

**Semester V (Third year) Curriculum**  
**Branch/Course: Information Technology**

Sl. No	Type of Course	Code	Course Title	Hours Per Week			Credits	Marks
				L	T	P		
1	Engineering Science	ESC-EC 501	Signals & Systems	3	0	0	3	100
2	Professional Core Course	PCC-IT 501	Database Management Systems	3	0	0	3	100
		PCC-IT 551	Database Management Systems Laboratory	0	0	4	2	100
3	Professional Core Course	PCC-IT 502	Formal Language & Automata Theory	3	0	0	3	100
4	Professional Core Course	PCC-IT 503	Object Oriented Programming	2	0	0	2	100
		PCC-IT 553	Object Oriented Programming Laboratory	0	0	4	2	100
5	Professional Elective Course	PEC-IT I	Professional Elective –I	3	0	0	3	100
6	Mandatory Course	MC-HU 501	Constitution of India	3	0	0	0	100*
7	Humanities and Social Sciences including Management courses	HSM-HU 581	Grooming & Personality Development	0	0	2	1	100
				<b>Total</b>			<b>19</b>	<b>800</b>

PEC-IT I		
Sl. No.	Code	Subject Name
1	PEC-IT 511(a)	Advanced Algorithm
2	PEC-IT 511(b)	Advanced Computer Architecture
3	PEC-IT 511(c)	Artificial Intelligence
4	PEC-IT 511(d)	Computer Graphics

\*Marks for this non-credit subject will not be considered in total marks of the semester.

**Semester VI (Third year) Curriculum**  
**Branch/Course: Information Technology**

Sl. No	Type of Course	Code	Course Title	Hours Per Week			Credits	Marks
				L	T	P		
1	Professional Core Course	PCC-IT 601	Software Engineering	3	0	0	3	100
		PCC-IT 651	Software Engineering Laboratory	0	0	4	2	100
2	Professional Core Course	PCC-IT 602	Computer Networks	3	0	0	3	100
		PCC-IT 652	Computer Networks Laboratory	0	0	4	2	100
3	Professional Core Course	PCC-IT 653	Programming with Python	0	0	4	2	100
4	Professional Elective Course	PEC-IT II	Professional Elective -II	3	0	0	3	100
5	Professional Elective Course	PEC-IT III	Professional Elective -III	3	0	0	3	100
6	Open Elective Course	OEC-X 621**	Open Elective-I	3	0	0	3	100
7	Humanities and Social Sciences including Management courses	HSM-HU 681	Group Discussion & Personal Interview	0	0	2	1	100
8	Project	PROJ-IT 691	Project – I	0	0	6	3	100
				<b>Total</b>			<b>25</b>	<b>900</b>

PEC-IT II			PEC-IT III		
Sl. No.	Code	Subject Name	Sl. No.	Code	Subject Name
1	PEC-IT 611(a)	Parallel and Distributed Algorithms	1	PEC-IT 612(a)	Computational Number Theory
2	PEC-IT 611(b)	Compiler Design	2	PEC-IT 612(b)	Advanced Operating System
3	PEC-IT 611(c)	Data Mining	3	PEC-IT 612(c)	Machine learning
4	PEC-IT 611(d)	Image Processing	4	PEC-IT 612(d)	Web & Internet Technology

\*\* Here X indicates the codes of the offering departments such as HU/EC/EI/M. Refer to Appendix-I

**Semester VII (Fourth year) Curriculum**  
**Branch/Course: Information Technology**

Sl. No	Type of Course	Code	Course Title	Hours Per Week			Credits	Marks
				L	T	P		
1	Professional Elective Course	PEC-IT IV	Professional Elective –IV	3	0	0	3	100
2	Professional Elective Course	PEC-IT V	Professional Elective –V	3	0	0	3	100
3	Open Elective Course	OEC-X 721**	Open Elective-II	3	0	0	3	100
4	Humanities & Social Sciences Including Management Courses	HSM-HU 702	Values and Ethics	2	0	0	2	100
5	Project	PROJ-IT 791	Project-II	0	0	12	6	100
6	Project	PROJ-INT 791	Internship	0	0	***	2	100
				<b>Total</b>			<b>19</b>	<b>600</b>

