Curriculum for Undergraduate Degree (B.Tech.) in Information Technology (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Fifth Semester

Course Name:	**Compiler Design**		
Course Code:	PC-IT501	**Category:**	Engineering Science
Semester:	Fifth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic concepts of programming language
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the different stages in the compilation process.
2	Identify different methods of lexical analysis.
3	Design top-down and bottom-up parsers.
4	Identify synthesized and inherited attributes.
5	Develop syntax directed translation schemes.
6	Develop algorithms to generate coding for a target machine.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Compiling: Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.	3L
2	Lexical Analysis: The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of alexical analyzer generator (Lex).	4L
3	Syntax Analysis: The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, No recursive ,Predictive parsing(LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.	5L
4	Syntax Directed Translation: Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.	4L

5	Type Checking: Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions	3L
6	Runtime Environments: Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.	3L
7	Intermediate code generation: - Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).	3L
8	Code optimization: Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The Principle sources of optimization, Loops in flow graph, Peephole optimization.	3L
9	Code generations: Issues in the design of code generator, a simple code generator, Register allocation & assignment.	2L
Total		**30L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand given grammar specification, develop the lexical analyzer.
2	Design a given parser specification, design top down and bottom up parser.
3	Develop syntax directed translation schemes.
4	Develop algorithms to generate code for a target machine.

Learning Resources:	
1	Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" - Pearson Education.
2	Holub - "Compiler Design in C" - PHI.

Course Name:	**Operating Systems**		
Course Code:	PC-IT502	**Category:**	PC
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Computer Organization
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the services provided by and the design of an operating system.
2	Students should be able to use system calls for managing processes, memory and the file system.
3	Students should understand the data structures and algorithms used to implement an OS.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction: Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi programmed, time-sharing, real-time, distributed, and parallel.	4L
2	System Structure: Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, system calls.	3L
3	Process Management: Processes [3L]: Concept of processes, process scheduling, operations on processes, co-operating processes, inter-process communication. Threads [2L]: overview, benefits of threads, user and kernel threads.CPU scheduling [3L]: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, and priority), and algorithm evaluation, multi-processor scheduling. Process Synchronization [5L]: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores. Deadlocks [3L]: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.	16L
4	Storage Management: Memory Management [4L]: Background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging. Virtual Memory [3L]: Background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing. File Systems [2L]: File concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, and indexed), and free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance. I/O Management [2L]:	14L

	I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and non blocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance. Disk Management [3L]: disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN), disk reliability, disk formatting, boot block, bad blocks.	
5	Protection & Security: Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.	3L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the knowledge of basic concepts of operating system.
2	Apply concepts of memory management including virtual memory, and disk management system, file management and multithreading.
3	Apply concepts to protection and security mechanisms

Learning Resources:	
1	Milenkovie M., "Operating System: Concept & Design", McGraw Hill.
2	Tanenbaum A.S., "Operating System Design & Implementation", Practice Hall NJ.
3	Silbersehatz A. and Peterson J. L., "Operating System Concepts", Wiley.
4	Dhamdhere: Operating System TMH
5	Stalling, William, "Operating Systems", Maxwell McMillan International Editions, 1992.
6	Dietel H. N., "An Introduction to Operating Systems", Addison Wesley.

Course Name:	**Object Oriented Programming**		
Course Code:	PC- IT503	**Category:**	Professional Core Courses
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Concept of Computer Programming for Problem Solving
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn the fundamentals of object-oriented concepts
2	To implement the object-oriented concepts by a programming language
3	To be able to apply the programming skill to implement real world project

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction: Features of object-oriented programming, major and minor elements, relationships among classes and among objects	12L
2	Fundamentals of OOP: classes and objects, polymorphism, inheritance, interfaces	8L
3	Commands as methods and as objects, Memory management, Generic types and collections, Exception Handling	8L
4	Graphical programming and Applets, Event Handling	6L
5	The software development process	6L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Specify simple abstract data types and design implementations, using abstraction functions to document them.
2	Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity
3	Apply some common object-oriented design patterns and give examples of their use
4	Design applications with an event-driven graphical user interface

