on Arduino kits also.
2. It is mandatory to perform experiment on any one of the EDA Tools before the experiment is done on hardware. All experiments must be unique, design specifications should not be common in the lab

Course outcomes:

After the completion of this Laboratory course, the student will be able to

CO 1	Understand the implementation of discrete digital components
CO 2	Utilize the ICs of Decoder, Multiplexer, Seven segment display unit in combination circuit design
CO 3	Utilize the ICs of suitable Flipflops in sequential circuit design
CO 4	Utilize the Programmable Logic devices in digital design
CO 5	Understand the concepts of setup time, hold time, propagation delays
CO 6	Design circuits with optimal features of Area, Power and delay
CO 7	Design and implement prototypes of complete digital systems

Assessment Method

Assessment Tool	Experiment	Report/Viva-Voce/ Quiz/MCQ/Lab	Total

Course Nature		Practical		
Assessment Method				
Assessment Tool	Experiments	Record	Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	5%	10%	40%
End Semester Examination weightage (%)				60%

Course code	Course name	Course Category	L-T-P	Credits
20CS2182	**Database Management Systems Laboratory**	**PCC**	**0-0-3**	**1.5**

Course Objectives:

1. Analyze the problem and identify the Entities and Relationships, keys for given database.
2. Design, develop and query a database.
3. Able to construct queries and maintain a simple database using MySQL.
4. Normalization of data present in database tables.
5. Develop triggers programs using PL/SQL.

List of Experiments:

1. Designing the Database through Identifying Entities, Relationship Attributes.

MySQL

1. Queries to facilitate acquaintance of Built-In Functions, String Functions, Numeric Functions,
2. Queries to facilitate acquaintance of Date Functions and Conversion Functions.
3. Queries for Creating, Dropping, and Altering Tables
4. Queries using operators in SQL
5. Queries to Retrieve and Change Data: Select, Insert, Delete, and Upd
6. Queries using Group By, Order By, and Having Clauses
7. Queries on Controlling Data: Commit, Rollback, and Save point
8. Queries for creating Views, and Constraints
9. Queries on Joins (Outer and Inner joins)
10. Queries on Correlated Sub-Queries

PL/SQL

1. Write a PL/SQL Code using Basic Variable, Anchored Declarations, and Usage of Assignment Operation
2. Write a PL/SQL block using SQL and Control Structures in PL/SQL
3. Write a PL/SQL Code using Cursors, Exceptions and Composite Data Types
4. Write a PL/SQL Code using Procedures, Functions, and Packages FORMS

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

CO 1	Identify the entities, attributes, relationships, keys for given database.
CO 2	Design a database schema for given problem.
CO 3	Formulate queries using MySQL DML, DDL commands.
CO 4	Formulate SQL queries using constraints and set comparison operators.
CO 5	Apply the normalization techniques for development of application software to realistic problems.
CO 6	Develop PL/SQL programs using triggers, procedures
CO 7	Ability to design and implement given case study.

Course Nature		Practical		
Assessment Method				
Assessment Tool	Experiments	Record	Viva-Voce/ Quiz/MCQ/Lab project	Total
Weightage (%)	25%	5%	10%	40%
End Semester Examination weightage (%)				60%

ENGINEERING SECOND YEAR: SEMESTER-2

Course code	Course name	Course Category	L-T-P	Credits