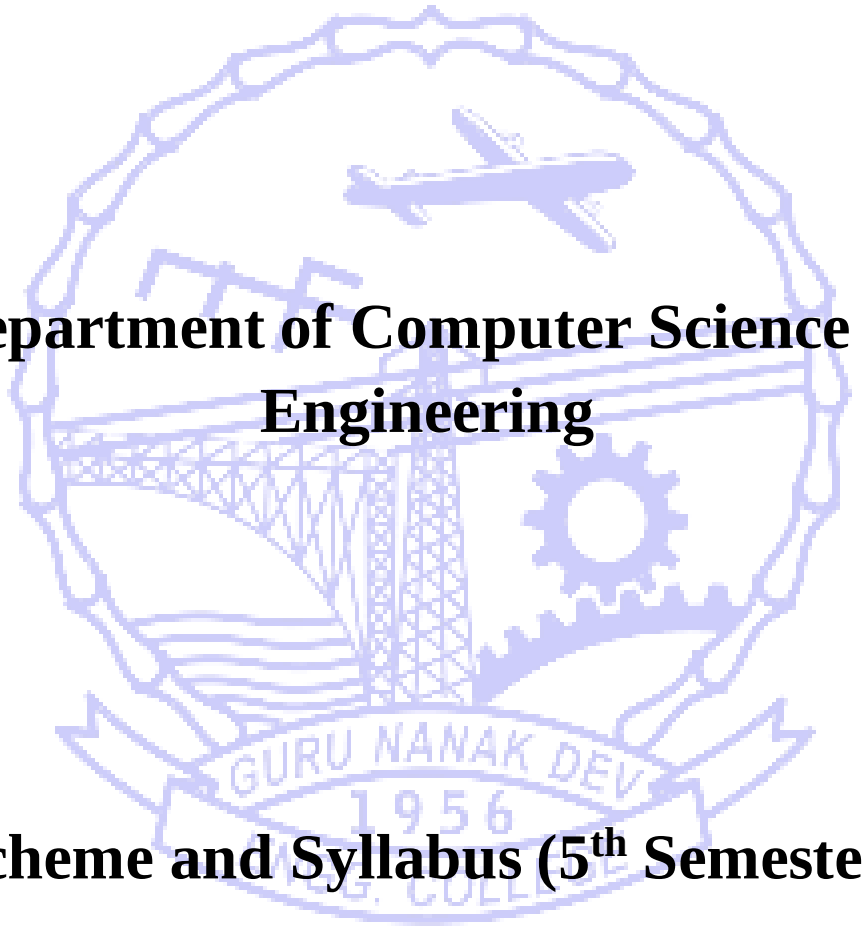
Guru Nanak Dev Engineering College, Ludhiana



Department of Computer Science & Engineering

Scheme and Syllabus (5th Semester)

B. Tech. Computer Science & Engineering (2018 Batch Onwards)

5th Semester

Category	Course Code	Course Name	Subject Type (Theory/ Practical)	Load Allocation (per week)			Marks Distribution		Total Marks	Credits
				L	T	P	Internal	External		
Professional Core Courses	PCCS-108	Artificial Intelligence	Theory	3	0	0	40	60	100	3
Professional Core Courses	PCCS-109	Database Management Systems	Theory	3	0	0	40	60	100	3
Professional Core Courses	PCCS-110	Formal Language & Automata Theory	Theory	3	1	0	40	60	100	4
Professional Core Courses	PCCS-111	Design and Analysis of Algorithms	Theory	3	1	0	40	60	100	4
Professional Elective Courses	PECS-XXX	Elective-I	Theory	3	0	0	40	60	100	3
Professional Core Courses	LPCCS-106	Artificial Intelligence Laboratory	Practical	0	0	2	30	20	50	1
Professional Core Courses	LPCCS-107	Database Management Systems Laboratory	Practical	0	0	2	30	20	50	1
Professional Core Courses	LPCCS-108	Design and Analysis of Algorithms Laboratory	Practical	0	0	2	30	20	50	1
Mandatory Courses	MCI-102	Constitution of India	Theory	2	0	0	50	0	50	0
Industrial/ Institutional Training	TR-102	Training-II**	Practical	-	-	-	60	40	100	1

Mentoring and Professional Development[#]		Mentoring and Professional Development	Practical	0	0	1				0
				17	**2**	**7**	**400**	**400**	**800**	**21**
			Contact Hours= 25 + 1[#]							

**Evaluation of 4 weeks industrial/institutional training held after 4th semester.

[#] There will be one period per week for Mentoring and Professional Development; final evaluation of this course will be done based on the combined assessment of odd and even semester of respective year of study.

Professional Elective Courses

Software Engineering:

1. PECS-101 Software Project Management [3-0-0]
2. PECS-102 Object Oriented Design using UML [3-0-0]
3. PECS-103 Agile Software Development [3-0-0]
4. PECS-104 Software Testing and Quality Assurance [3-0-0]
5. PECS-105 Component Based Development [3-0-0]
6. LPECS-101 Object Oriented Design using UML Laboratory [0-0-2]
7. LPECS-102 Software Testing and Quality Assurance Laboratory [0-0-2]

Network Technologies:

1. PECS-106 Advanced Computer Networks [3-0-0]
2. PECS-107 Adhoc and Sensor Wireless Networks [3-0-0]
3. PECS-108 Wireless and Mobile Networks [3-0-0]
4. PECS-109 Block Chain Technology [3-0-0]
5. PECS-110 Internet of Things [3-0-0]
6. LPECS-103 Adhoc and Sensor Wireless Networks Laboratory [0-0-2]
7. LPECS-104 Block Chain Technology Laboratory [0-0-2]

Data Management:

1. PECS-111 Statistics for Data Science [3-0-0]
2. PECS-112 Advanced Database Management Systems [3-0-0]
3. PECS-113 Data Warehouse and Data Mining [3-0-0]
4. PECS-114 Data Science [3-0-0]
5. PECS-115 Cloud Computing [3-0-0]
6. LPECS-105 Advanced Database Management Systems Laboratory [0-0-2]
7. LPECS-106 Data Science Laboratory [0-0-2]

Machine Intelligence:

1. PECS-116 Information Retrieval [3-0-0]
2. PECS-117 Pattern Recognition [3-0-0]
3. PECS-118 Natural Language Processing [3-0-0]
4. PECS-119 Soft Computing [3-0-0]
5. PECS-120 Deep Learning [3-0-0]

6. LPECS-107 Pattern Recognition Laboratory [0-0-2]
7. LPECS-108 Soft Computing Laboratory [0-0-2]

Algorithm Design and Programming:

1. PECS-121 System Programming [3-0-0]
2. PECS-122 Java Programming [3-0-0]
3. PECS-123 Advanced Algorithm Design and Analysis [3-0-0]
4. PECS-124 .NET Technologies [3-0-0]
5. PECS-125 Parallel and Distributed Algorithms [3-0-0]
6. LPECS-109 Java Programming Laboratory [0-0-2]
7. LPECS-110 .NET Technologies Laboratory [0-0-2]

Open Electives Courses

1. OECS-101 Software Project Management [3-0-0]
2. OECS-102 Object Oriented Programming using Java [3-0-0]
3. OECS-103 Cyber Law and Ethics [3-0-0]
4. OECS-104 Data Structures [3-0-0]
5. OECS-105 Computer Networks [3-0-0]
6. OECS-106 Operating Systems [3-0-0]
7. OECS-107 Database Management System [3-0-0]

Subject Code: PCCS-108

Subject Name: Artificial Intelligence

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 5th	**Teaching Hours:** 38
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 60%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Course Status:** Compulsory

Prerequisites: Knowledge of problem solving using different algorithms and basic programming.