Learning Resources:	
1	Rambaugh, James Michael, Blaha – "Object Oriented Modeling and Design" – Prentice Hall, India
2	Ali Bahrami – "Object Oriented System Development" – McGraw Hill
3	Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
4	E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH
5	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson

Course Name:	**Economics for Engineers**		
Course Code:	HM-HU 501	**Category:**	Management Science & Humanities
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 5

Course Objectives:	
1	Understand the role and scope of Engineering Economics and the process of economic decision making
2	Understand the different concepts of cost and different cost estimation techniques
3	Familiarization with the concepts of cash flow, time value of money and different interest formulas
4	Appreciation of the role of uncertainty in future events and using different concepts from probability to deal with uncertainty
5	Understand the concepts of Depreciation and Replacement analysis along with their methods of calculation
6	Familiarization with the phenomenon of inflation and the use of price indices in engineering Economics
7	Introduction to basic concepts of Accounting and Financial Management

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Economic Decisions Making: Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models – Per Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve.	8L
2	Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal& Effective Interest. Cash Flow & Rate of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing an Analysis Method, Future Worth Analysis,	9L

	Benefit-Cost Ratio Analysis, Sensitivity and Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks.	
3	Inflation and Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees,	9L
4	Depreciation: Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. Accounting and Finance – Function, Balance Sheet, Income Statement, Financial Ratio Analysis. Break Even Analysis.	10L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Discuss fundamentals of economic analysis.
2	Describe rate of return and profitability analysis, Present, Future, Annuity, Risk and return, BEP and Sensitivity Analysis, Bayesian joint probability and quantitative decision making, basic accounting system and balance sheet and P & L accounts etc.
3	Apply decision making skills in terms of Economic, financial considerations in practice.
4	Apply knowledge to take right financial decision at the right point in time in real world situation.

Learning Resources:	
1	James L.Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e,Tata McGraw-Hill
2	Donald Newnan, Ted Eschembach, Jerome Lavelle: Engineering Economics Analysis, OUP

3	R. Paneer Seelvan: Engineering Economics, PHI
4	Sullivan and Wicks: Engineering Economy, Pearson
5	John A. White, Kenneth E. Case, David B. Pratt : Principle of Engineering EconomicAnalysis, John Wiley

Course Name:	**Theory of Computation**		
Course Code:	PE-IT 501A	**Category:**	Professional Elective Courses
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Formal Language & Automata Theory
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To construct finite state machines and the equivalent regular expressions.
2	To prove the equivalence of languages described by finite state machines and regular expressions.
3	To construct pushdown automata and the equivalent context free grammars.
4	To prove the equivalence of languages described by pushdown automata and context free grammars.
5	To construct Turing machines.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Fundamentals:** Basic definition of sequential circuit, block diagram, mathematical representation, and concept of transition table and transition diagram (Relating of Automata concept to sequential circuit concept) Design of sequence detector, Introduction to finite state model [2L]. **Finite state machine:** Definitions, capability & state equivalent, k^{th}-equivalent concept [1L]. Merger graph, Merger table, Compatibility graph [1L]. Finite memory definiteness, testing table & testing graph. [1L]. Deterministic finite automaton and non-deterministic finite automaton [1L].Transition diagrams and Language recognizers [1L]. **Finite Automata:** NFA with Î transitions - Significance, acceptance of languages [1L]. **Conversions and Equivalence:** Equivalence between NFA with and without Î transitions. NFA to DFA conversion [2L]. Minimization of FSM, Equivalence between two FSM's, Limitations of FSM [1L]. Application of finite automata, Finite Automata without put-Moore & Melay machine [2L].	13L