PEC-IT IV			PEC-IT V		
Sl. No.	Code	Subject Name	Sl. No.	Code	Subject Name
1	PEC-IT 711(a)	Pattern Recognition	1	PEC-IT 712(a)	Quantum Computing
2	PEC-IT 711(b)	Internet of Things	2	PEC-IT 712(b)	Distributed System
3	PEC-IT 711(c)	Data Analytics	3	PEC-IT 712(c)	Soft Computing
4	PEC-IT 711(d)	Natural Language Processing	4	PEC-IT 712(d)	Cryptography and Network Security

\*\* Here X indicates the codes of the offering departments such as HU/EC/EI/M. Refer to Appendix-I

\*\*\* An Internship of 40 hours per week to be done after 2<sup>nd</sup> / 4<sup>th</sup> / 6<sup>th</sup> semester examination (during semester gap)

**Semester VIII (Fourth year) Curriculum**  
**Branch/Course: Information Technology**

Sl. No	Type of Course	Code	Course Title	Hours Per Week			Credits	Marks
				L	T	P		
1	Professional Elective Course	PEC-IT VI	Professional Elective –VI	3	0	0	3	100
2	Open Elective Course	OEC-X 821**	Open Elective-III	3	0	0	3	100
3	Open Elective Course	OEC-X 822**	Open Elective-IV	3	0	0	3	100
4	Project	PROJ-IT 891	Project-III	0	0	12	6	100
				<b>Total</b>			<b>15</b>	<b>400</b>

PEC-IT VI		
Sl. No.	Code	Subject Name
1	PEC-IT 811(a)	Cyber Security and Computer Forensics
2	PEC-IT 811(b)	Multimedia Technology
3	PEC-IT 811(c)	Neural Networks and Deep Learning
4	PEC-IT 811(d)	Cloud Computing

\*\* Here X indicates the codes of the offering departments such as HU/EC/EI/M. Refer to Appendix-I

## **APPENDIX-I**

### **Open Elective Courses (OEC) List**

Sl. No	Paper code	Sem.	Name of the paper
1.	OEC-HU 521(a)	5th	Sanskrit for Technical Knowledge
2.	OEC-PH 521(b)	5th	Material Science
3.	OEC-EC 521(c)	5th	Bio Medical Electronics
4.	OEC-CSE 521(d)	5th	Introduction to Object Oriented Technology & Python
5.	OEC- EI 521(e)	5th	Optical Instrumentation
6.	OEC-HU 621(a)	6th	History of Science & Engineering in India
7.	OEC-HU 621 (b)	6th	Infrastructure Finance
8.	OEC-EC 621(c)	6th	Microprocessors & Its Applications
9.	OEC-EI 621(d)	6th	Microprocessors & Its Programming
10.	OEC-M 621(e)	6th	Computational Methods
11.	OEC-HU 721(a)	7th	Introduction to Comparative literature
12.	OEC-HU 721(b)	7th	Economic Policies in India
13.	OEC-M 721(c)	7th	Mathematical Formulation & Approximations
14.	OEC-HU 721(d)	7th	Soft Skills & Interpersonal Communication
15.	OEC-EI 721(e)	7th	MEMS
16.	OEC-EC 721(f)	7th	Nano Electronics
17.	OEC-EE 722(a)	7th	Renewable Energy
18.	OEC-ME 722(b)	7th	Modern Manufacturing Practice
19.	OEC-ME 722(c)	7th	Heat & Thermal Engineering
20.	OEC-M 821(a)	8th	Advanced Operations Research
21.	OEC-EE 821(b)	8th	Advanced Topics in Power Systems
22.	OEC-CE 821(c)	8th	Quality Control & Management
23.	OEC-HU 821(d)	8th	Cyber Law and Computer Ethics
24.	OEC-EC 821(e)	8th	Satellite Communication
25.	OEC-EE 821(f)	8th	Energy Audit & Management
26.	OEC-HU 822(a)	8th	Digital Marketing
27.	OEC-HU 822(b)	8th	Human Resource Development & Organizational Behavior
28.	OEC-EC 822(c)	8th	Machine Learning
29.	OEC-EI 822(d)	8th	Sensor Technology
30.	OEC-EE 822(e)	8th	Automotive Control & Robotics
31.	OEC-ME 822(f)	8th	Power Plant Engineering

**Note: Please Refer the OEC Booklet for Detailed Syllabus of these papers**

## Appendix-II

### **List of Massive Open Online Courses (MOOCs) for Information Technology**

In order to have an Honours degree, a student may choose 20 credits from the following courses in addition to the regular curriculum. He / She have to complete MOOCs during entire four years of B.E course and before the final semester (regular) examinations.