Additional Material Allowed in ESE: [NIL]

On completion of the course, the student will have the ability to:

CO#	Course Outcome
1.	Understand the concept of Artificial Intelligence, Agents, their types and structure.
2.	Apply and analyze search strategies to solve the informed and uninformed problems.
3.	Design and evaluate intelligent expert models for perception and prediction from intelligent environment.
4.	Formulate valid solutions for problems involving uncertain inputs or outcomes by using decision making techniques.
5.	Demonstrate and enrich knowledge to select and apply AI tools to synthesize information and develop models within constraints of application area.
6.	Examine the issues involved in knowledge bases, reasoning systems and planning.

Detailed Contents:

Part A

Introduction: Intelligence, Foundations of artificial intelligence (AI). History of AI, Agents and Environments, Rationality of Agents, Nature and Structure of Agents, Communication among Agents. **[3 Hours]**

Problem Formulation and solution: Problem types, States and operators, State space, Uninformed Search Strategies, Informed Search Strategies– Best first search, A* algorithm, Heuristic functions, Iterative deepening A*(IDA), Small memory A*(SMA). **[5 Hours]**

Game playing: Perfect Information game, Imperfect Information game, Evaluation function, Minimax algorithm, Alpha-beta pruning. **[3 Hours]**

Logical Reasoning: Inference in Propositional logic and First order Predicate logic, Resolution, Logical reasoning, Forward chaining, Backward chaining; Knowledge representation techniques: semantic networks, Frames. **[7 Hours]**

Part B

Planning: Basic representation of plans, Partial order planning, Planning in the blocks world, Hierarchical planning, Conditional planning, Representation of time, schedule and resource constraints, Measures, temporal constraints. **[5 Hours]**

Uncertainty: Basic probability, Bayes rule and its use, Belief networks, Default reasoning, Fuzzy sets and fuzzy logic; Decision making– Utility theory, Utility functions, Decision theoretic expert systems. **[5 Hours]**

Inductive learning: Decision trees, Rule based learning, Current-best-hypothesis search, Least commitment search, Neural networks, Reinforcement learning, Genetic algorithms. **[6 Hours]**

Applications: Areas of AI, Natural language processing, Case study of existing expert systems. **[4 Hours]**

Text Books

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India.

Reference Books

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill.
2. Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi.
3. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University.

E-Books and online learning material

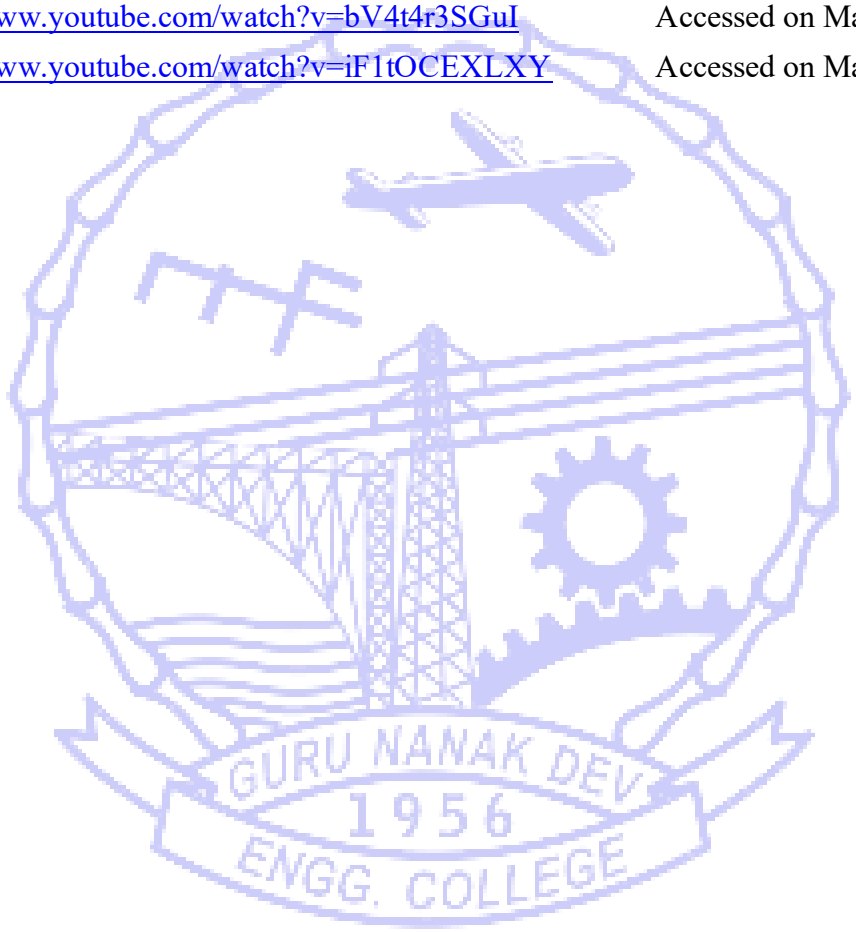
1. HandBook of Artificial Intelligence Edited by Avron Barr and Edward A. Feigenbaum, Computer Science Department, Stanford University.

   https://stacks.stanford.edu/file/druid:qn160ck3308/qn160ck3308.pdf

Online Courses and Video Lectures

1. https://www.coursera.org/courses?query=artificial%20intelligence

   Accessed on May 20,2020.
2. https://nptel.ac.in/courses/106/105/106105077/ Accessed on May 20,2020.
3. https://nptel.ac.in/courses/106/102/106102220/ Accessed on May 20,2020.
4. https://www.youtube.com/watch?v=bV4t4r3SGuI Accessed on May 20,2020.
5. https://www.youtube.com/watch?v=iF1tOCEXLXY Accessed on May 20,2020.