2	**Regular Languages:** Regular sets [1L]. Regular expressions, identity rules. Arden's theorem state and prove [1L]. Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA [1L]. Pumping lemma of regular sets. Closure properties of regular sets (proofs not required) [1L]. **Grammar Formalism:** Regular grammars – right linear and left linear grammars [1L]. Equivalence between regular linear grammar and FA.[1L] Interconversion, Context free grammar[1L]. Derivation trees, sentential forms. Right most and left most derivation of strings (Concept only) [1L].	8L
3	**Context Free Grammars:** Ambiguity in context free grammars [1L]. Minimization of Context Free Grammars [1L]. Chomsky normal form and Greibach normal form [1L]. Pumping Lemma for Context Free Languages [1L]. Enumeration of properties of CFL (proofs omitted). Closure property of CFL, Ogden's lemma & its applications [1L]. **Push Down Automata:** Push down automata, definition.[1L] Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence[1L]. Equivalence of CFL and PDA, inter conversion. (Proofs not required)[1L]. Introduction to DCFL and DPDA.[1L]	9L
4	**Turing Machine:** Turing Machine, definition, model [1L]. Design of TM, Computable functions [1L]. Church's hypothesis, counter machine [1L]. Types of Turing machines (proofs not required)[2L]. Universal Turing Machine, Halting problem [2L].	6L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Define a system, recognize the behavior of a system, minimize and compare different systems.
2	Convert Finite Automata to regular expression and able to check equivalence between regular linear grammar and FA.
3	Minimize context free grammar, and check equivalence of CFL and PDA.
4	Design Turing Machine.

Learning Resources:	
1	"Introduction to Automata Theory Language and Computation", Hopcroft H.E. and Ullman J. D., Pearson education.
2	"Theory of Computation", R. B.Patel & Prem Nath, Khanna Book Publishing.
3	"Theory of Computer Science", Automata Languages and computation", Mishra and Chandrashekaran, 2nd edition, PHI.
4	"Formal Languages and Automata Theory", C. K. Nagpal, Oxford

5	"Switching & Finite Automata", ZVI Kohavi, 2nd Edn.,Tata McGraw Hill
6	"Introduction to Computer Theory", DanielI. A. Cohen, John Wiley
7	"Introduction to languages and the Theory of Computation", John C Martin,TMH
8	"Elements of Theory of Computation", Lewis H.P. & Papadimitrou C.H. Pearson, PHI

Course Name:	**Machine Learning**		
Course Code:	PE-IT501B	**Category:**	PE
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic knowledge of probability and statistics and knowledge of programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
2	To design and analyze various machine learning algorithms and techniques
3	Explore supervised and unsupervised learning paradigms of machine learning
4	To explore recent trends in various machine learning techniques

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Machine Learning:** • Machine Learning Concepts • Application, Issues and tools of Machine Learning	3L
2	**Concept Learning:** Inductive learning hypothesis, FIND-S algorithm, Version space, candidate elimination algorithm, Inductive bias	4L
3	**Supervised Learning (Regression/Classification)**: • Basic Classification methods: k-Nearest-Neighbors, Decision Trees, Naive Bayes, Support Vector Machine •Regression: Simple and Multiple Regression, Logistic Regression	9L
4	**Unsupervised Learning:** • Clustering Techniques: Partitioning methods (k-Means, k-Medoid). Hierarchical methods(Agglomerative and Decisive	7L