Subject Code: PCCS-109

Subject Name: Database Management Systems

Programme: B.Tech. (CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 5	**Teaching Hours:40**
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** Nil
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hrs
Total Marks: 100	**Elective Status:** Compulsory

Additional Material Allowed in ESE: Not Any

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Analyze the Information Systems as socio-technical systems, its need and advantages as compared to traditional file based systems.
2	To study the physical and logical database designs, database modeling, relational, hierarchical, and network models.
3	Analyze Database design using E-R data model by identifying entities, attributes, relationships, generalization and specialization along with relational algebra.
4	To understand and use data manipulation language to query, update, and manage a database.
5	Apply and create Relational Database Design process with Normalization and De-normalization of data.
6	To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency.

Detailed Contents:

Part-A

Introduction to Database Concepts: Introduction, Database systems versus file systems, Difference between Database and non-database system, Characteristics of Database Approach, Advantages and Disadvantages of Using DBMS. Data base users and administrators, Schemas and Instances, DBMS Architecture, components of a database system, Data Independence, Database

Language and Interfaces, Classification of Database Management Systems. Introduction to NoSQL database. **[5 Hours]**

Entity Relationship Model: Data models, Entity types, Entity sets, Attributes and keys, Relationship types, Relationship sets, Roles and structural constraints, Weak entity types, Design choices for ER conceptual design, Comparison of Models. **[4 Hours]**

Relational Model: Relational model concepts, Constraints, Update operations, Transaction and dealing with constraint violations. Relational Algebra –Unary relational operations, Operations from Set theory, Binary relational operations, DIVISION operation and additional relational operations. Relational Calculus – Tuple relational calculus and Domain relational calculus, Queries related to Relational Algebra and Relational Calculus. **[7 Hours]**

SQL: SQL Data Definition and data types, specifying constraints in SQL, Schema change statements, Basic queries in SQL, Set operations, Aggregate functions and views, Complex queries in SQL, Additional features of SQL. **[7 Hours]**

Part-B

Relational Database Design: Informal design guidelines for Relational Schemas, Functional dependencies, Inference rules for functional dependencies, Equivalence of set of functional dependencies, 2QMinimal cover, Normal forms based on primary keys– (1^{st}NF, 2^{nd}NF, 3^{rd}NF, 4^{th}NF and 5^{th}NF) Decomposition into normalized relations. Physical Database Design – File structures (Sequential files, Indexing, B tree). **[6 Hours]**

Transaction Management and Concurrency Control: Introduction to Transaction Processing, Transaction and System Concepts, need of concurrency control, ACID properties, Schedules, Characterizing schedules based on recoverability and serializability, Two - phase locking techniques for concurrency control. **[4 Hours]**

Database Recovery and Security: Need of recovery, Recovery concepts, Recovery techniques Deferred update, Immediate update, Shadow paging. Database security – Threats to databases, Control measures, Database security and DBA, Discretionary access control based on granting and revoking privileges, Mandatory access control, Introduction to Statistical Database Security, Encryption and decryption. **[7 Hours]**

Text Books

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw Hill Education.
2. Ramez Elmasri, Shamkant B Navathe, "Fundamentals of Database Systems", Pearson Education.
3. Connolly, "Specifications of Database Systems: A Practical Approach to Design, Implementation and Management", Pearson India.
4. Alexis Leon, Mathews Leon, "Database Management Systems" Leon Press.
5. S.K. Singh, "Database Systems Concepts, Design and Applications, Pearson Education.
6. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", Tata McGrawHill.

Reference Books

1. SQL,PL/SQL ,The programming language of oracle, Ivan Bayross BPB Publication
2. An introduction to database system by C.J.Date (Addison Welsey, Publishing house).
3. An introduction to Database Systems by Bipin C. Desai, Galgotia publications.
4. Prateek Bhatia, Database Management system, Kalayani Publishers

E-Books and online learning material

1. Database Management system. 2nd Ed.

https://ff.tu-sofia.bg/~bogi/knigi/BD/Database%20Management%20Systems.%202nd%20Ed.pdf

2. Fundamentals of Database Management Systems eBook.

https://circuitmix.com/free-download-fundamentals-of-database-management-systems-ebook/

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/106/106/106106220/ Accessed on Jan22, 2020
2. https://www.youtube.com/watch?v=5TU7zH0Z8 Accessed on Jan 22, 2020
3. https://www.youtube.com/watch?v=Z2Zx2G02aI4 Accessed on Jan 22, 2020
4. https://www.youtube.com/watch?v=Kmp76uRHz9c Accessed on Jan 22, 2020
5. https://www.youtube.com/watch?v=QYd6ZjHpzBg Accessed on Jan 22, 2020

Subject Code: PCCS-110

Subject Name: Formal Language and Automata Theory

Programme: B.Tech. (CSE)	**L:** 3 **T:** 1 **P:** 0
Semester: 5	**Teaching Hours:** 40
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 35%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hrs
Total Marks: 100	**Elective Status:** Compulsory

Additional Material Allowed in ESE: Not Any

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply the knowledge of mathematics and statistics to solve complex engineering problems related to automata theory.
2	Identify, formulate and analyze uses and Constraints of various computational models used in engineering practice.
3	Make use of research-based knowledge to abstract the models of computing and their powers to recognize the grammars.
4	Design and evaluate abstract machines that demonstrate the properties of physical machines and be able to specify the possible inputs, processes and outputs of these machines.
5	Compare and analyze different computational models including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	Recognize and comprehend formal reasoning about machines and languages to engage in independent and life-long learning in the broadest context of technological change.

Detailed Contents:

Part-A

Finite Automata: Deterministic Finite Automata, Acceptance by Finite Automata, Transition systems, Non-Deterministic Finite Automata, Equivalence of DFA and NDFA, Moore and Mealy

machines, Equivalence of Moore and Mealy machine, Minimization of Finite Automata, Applications and limitations of Finite Automata. **[6 Hours]**

Formal Languages: Basics of strings, Alphabets, grammar, Formal language, Chomsky classification of languages, Languages and their relation, Operations on languages, Closure properties of language classes. **[4 Hours]**

Regular Grammar: Regular grammars, Regular expressions, Algebraic method using Arden's theorem, Equivalence of Finite Automata and Regular expressions, Properties of regular languages, Pumping lemma. **[5 Hours]**

Context Free Language: Derivation, Ambiguity, Simplification of context free grammar, normal forms– Chomsky Normal Form, Greibach Normal Form, Pumping lemma. **[5 Hours]**

Part-B

Push Down Automata: Description and definition, Acceptance by Push Down Automata, Equivalence of Push Down Automata and context free grammars and languages. **[6 Hours]**

Turing Machine: Definition and Model, Representation of Turing Machine, Design of Turing Machine, Variants of Turing Machine, Decidability and recursively enumerable languages, Halting problem, Post correspondence problem. **[6 Hours]**

Context Sensitive Language: Context sensitive language, Model of linear bounded automata, Relation between linear bounded automata and context sensitive language. **[5 Hours]**

Text Books

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education.
2. K.L.P. Mishra and N. Chandrasekaran, "Theory of Computer Science", Third Edition, PHI Learning Private Limited.
3. K.V.N. Sunitha, N. Kalyani, "Formal Languages and Automata Theory", McGraw-Hill.

Reference Books

1. Daniel, A.Cohen, "Introduction to Computer Theory", Wiley India Pvt. Ltd.
2. M. Sipser, "Introduction to the Theory of Computation", Second Edition, Cengage Learning.
3. M. A. Harrison, "Introduction to Formal Language Theory", Addison-Wesley
4. Peter Linz, "An Introduction to Formal Languages and Automata", Jones and Bartlett Publishers.

E-Books and online learning material

1. Jean-Eric Pin, "Mathematical Foundations of Automata Theory", Lecture notes LIAFA, Université Paris https://www.irif.fr/~jep//PDF/MPRI/MPRI.pdf
2. Michael Sipser, "Introduction to the Theory of Computation",Thomson Course Technology http://en.bookfi.net/book/1139836
3. Anil Maheshwariand Michiel Smid, "Introduction to Theory of Computation", School of Computer Science, Carleton University, Ottawa Canada https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf
4. Michael Levet, "Theory of Computation", Lecture Notes, University of South Carolina-Columbia http://people.math.sc.edu/mlevet/Lecture_Notes.pdf

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/106/104/106104028/ Accessed on May 23, 2020
2. https://nptel.ac.in/courses/106/106/106106049/ Accessed on May 23, 2020
3. https://nptel.ac.in/courses/106/104/106104148/ Accessed on May 23, 2020

Subject Code: PCCS-111

Subject Name: Design and Analysis of Algorithms

Programme: B.Tech. (CSE)	**L:** 3 **T:** 1 **P:** 0
Semester: 5	**Teaching Hours:** 40
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 90%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hrs
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Knowledge of Data Structures and Algorithms

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	COURSE OUTCOMES
1	Understand and learn the fundamental techniques for designing algorithms.
2	Learn various advanced techniques to design algorithms for solving complex problems.
3	Design the algorithms using basic and advanced algorithm design techniques.
4	Identify and design various existing algorithms based on advanced techniques.
5	Analyze the algorithms based on time and space complexity to find optimal algorithm for a given problem.
6	Categorize various problems based on the complexity and properties of algorithms that solves these problems.

Detailed Contents:

Part-A

Introduction: Algorithms, Algorithm Specification, Performance Analysis: Space complexity, Time complexity, Asymptotic Notations- Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ), and Little-oh notation (o), Mathematical analysis of Non-Recursive and recursive Algorithms with Examples. **[4 Hours]**

Divide and Conquer: General method, solving recurrences using recurrence trees, repeated substitution, statement of Master Theorem, applications – Binary search, Merge sort, Quick sort, Strassen's Matrix Multiplication, Finding the maximum and minimum. **[5 Hours]**

Greedy Algorithms: Greedy choice, optimal substructure property, minimum spanning trees-Prims and Kruskals, Dijkstra shortest path using arrays and heaps, fractional knapsack, Travelling salesperson problem and Huffman coding. **[5 Hours]**

Dynamic Programming: Introduction to dynamic programming and application of the algorithm to solve multistage graphs, edit distance, matrix chain multiplication, All pairs shortest path problem and Knapsack problem. **[5 Hours]**

Part-B

Backtracking: General method, N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles. **[4 Hours]**

Application of Graph Traversal Techniques: Representation of graphs, BFS (as a method for SSSP on unweighted graphs), DFS, connected components, topological sorting of DAGs, biconnected components, and strongly connected components in directed graphs. **[5 Hours]**

String Matching: Introduction, Brute Force algorithm, Rabin-Karp algorithm, KMP algorithm, Boyer-Moore algorithm. **[5 Hours]**

NP Completeness: classes NP, P, NP-complete, and polynomial time reductions, Introduction to approximation algorithms, Absolute approximations, E-approximations. **[7 Hours]**

Text Books:

1. Ellis Horowitz, Sartaj Sahni and S. Rajasekharan, "Fundamentals of Computer Algorithms, Universities Press.
2. P. H. Dave, H. B. Dave, "Design and Analysis of Algorithms", Pearson Education.

Reference Books:

1. M. T. Goodrich and R. Tomassia, "Algorithm Design: Foundations, Analysis and Internet examples", John Wiley and sons.
2. S. Sridhar, "Design and Analysis of Algorithms", Oxford Univ. Press
3. Aho, Ullman and Hopcroft, "Design and Analysis of algorithms", Pearson Education.
4. R. Neapolitan and K. Naimipour, "Foundations of Algorithms", 4th edition, Jones and Bartlett Student edition.
5. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to Algorithms, 3rd Edition", PHI

E-Books and online learning material:

1. Ellis Horowitz, Sartaj Sahni and S. Rajasekharan, "Fundamentals of Computer Algorithms, 2nd Edition", Universities Press.

   https://nasirmir.files.wordpress.com/2012/09/fundamentals-of-computer-algorithms-by-ellis_horowitz-1984.pdf

Online Courses and Video Lectures:

1. https://nptel.ac.in/content/storage/MP4/new/106106131/mod01lec01.mp4

2. https://nptel.ac.in/content/storage/MP4/new/106106131/mod01lec05.mp4
3. https://nptel.ac.in/content/storage/MP4/new/106106131/mod01lec06.mp4
4. https://nptel.ac.in/content/storage/MP4/new/106106131/mod02lec09.mp4
5. https://nptel.ac.in/content/storage/MP4/new/106106131/mod02lec13.mp4
6. https://nptel.ac.in/content/storage/MP4/new/106106131/mod03lec18.mp4
7. https://nptel.ac.in/content/storage/MP4/new/106106131/mod09lec44.mp4
8. https://nptel.ac.in/content/storage/MP4/new/106106131/mod10lec50.mp4

Subject Code: LPCCS-106

Subject Name: Artificial Intelligence Laboratory

Programme: B.Tech. (CSE)	**L:** 0 **T:** 0 **P:** 2

Semester: 5	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Design and implement efficient Uninformed search techniques to solve problems.
2	Apply the knowledge of different informed search to identify and implement the appropriate techniques in problem solving
3	Utilize knowledge and techniques of game playing to develop single player game.
4	Handle uncertainty by designing the Bayesian network and inferring from the given data.
5	Utilize the knowledge and techniques of Artificial Intelligence while working in multidisciplinary teams.
6	Design and develop projects using Artificial Intelligence tools and techniques.