	Techniques: (MIN, MAX, Group Average, Ward's method) and Density based Methods (DBSCAN) • Soft clustering Algorithms: Weighted K-means, FCM, Gaussian mixture model (GMM) with Expectation Maximization (EM)	
5	**Model Evaluation:** • Evaluating Machine Learning algorithms and Model Selection • Ensemble Methods (Boosting, Bagging, Random Forests) • Modeling Time Series Data	4L
6	**Artificial Neural Network:** • How ANN Works, Activation functions, Perceptron, McCulloh-Pits model • Architecture of ANN(single layer feed forward, multilayer feed forward, competitive network, recurrent network) • Back propagation Algorithm • Concepts of Deep Learning: Basics of CNN and RNN	6L
7	**Reinforcement Learning:** • Basic Concepts • Model based learning • Temporal difference based learning	3L
8	Recent trends in various learning techniques of machine learning and classification methods	4L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the methods involved in generating models from data
2	Understand a wide variety of learning algorithms
3	Understand how to evaluate models generated from data
4	Optimize the models learned and report on the expected accuracy that can be achieved when applying the models to solve the problems
5	Apply the machine learning algorithms to solve various real-world problems

Learning Resources:	
1	Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2	Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online).
3	Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4	Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018.
5	Ethem Alpaydin, Introduction to Machine Learning, Second Edition.

Course Name:	**Data Mining**		
Course Code:	PE-IT501C	**Category:**	Professional Elective
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Should have knowledge of Programming Logic
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand data pre-processing and data visualization techniques
2	Study algorithms for finding hidden and interesting patterns in data
3	Understand and apply various classification and clustering techniques using tools.
4	Understand and apply Data Mining Tools to solve real life problems

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to Data Mining**: Data Mining Concept, Goals, Stages of Mining Process, Applications, Techniques, Knowledge representation methods, Challenges.	4L
2	**Data Preprocessing**: Data types, Quality, Descriptive data summarization – central tendency and dispersion measure, Data cleaning, Outlier detection, Data integration and transform, Data dimension reduction.	6L
3	**Association Rule Mining**: Market-basket analysis basics, Naïve algorithm, Apriori algorithm, Software for Association Rule Mining.	6L
4	**Classification and Prediction**: Decision Tree, Bayesian classification, Rule-based classification, Prediction – Linear Regression	6L
5	**Clustering**: Basic issues in clustering, Partitioning methods: k-means, Hierarchical methods: distance-based agglomerative and divisible clustering, Cluster Analysis.	6L
6	**Data Mining Software and Applications**: Text mining Basics: extracting attributes(keywords), structural approaches (parsing, soft parsing), Bayesian approach to classifying text, Web mining: classifying web pages, extracting knowledge from the web, Social impacts of data mining, information privacy and data security, IT Act overview.	8L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply suitable pre-processing and visualization techniques for data analysis
2	Apply frequent pattern and association rule mining techniques for data analysis
3	Apply appropriate classification and clustering techniques for data analysis
4	Use Data Mining tools and Software's to solve real world problems

Learning Resources:	
1	Tan, Steinbach and Kumar, Introduction to Data Mining, Pearson
2	Han and Camber, Data Mining: Concepts and Techniques, Morgan Kaufmann
3	Foreman, Data Smart: Using Data Science to Transform Information into Insight, John Wiley
4	Dunham, Data Mining : Introductory and Advanced Topics, Pearson
5	Vipin Kumar: Introduction to Data Mining, Pearson
6	Ian, H. Witten, Frank: Data Mining: Practical Machine Learning Tools and Techniques,