List of Practicals:

1. Introduction to python Interpreter.
2. Programs to implement input output and control flow tools in python.
3. Programs to implement different Data Structures in Python.
4. Introduction to Standard Library, Virtual Environments and packages in Python.
5. Write a program to implement Breadth First search for water jug problem.
6. Write a program to implement Depth First search for water jug problem.
7. Write a Program to implement Best First Search.
8. Write a program to implement A*algorithm.
9. Write a Program to implement tic tac toe game for 0 and X.
10. Write a Program to construct a Bayesian network from given data.
11. Write a Program to infer from the Bayesian network

Project:

Students are required to develop an expert system for real life problems/games, Expert system; implement a production system, medical diagnosis expert system, agriculture expert system, troubleshooting of computer systems, and implementation of neural/fuzzy network.

Subject Code: LPCCS-107

Subject Name: Database Management Systems Laboratory

Programme: B.Tech. (CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 5	**Teaching Hours:** 24

Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: Fundamentals of Computers.

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand, analyze and apply common SQL statements including DDL, DML and DCL statements to perform different operations.
2	Design different views of tables for different users and to apply embedded and nested queries.
3	Design and implement a database for a given problem according to well known design principles that balance data retrieval performance with data consistency.
4	Demonstrate and understand relational algebra in Database which is helpful to design related database software components.
5	Identify the user requirements from a typical business situation, and to document them.
6	Emphasize on team work and developing database applications using modern database tools

Special Instruction related to resources requirement: MY SQL, SQL Server, Oracle can be used for the queries.

List of Practicals:

1. Write the queries for Data Definition (create, drop, alter and rename) and Data Manipulation Language (select, insert, update and delete).
2. Write SQL queries using logical operators (,=etc).
3. Write SQL queries using SQL operators (between, and, or, in, like, null).
4. Write SQL query using character, number, date and group functions
5. Write SQL queries for Relational Algebra (union, intersect, and minus, etc.)
6. Write SQL queries for extracting data from more than one table (equi-Join, non-equi-join, outer join)

7. Write SQL queries for sub queries, nested queries. 8. Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
8. Queries (along with sub Queries) using any, all, in, exists, notexists, union, intersect, constraints. Example - Select the roll number and name of the student who secured fourth rank in the class.
9. Queries using aggregate functions (count, sum, avg, max and min), group by, having and creation and dropping of views.
10. Queries using conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date).

11. Write SQL queries to create views and also apply different operations on views.

Minor Project: By using standard database design rules, database has to be designed for a specific assigned problem to a group of two to three students. ER diagram related to project must also be prepared with an open source database tool like MYSQL workbench. The group of students must submit a project report of 8 to 10 pages (approximately) and the team will have to demonstrate as well as have to give a presentation of the same.

Subject Code: LPCCS-108

Subject Name: Design and Analysis of Algorithms Laboratory

Programme: B.Tech. (CSE)	**L:** 0 **T:** 0 **P:** 2

Semester: 5	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 2 hrs
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: Basic Programming

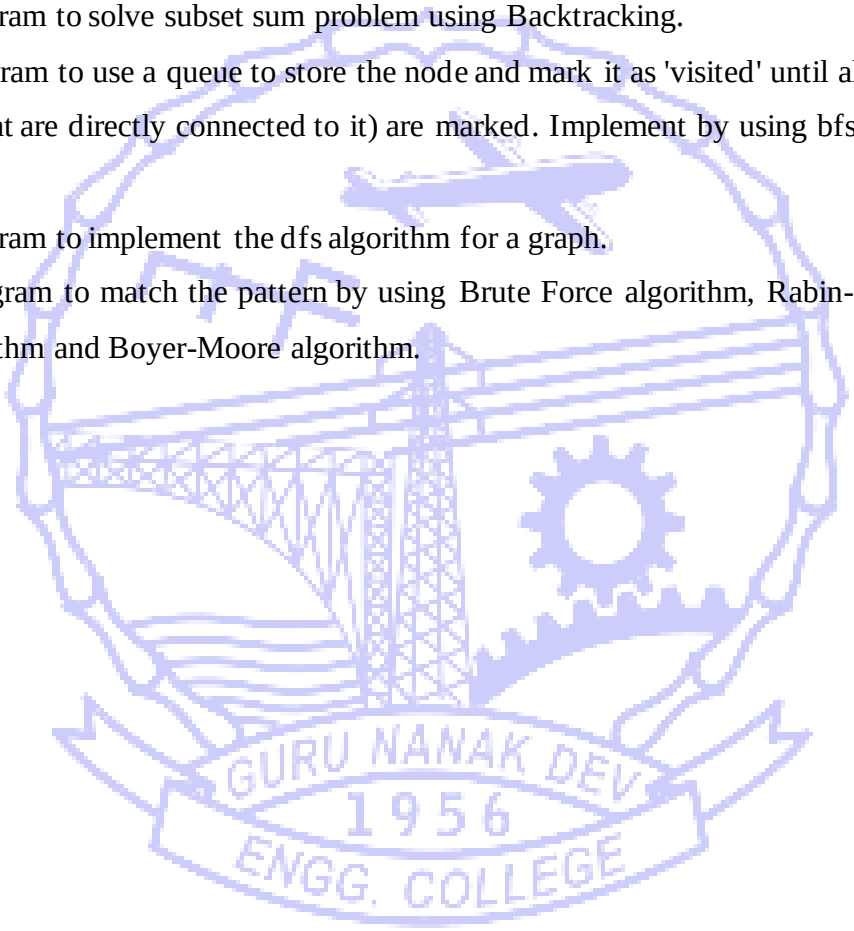
On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Construct algorithms using basic design techniques for searching, sorting and graph algorithms.
2	Design algorithm using advanced techniques for solving complex problems.
3	Identify the given problem and formulate and design algorithm for solving given problem.
4	Use modern engineering tools and latest programming language to implement the designed algorithms.
5	Apply knowledge and function on multi-disciplinary teams through mini projects based on various problems.
6	Analyse the performance of various algorithms to choose the optimum algorithm

List of Practicals:

1. Write a program to find out a roll number from college database using binary search algorithm.
2. Write a program to sort the class roll numbers of your class using merge sort algorithm and determine the time required to sort the elements.
3. Write a program to sort the university roll numbers of your class using Quick sort method and determine the time required to sort the elements.
4. Write a program to solve 0/1 knapsack using Greedy algorithm.
5. Write a program to find minimum cost to set the phone lines to connect all the cities of your state using Prim's algorithm.
6. Write a program to find the minimum cost of connecting all the engineering colleges in your state using Kruskal's algorithm.
7. Write a program to find minimum route for a newspaper distributer of your locality using Greedy algorithm.

8. Write a program to find shortest path from your home to college using Dijkstra's algorithm.
9. Write a program to find shortest path from your home to college using Bellman-Ford algorithm.
10. Write a program to solve 0/1 knapsack using dynamic programming.
11. Write a program to find the shortest path of the multistage graph using dynamic programming.
12. Write a program to find minimum distance between different cities of your state using FloydWarshall algorithm.
13. Write a program to find the solution to the 8 queen's problem using the backtracking.
14. Write a program to solve subset sum problem using Backtracking.
15. Write a program to use a queue to store the node and mark it as 'visited' until all its neighbours (vertices that are directly connected to it) are marked. Implement by using bfs algorithm for a graph.
16. Write a program to implement the dfs algorithm for a graph.
17. Write a program to match the pattern by using Brute Force algorithm, Rabin-Karp algorithm, KMP algorithm and Boyer-Moore algorithm.



Subject Code: PECS-101

Subject Name: Software Project Management

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0

Semester: 5th	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Course Status:** Elective

Prerequisites:

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Understand and apply the activities involved in the management of software projects.
2.	Analyse the various software development environments and risk management.
3.	Develop and apply the key strategies to monitor, control and quality assurance of software projects.
4.	Select the appropriate planning and estimation models to better evaluate the software projects.
5.	Create a strong working knowledge of ethics and professional responsibility.
6.	Develop effective organisational, leadership and change skills for managing projects, teams and stakeholders.

Detailed Contents:

Part-A

Introduction to Project Management: The characteristics of software projects, Objectives of project management: time, cost and quality, Basics of Project Management, Stakeholders, Stages of Project, The Feasibility Study, Cost-benefit Analysis, Planning, Project Execution, Project and Product Life Cycles, Project Management Knowledge areas, Project Management Tools & Techniques, Project success factors, role of project manager **[5 Hours]**

Project Evaluation and Planning: Activities in Software project management, Project evaluation – Cost benefit analysis, Cash flow forecasting, Cost benefit evaluation techniques, Risk evaluation. Project planning – Stepwise project planning, Software processes and process models. Project

costing, COCOMO II, Staffing pattern, Effect of schedule compression, Putnam's equation, Capers Jones estimating rules of thumb. **[6 Hours]**

Project Scheduling and Risk Management: Project sequencing and scheduling activities, Scheduling resources, Critical path analysis, Network planning, Risk management – Nature and types of risks, Risk planning and control, Risk assessment, Hazard identification, Hazard analysis, PERT and Monte Carlo simulation techniques. **[6 Hours]**

Part-B

Monitoring and Control: Collecting data, Review techniques, Project termination review, Visualizing progress, Cost monitoring, Earned value analysis, Change control, Software Configuration Management (SCM), Managing contracts and acceptance. **[7 Hours]**

People Management: Introduction, Understanding behaviour, Organizational behaviour, Recruitment process, Motivation, The Oldman – Hackman Job Characteristics model, Stress, Health and safety. Working in teams, Decision making, Leadership, Organization and team structures. **[7 Hours]**

Software Quality Management: ISO Standards, Process capability models, Testing and software reliability, Quality plans, Test automation, Overview of project management tools. **[6 Hours]**

Text Books

1. Bob Hughes, Mike Cotterell, "Software Project Management", Tata McGraw Hill.
2. Royce, "Software Project Management", Pearson Education.
3. Robert K. Wysocki, "Effective Software Project Management", Wiley.

Reference Books

1. Ian Sommerville, "Software Engineering", Pearson Education.
2. R.S. Pressman, "Software Engineering: A Practitioner's Approach", Tata McGraw Hill.
3. Kassem, "Software Engineering", Cengage Learning

E-Books and online learning material

https://www.kopykitab.com/Software-Project-Management-eBook-By-isbn-9789382122005

1. https://www.kobo.com/us/en/ebook/effective-software-project-management-1
2. https://epdf.pub/effective-software-project-management.html

E-Books and online learning material:

1. Dwayne Phillips, “The Software Project Manager's Handbook: Principles That Work at Work”, Wiley-

   IEEE Press, URL: https://ieeexplore.ieee.org/servlet/opac?bknumber=5989544

2. Mark Christensen; Richard H. Thayer, “The Project Manager's Guide to Software Engineering's Best Practices, Wiley-IEEE Press”,

   URL: https://ieeexplore.ieee.org/servlet/opac?bknumber=5989224

3. Walker Royce, “Software Project Management: A Unified Framework”, Addison-Wesley Professional”, URL: https://dl.acm.org/doi/book/10.5555/1942096

Online Courses and Video Lectures

1. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs70/
2. https://nptel.ac.in/courses/106/105/106105182/

Subject Code: PECS-107

Subject Name: Advanced Computer Networks

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 5	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Course Status:** Elective

Prerequisites: Basics of computer networks

Additional Material Allowed in ESE: scientific calculator

On completion of the course, the student will have the ability to:

CO #	Course Outcomes
1.	Understand the core ideas of networks thoroughly with network architecture and performance metrics for network designing.
2.	Apply the knowledge of various modes of communication to solve problems of data communication over different medium using various technologies.
3.	Understand and utilize various communication protocols that provide reliable, ordered, and error-checked delivery of a stream of octets.
4.	Design and implement various algorithms of network to ease the communication problems over different geographical areas.
5.	Compare different routing protocols and propose the optimal solution concerning different structures of networks.
6.	Design and implementation of routing and transport layer protocols for advanced multi hop networks for smooth flow of data over different networks.

Detailed Contents:

Part-A

Introduction: Basics, History of Internet, Requirements: perspectives, scalable connectivity, cost effective resource sharing, support for common services, manageability, network architecture: layering and protocols, Internet architecture, network performance: bandwidth, latency, high-speed networks, application performance needs. **[4 Hours]**

Internetworking: half and full duplex**,** Ethernet at physical layer: standard Ethernet, fast Ethernet, gigabit Ethernet, Ethernet cabling-straight-through, crossover and rolled cable, Data encapsulation. Ethernet at data link layer: CSMA, CSMA/CD and CSMA/CA. **[4 Hours]**

Wireless LANs: Introduction: architecture comparison, characteristics, access control. IEEE 802.11: architecture, MAC Sublayer, Physical layer. Bluetooth: architecture and its layers.