Course Name:	**Distributed Systems**		
Course Code:	**PE-IT501D**	**Category:**	**Professional Elective**
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Database Management System, Operating System
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the fundamentals of distributed systems.
2	To understand theoretical concepts, namely, virtual time, agreement and consensus protocols.
3	To understand IPC, Group Communication & RPC Concepts.
4	To understand the DFS and DSM Concepts.
5	To understand the concepts of transaction in distributed environment and associated concepts, namely, concurrency control, deadlocks and error recovery.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Characterization of Distributed Systems:** Introduction, Examples of Distributed Systems, Resource Sharing and the Web, Challenges. **System Models:** Introduction, Architectural Models, Fundamental Models	5L
2	**Time and Global States:** Introduction, Clocks Events and Process States, Synchronizing Physical Clocks, Logical Time and Logical Clocks, Global States, Distributed Debugging. **Coordination and Agreement:** Introduction, Distributed Mutual Exclusion, Elections, Multicast Communication, Consensus and Related Problems.	8L
3	**Inter Process Communication:** Introduction, The API for the Internet Protocols, External Data Representation and Marshalling, Client-Server Communication, Group Communication, Case Study : IPC in UNIX. **Distributed Objects and Remote Invocation:** Introduction, Communication between Distributed Objects, Remote Procedure Call, Events and Notifications, Case Study: JAVA RMI.	9L
4	**Distributed File Systems:** Introduction, File Service Architecture Case Study 1: Sun Network File System, Case Study 2: The Andrew File System. **Name Services:** Introduction, Name Services and the Domain Name System, Directory Services, Case Study of the Global Name Services. **Distributed Shared Memory:** Introduction, Design and Implementation Issues, Sequential Consistency and IVY case study, Release Consistency, Other Consistency Models	8L
5	**Transactions and Concurrency Control:** Introduction, Transactions, Nested Transactions, Locks, Optimistic Concurrency Control, Timestamp Ordering, Comparison of Methods for Concurrency Control. **Distributed Transactions:** Introduction, Flat and Nested Distributed Transactions, Atomic Commit Protocols, Concurrency Control in Distributed Transactions, Distributed Deadlocks, Transaction Recovery	6L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the concept of Distributed Systems.
2	Understand the various synchronization issues and global state for distributed systems.
3	Understand the Mutual Exclusion and Deadlock Detection algorithms in distributed systems.
4	Describe the agreement protocols and fault tolerance mechanisms in distributed systems.
5	Describe the features of peer to peer and distributed shared memory systems

Learning Resources:	
1	Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems, Principles and Paradigms" PHI.
2	Sukumar Ghosh,"Distributed Systems, An Algorithm Approach", Chapman & Hall/CRC, Taylor &Fransis Group.
3	Pradeep K. Sinha, "Distributed Operating Systems: Concepts and Design", PHI.
4	MukeshSinghal and Niranjan G. Shivratri, "Advanced concepts in Operating Systems", McGraw-Hill Inc.

Course Name:	**Compiler Design Lab**		
Course Code:	PC-IT591	**Category:**	Engineering Science
Semester:	Fifth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Basic concepts of programming language
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To facilitate students with the implementation of symbol table, lexical analyzer using LEX and YACC tool.
2	To understand how to implement control flow analysis and Data flow Analysis.
3	To implement type checking.
4	To implement idea of storage allocation strategies.
5	To develop construction of DAG.
6	To understand how to implement the back end of the compiler.
7	Implementation of Simple Code Optimization Techniques.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Lab1: Implementation of Symbol Table. Lab2: Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.)	6P
2	Lab3: Implementation of Lexical Analyzer using Lex Tool. Lab4: Generate YACC specification for a few syntactic categories. a) Program to recognize a valid arithmetic expression that uses operator +, – , * and /. b) Program to recognize a valid variable which starts with a letter	6P

	followed by any number of letters or digits. c)Implementation of Calculator using LEX and YACC	
3	Lab5: Convert the BNF rules into Yacc form and write code to generate Abstract Syntax Tree. Lab6: Implement type checking.	9P
4	Lab7: Implement control flow analysis and Data flow Analysis. Lab8: Implement any one storage allocation strategies (Heap, Stack, and Static).	9P
5	Lab9: Implement the back end of the compiler which takes the three address code and produces the 8086 assembly language instructions that can be assembled and run using 8086 assembler. The target assembly instructions can be simple move, add, sub, jump. Also simple addressing modes are used.	6P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Be exposed to compiler writing tools.
2	Learn to implement the different Phases of compiler.
3	Be familiar with control flow and data flow analysis.
4	Learn simple optimization techniques.