[3 Hours]

Switching: Switching and bridging: datagrams, virtual circuit switching, source routing, Switches: Basics, its function, types of switches, Spanning Tree Protocol (STP), Virtual LANs (VLANs): purpose, memberships, configuration, connection between switches, advantages, types of VLANs: static and dynamic. **[5 Hours]**

Part-B

TCP Protocols: Internet Protocol (IP): service model, global addresses, datagram forwarding in IP, subnetting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error reporting (ICMP). ` **[5 Hours]**

Routing: Network as a graph, Distance Vector (RIP), Link state (OSPF), metrics. Inter-domain routing: routing policies, routing protocols (BGP), Intra-domain routing: routing policies, routing protocols (DVMRP). **[5 Hours]**

Transport Service and Protocols: User Datagram Protocol (UDP): header format, services, and applications, Transmission Control Protocol (TCP): transport service characteristics; transport protocol: features, segment, TCP connection. **[3 Hours]**

Wireless Ad hoc Networks: Mobile Ad hoc Networks (MANETs): features, advantages, routing in MANETs, applications of MANETs, Recent trends in networks: green networking, social networks, software data networks and vehicular ad hoc networks (VANETs). **[3 Hours]**

Text Books:

1. L. L. Peterson, B. S. Davie, Computer Networks. A Systems Approach, Morgan Kaufmann Publishers Inc
2. B.A. Forouzan, Data Communications and Networking, Mc-Graw Hill Education
3. Andrew S. Tanenbaum, "Computer Networks", Pearson Education

Reference Books:

1. J. F. Kurose, K. W. Ross, Computer Networking. A Top-Down Approach, Addison Wesley Longman
2. G. Antoniou, F. van Harmelen, Semantic Web Primer, The MIT Press
3. J. Day, Pattterns in Network Architecture. A Return to Fundamentals, Prentice Hall
4. Douglas E. Comer, "Internetworking with TCP/IP", Volume-I, Pearson Education.
5. W. Stallings, "Data and Computer Communication", Prentice Hall of India.

E-Books and online learning material

- An Introduction to Computer Networks by Peter L Dordal, Department of Computer Science, Loyola University Chicago.

http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf Accessed on May 21, 2020

Online Courses and video lectures

https://swayam.gov.in/nd1_noc20_cs23/preview Accessed on May 21, 2020

https://nptel.ac.in/courses/106105081/ Accessed on May 21, 2020

https://nptel.ac.in/courses/106105081/2 Accessed on May 21, 2020

https://nptel.ac.in/courses/106105081/5 Accessed on May 21, 2020

https://nptel.ac.in/courses/106105081/16 Accessed on May 21, 2020

https://nptel.ac.in/courses/106105081/31 Accessed on May 21, 2020

Subject Code: PECS-111

Subject Name: Statistics for Data Science

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 5	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 60%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Course Status:** Elective

Additional Material Allowed in ESE: [NIL]

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Able to understand the basic knowledge on fundamental probability concepts, probability of an event, additive rules and conditional probability, Bayes' Theorem, Combinatorial Analysis, Permutations ,Combinations, Binomial Coefficients.
2.	To understand the concept of random variables, properties of common types of random variables, how to identify them and apply them to solve probabilistic problems.
3.	To apply the knowledge of various sampling distributions to compute confidence intervals for the population parameters.
4.	To solve different types of Statistics related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries;
5.	To understand basic components of hypothesis testing and perform hypothesis tests on population means, variances and proportions.
6.	To perform Statistical analysis in several circumstances and interprets the results in an applied context.

Detailed Contents:

PART A

Random Variables and Probability Distributions: Random Variables, Discrete Probability Distributions, Distribution Functions for Random Variables, Distribution Functions for Discrete Random Variables , Continuous Random Variables, Joint Distributions, Independent Random

Variables, Change of Variables, Probability Distributions of Functions of Random Variables, Convolutions, Conditional Distributions, Applications to Geometric Probability. **[8 Hours]**

Special Probability Distributions- Binomial Distribution, Normal Distribution , Poisson Distribution, The Central Limit Theorem, Multinomial Distribution, Hyper geometric Distribution, Uniform Distribution, Cauchy Distribution, Gamma Distribution, Beta Distribution, The Chi-Square Distribution, Student's t Distribution, F Distribution, Relationships Among Chi-Square, t, and F Distributions ,Bivariate Normal Distribution. **[10 Hours]**

Introduction to Statistics: Population and sample, parameters and statistics, Simple descriptive statistics - Mean, Median, Quantiles, percentiles, and quartiles, Variance and standard deviation, Standard errors of estimates, Interquartile range. **[5 Hours]**

PART B

Correlation: Definition of Correlation, Types of Correlation, Scatter Diagram Method, Karl Person's Correlation Coefficients, Correlation Coefficients for Bivariate frequency distribution, Probable error for Correlation Coefficients, Rank Correlation Co-efficient. **[3 Hours]**

Regression: Definition of Regression, Regression lines, Regression Coefficients, Properties of regression Coefficients, and Fitting of regression lines and estimation for Bivariate frequency distribution, Multiple Linear Regression. **[4 Hours]**

Testing of hypothesis: Meaning, Basic concepts, Flow diagram, Power of a hypothesis test, Important parametric tests, Types of hypothesis (null and alternate), Limitations of tests of hypothesis. **[3 Hours]**

Statistical analysis: Parametric tests, Non-parametric tests, Students t-test, chi square test, analysis of variance (ANOVA). **[3 Hours]**

Text Books

1. C.R Kothari, "Research Methodology: Methods and Techniques", New age international.
2. S.P. Gupta, "Statistical Methods", S. Chand & company.

Reference Books

1. S.C. Gupta, V.K. Kapoor, “Fundamental of Applied Statistic”, Sultan Chand Publication.
2. H.R. Vyas
3. , “Business Statistics”, B.S. Shah Prakashan.
4. Michael Baron, “Probability and Statistics for Computer Scientists”, Chapman and Hall/CRC.
5. John Schiller, R. Alu Srinivasan, Murray Spiegel, “Probability and Statistics”, McGraw-Hill Education.

E-Books and online learning material

1. Michael Baron, “Probability and Statistics for Computer Scientists”, https://www.academia.edu/35869356/Probability_and_Statistics_for_Computer_Scientists.
2. John Schiller, R. Alu Srinivasan, Murray Spiegel, “Probability and Statistics”, McGraw-Hill Education, https://www.academia.edu/35869356/Probability_and_Statistics_for_Computer_ Scientists.

Online Courses and Video Lectures

1. https://www.youtube.com/watch?v=VudrNXCYJt4
2. https://nptel.ac.in/content/storage2/MP4/111106112/mod03lec12.mp4
3. https://nptel.ac.in/content/storage2/MP4/111106112/mod04lec18.mp4
4. https://nptel.ac.in/content/storage2/MP4/111106112/mod04lec19.mp4
5. https://nptel.ac.in/content/storage2/MP4/111106112/mod04lec20.mp4
6. https://youtu.be/0AE_oSOXSC4
7. https://youtu.be/vGn6boqvmpw

Subject Code: PECS-119

Subject Name: Information Retrieval

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 5	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hours
Total Marks: 100	**Course Status:** Elective

Additional Material Allowed in ESE: [NIL]

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Outline basic terminology and components in information retrieval systems.
2.	Understand the issues involved in providing an IR service on a web Scale.
3.	Compare and contrast information retrieval models and internal mechanisms.
4.	Evaluate information retrieval algorithms and give an account of the difficulties of evaluation.
5.	Identify and analyze the various aspects of a specific problem and apply the concepts of information retrieval to develop a model.
6.	Develop the ability to develop a complete IR system from scratch.