Learning Resources:	
1	Holub - "Compiler Design in C" - PHI.
2	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name:	**Operating Systems Lab**		
Course Code:	PC-IT 592	**Category:**	PC
Semester:	Fifth	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Knowledge of Linux operating system
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To understand the main components of an OS & their functions.
2	To study the process management and scheduling.
3	To understand various issues in Inter Process Communication (IPC) and the role of OS in IPC.
4	To understand the working of an OS as a resource manager, file system manager, process manager, memory manager and I/O manager and methods used to implement the different parts of OS.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	Shell programming: Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, and commands.	8P
2	Process: Starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.	8P
3	Signal: Signal handling, sending signals, signal interface, signal sets.	8P
4	Semaphore: Programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).	8P
5	POSIX Threads: Programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel).	8P
6	Inter-process communication: Pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO).	8P
Total		**48P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the practical knowledge of the different types functions and structures of Unix OS.
2	Apply the necessary knowledge various process management concepts like scheduling, synchronization etc.
3	Apply the necessary knowledge and skills for developing and debugging C and other programs in UNIX environment.

Learning Resources:	
1	Unix Shell Programming by Yashvant Kanetkar
2	Unix & Shell Programming by Behrouz A. Forouzan
3	Lab Manual

Course Name:	**Object Oriented Programming Lab**		
Course Code:	PC-IT593	**Category:**	Professional Core Courses
Semester:	Fifth	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Concept of Computer Programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To learn the fundamentals of object-oriented concepts
2	To implement the object-oriented concepts by a programming language
3	To be able to apply the programming skill to implement real world project

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Assignments on class, constructor, overloading, inheritance, overriding	16P
2	Assignments on Wrapper classes and Arrays	4P
3	Assignments on Interfaces - multiple inheritance, extending interfaces	8P
4	Assignments on creating and accessing Packages	4P
5	Assignments on Exception Handling	4P
6	Assignments on Applet Programming	12P
Total		**48P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Specify simple abstract data types and design implementations, using abstraction functions to document them.
2	Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity
3	Apply some common object-oriented design patterns and give examples of their use
4	Design applications with an event-driven graphical user interface

Learning Resources:	
1	Rambaugh, James Michael, Blaha – "Object Oriented Modeling and Design" – Prentice Hall, India
2	Ali Bahrami – "Object Oriented System Development" – McGraw Hill
3	Patrick Naughton, Herbert Schildt – "The complete reference – Java2" – TMH

4	E. Balagurusamy – "Programming With Java: A Primer" – 3rd Ed. – TMH
5	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson

Course Name:	**Soft Skill Development Lab**		
Course Code:	HM-HU591	**Category:**	HM
Semester:	Fifth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To equip the students with good communication skills.
2	Enable the students to think and speak effectively on everyday topics, including topics related to technical concepts.
3	To prepare them for interviews and future job environments.
4	Developing industry-ready attitude towards professional communication.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	Conversation Practice Sessions - General Conversation – Warm-up sessions – Basics of Communication, verbal and non-verbal communication.	4P
2.	Group Discussion - Group Discussion & Debates, Do's & Don'ts, etc., Intensive Practice Sessions.	8P
3.	Interview sessions: Principles and practices of Personal Interview. Do's and Don'ts of facing an interview. SWOC Analysis. Rigorous practices of mock-interviews.	6P
4.	Presentations: Fundamentals of presentation skills, Secrets of an effective presentation, Presentation Practice Sessions with the help of power point presentation and other audio-visual aids, Face question answer sessions at the end of their presentation.	6P
Total		**24P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Honing over all Communicative Competence.
2	Develop Team Building and Leadership Quality.
3	Deliver an enthusiastic and well-practiced presentation
4	Communicate with clarity and confidence thereby enhancing employability skills of the students.