Detailed Contents:

Part A

Introduction: Introduction , History of IR, Components of IR, The IR Problem, The IR System, The Software Architecture of the IR System, The impact of the web on IR, The role of artificial intelligence (AI) in IR, IR Versus Web Search, Components of a Search engine. **[5 Hours]**

Basic IR Models: Boolean and vector-space retrieval models; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity. **[5 Hours]**

Experimental Evaluation of IR: Performance metrics: recall, precision, and F-measure; Evaluations on benchmark text collections. **[3 Hours]**

Retrieval Utilities, Indexing and Searching: Relevance feedback; clustering; Passage-Based Retrieval; N-Grams, Regression Analysis; Thesauri; Semantic Networks; Parsing, Searching Introduction; Inverted Files; Other indices for text; Boolean queries; Sequential searching; Structural queries; Compression. **[6 Hours]**

Part B

Cross Language Information Retrieval and Efficiency, Integrating Structured Data and Text: Introduction; Crossing the language barrier; Cross Language retrieval strategies; Cross language utilities. Duplicate Document Detection. Review of the relational model; a historical progression; Information retrieval as a relational application; Semi-structured search using a relational schema. **[6 Hours]**

Parallel Information Retrieval and Distributed Information Retrieval: Parallel text scanning; parallel indexing; Clustering and classification; Large parallel systems; A theoretic model of distributed information retrieval; Web search; Result fusion; Other architectures. **[6 Hours]**

Multimedia IR: Introduction; data modeling; Query languages; Spatial access methods; A general multimedia indexing approach; One-dimensional time series; Two-dimensional color images. **[5 Hours]**

Text Books:

1. Ricardo Baeza -Yates and Berthier Ribeiro - Neto, Modern Information Retrieval: The Concepts and Technology behind Search, ACM Press Books.
2. Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice, Addison Wesley.
3. Mark Levene, An Introduction to Search Engines and Web Navigation, Wiley.

Reference Books:

1. Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press.
2. Ophir Frieder "Information Retrieval: Algorithms and Heuristics: The Information Retrieval Series ", Springer.
3. Manu Konchady, "Building Search Applications: Lucene, Ling Pipe", Gate Mustru Publishing.

E-Books and online learning material

1. C. Manning, P. Raghavan, and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008.

http://www.cs.utexas.edu/users/mooney/ir-course

Online Courses and video lectures

1. https://www.coursera.org/learn/text-retrieval
2. https://www.youtube.com/watch?v=sNlGHK1gz-I

Subject Code: PECS-121

Subject Name: System Programming

Programme: B.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 5	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:**
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hours
Total Marks: 100	**Course Status:** Elective

Additional Material Allowed in ESE: [NIL]

On completion of the course, the student will have the ability to:

CO #	Course Outcomes
1.	Understand the relationship between system software and machine architecture.
2.	Study the architecture of a hypothetical machine, its assembly language and macro language.
3.	Identify the need and implementation of macro processor, linkers and loaders.
4.	Determine the basics of compiler design and their applications in programming languages.
5.	Analyze the process of scanning and parsing techniques.
6.	Identify the most common pitfalls of code using debuggers and be able to locate, analyze, and fix the errors.

Detailed Contents:

Part-A

Overview of System Software: System Software, Application Software, Systems Programming, Recent Trends in Software Development, Levels of System Software, Evolution of Operating Systems, Operating System & Kernel, Functions of Operating System, Machine Structure, Evolution of components of a programming system -Assembler, Loader, Macros, Compiler. **[5 Hours]**

Language Processors: Fundamentals of Language Processing & Language Specification, Language Processing Activities, Data Structures for Language Processing - Search Data structures, Allocation Data Structures. **[4 Hours]**

Introduction to Assembly Language Program: Elements of Assembly Language Programming, A Simple Assembly Scheme, Pass Structure of Assemblers, One-Pass and Two-Pass Assemblers with reference to IBM 360 machines. **[6 Hours]**

Macro and Macro Processors: Introduction, Macro Definition and Call, Macro Expansion, Nested Macro calls, Advanced Macro Facilities, Design of a Macro Pre-processor, design of a Macro Assembler, Functions of a Macro Processor. **[5 Hours]**

Part-B

Linkers and Loaders: Linkers - Relocation of Linking Concept, Design of a Linker, Self-Relocating Programs, Linking of Overlay Structured Programs, Dynamic Linking. Loaders - Different Loading Schemes, Sequential and Direct Loaders, Compile-and-Go Loaders, General Loader Schemes, Absolute Loaders, Relocating Loaders, Linker v/s Loader. **[6 Hours]**

Scanning and Parsing: Programming Language Grammars, Classification of Grammar, Ambiguity in Grammar Specification, Scanning, Parsing, Top Down Parsing, Bottom up Parsing, Language Processor Development Tools - LEX, YACC. **[4 Hours]**

Compilers: Causes of Large Semantic Gap, Compiler and its phases – lexical, syntax and semantic analysis, intermediate code generation, code optimization and code generation. **[7 Hours]**

Interpreters and Debuggers: Interpreters - Overview of interpreters, Benefits of Interpretation. Types of Errors, Debugging Procedures, Classification of Debuggers, Dynamic/Interactive Debuggers. **[3 Hours]**

Text Books

1. Donovan J.J., "Systems Programming", New York, Mc-Graw Hill.
2. D. M. Dhamdhere, "Systems Programming and Operating Systems", Tata McGraw-Hill.
3. Santanu Chattopadhyay, "System Software", Prentice-Hall India.

Reference Books

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Pearson Education Asia.
2. Kenneth C. Louden," Compiler Construction", Cengage Learning.

3. Leland L. Beck, “System Software: An Introduction to Systems Programming”, Pearson Education.
4. Adam Hoover, “System Programming with C and Unix”, Pearson Education.

E-Books and online learning material

1. https://www.engineerstudyhub.com/books/systems_programming_by_donovan.pdf
2. https://lecturenotes.in/subject/29/system-programming-sp
3. https://www.tutorialsduniya.com/notes/system-programming-notes/

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/106/108/106108052/ Accessed on 28/07/2020
2. https://www.coursera.org/learn/application-systems-programming Accessed on 28/07/2020
3. https://www.virtuq.com/module_details/linux-system-programming Accessed on 28/07/2020