Learning Resources:	
1	Soft Skills: Key to success in Workplace and Life, Meenakshi Raman and Shalini Upadhyay
2	Communication Skills. Sanjay Kumar and PushpLata, Oxford University Press, 2011.
3	Monipally: Business Communication, Tata McGraw Hill
4	Madhukar: Business Communications; Vikas Publishing House
5	Senguin J: Business Communication; Allied Publishers
6	Business Communication: Rajendrapal & Korlahalli

Course Name:	**Project-I**		
Course Code:	PW-IT581	**Category:**	Sessional Course
Semester:	Fifth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Knowledge of engineering, science and management subjects
Full Marks:	100		
Examination Scheme:	Semester Examination: 20		Continuous Assessment: 80

Course Objectives:	
1	In depth knowledge gain in the domain of the assigned topic.
2	To be able to formulate the problem in the assigned topic.
3	To be able to execute the action plan for conducting the project as a team work.
4	To be able to perform development of product/process, testing, analysing the results and future scope.

Course Outcomes:	
After completion of the course, students will be able to:	
1	Work as a team member.
2	Prepare a report in the standard format.
3	Present Seminar before any standard body.

Course Name:	**Aptitude Skill Development-I**		
Course Code:	MC571	**Category:**	**Mandatory Courses**
Semester:	Fifth	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	Basic knowledge of Mathematics and English Language
Full Marks:	100		
Examination Scheme:	Continuous Assessment: 100		

Course Objectives:	
1	To be familiar with the basic concepts of QUANTITATIVE ABILITY.
2	To be familiar with the basic concepts of LOGICAL REASONING Skills.
3	To be familiar with the basic concepts of PROBABILITY.
4	Acquire knowledge in VERBAL REASONING and VOCABULARY

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Basics of Quantitative Abilities: Number System, HCF and LCM, Average, Ratio, Proportion and Variations, Problems on Percentage.	4L
2	Arithmetic Quantitative Abilities: Problems on Ages, Profit and Loss, Time and Work, Problems on Simple and Compound Interest, Problems on Time, Speed and Distance.	6L
3	Permutation and Combination, Set theory, Venn Diagram, Probability	5L
4	Logical Reasoning: Number Series, Alpha Numerical, Letter & Symbol Series, Syllogisms Numerical and Alphabet Puzzles, Seating Arrangement, Blood Relation and Calendars.	7L
5	Data Interpretation	2L
6	Verbal: Analogies, Antonym, Synonym, Sentence Correction, Fill in the Blanks	3L
Total		**27L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the basic concepts of QUANTITATIVE ABILITY.

2	Understand the basic concepts of LOGICAL REASONING Skills.
3	Understand the basic concepts of PROBABILITY.
4	Acquire satisfactory competency in use of VERBAL REASONING

Learning Resources:	
1	Arun Sharma, "Quantitative abilities", McGraw-Hill
2	R.S.Agrawal, "Quantitative Aptitude for Competitive Examinations", S.Chand
3	R.S.Agarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning ", S.Chand

Course Name:	**Constitution of India**		
Course Code:	MC572	**Category:**	Mandatory Courses
Semester:	Fifth	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Continuous Assessment: 100		

Course Objectives:	
1	Develop an understanding of the nation's constitution.
2	Develop knowledge about the various levels of governance in the country.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction:** Sources and Constitutional history. Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.	3L
2	**Union Government and its Administration :** Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Lok Sabha, Rajya Sabha Supreme Court	6L
3	**State Government and its Administration:** Governor**.** Role and Position, CM and Council of ministers High Court	6L
4	**Local Administration District's Administration head:** Role and Importance, Municipalities: Introduction, Mayor, and role of Elected Representative. Pachayati raj: Introduction, Zila Pachayat, Elected officials and their roles. Importance of grass root democracy	6L

5	**Election Commission Election Commission:** Role and Functioning, Chief Election Commissioner	3L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Gain an understanding of the constitution of India.
2	Become aware of the various levels of governance in the country.

Learning Resources:	
1	'Indian Polity' by Laxmikanth
2	'Indian Administration' by Subhash Kashyap
3	'Indian Constitution' by D.D. Basu
4	'Indian Administration' by Avasti and Avasti