Sl.No.	List of courses	Duration (weeks)	Credit	Offered by	Pre-requisite (if any)
1	Introduction to scripting in Python	8	3	Coursera	Basic knowledge of computer programming
2	Web Application Development	6	2	Coursera	JAVA Scripts, HTML, CSS
3	Introduction to Cisco Networking	4	1	Coursera	Basic knowledge of networking
4	Introduction to Computing for Data Analysis with Python	6	2	edX	None
5	Algorithms for Big Data	8	3	NPTEL	Data Structure, Algorithms, Computer Architecture, Operating System, Database Management Systems
6	Programming, Data Structures and Algorithms using Python	8	2	NPTEL	School level mathematics
7	Ethical Hacking	8	2	Udemy	Basic concepts in programming and networking
8	Cybersecurity and its 10 domains	7	2	Coursera	Computer Network, Web & Internet
9	IoT Programming and Big Data	5	2	edX	Algorithms
10	Software testing	12	3	Coursera	Basic knowledge of programming
11	Entrepreneurship in Emerging Economies	6	2	edX	None
12	Robotics: Aerial Robotics	6	2	Coursera	None
13	Deep learning in Computer Vision	5	2	Coursera	Knowledge of image processing and neural networks
14	Optimization from fundamentals	12	4	NPTEL	None
15	Embedded Systems	12	3	NPTEL	Knowledge of computer architecture
16	Introduction to Industry 4.0 and Industrial Internet of Things	12	3	NPTEL	Basics of Internet of Things (IoT)
17	IoT System Design: Software and Hardware Integration	4	1	edX	Knowledge of basic electronics, machine learning
18	Block chain and Fin Tech: Basics, Applications, and Limitations	6	2	edX	Substantial programming experience, software engineering
19	Becoming an Entrepreneur	6	2	edX	None
20	Marketing Fundamentals	4	1	edX	None
21	IBM Data Science Professional Certificate	8	2	Cousera	Knowledge of programming, statistics and machine learning
22	Big Data Computing	8	3	NPTEL	Data Structure, Algorithms, Computer Architecture, Operating System, Database Management Systems
23	Machine learning with Tensor Flow on Google Cloud Platform Specialization	4	1	Cousera	Basic Knowledge of Deep learning and cloud computing
24	Convolution Neural Network	4	1	Cousera	Basic Knowledge of Neural Network
25	Cloud Computing Infrastructure	8	2	edX	Networking, Operating System, Virtualization
26	AWS Fundamental: Going Cloud Native	5	2	Coursera	Programming Language, OS, Networking

Sl.No.	List of courses	Duration (weeks)	Credit	Offered by	Pre-requisite (if any)
27	Remote Sensing and Digital Image Processing of Satellite Data	8	2	NPTEL	GIS fundamentals, Image processing
28	Leadership for Engineers	6	2	edX	None
29	Computer Forensics	8	2	edX	Computer security, knowledge of all operating systems, digital storage devices, networking, data recovery
30	Fuzzy Sets, Logic and System Application	12	3	NPTEL	Set Theory, Logic, and Engineering Mathematics.
31	Electronic Systems for Cancer Diagnostics	12	3	NPTEL	Electronics, Engineering Mathematics
32	Data Analytics with Python	12	3	NPTEL	Data science, Programming concept
33	Optical Engineering	12	3	NPTEL	Physics, Engineering Mathematics
34	Data Science for Engineers	8	2	NPTEL	Statistics, algorithms/logic
35	Embedded Systems Design	12	3	NPTEL	Basic electronics, digital electronics, knowledge of microcontrollers and programming
36	Introduction to Block Chain Technology and Applications	8	2	NPTEL	Data Structure, Algorithm, Programming language
37	User-Centric Computing for Human-Computer Interaction	8	2	NPTEL	Knowledge of C programming language/UNIX, Java
38	Reinforcement Learning	12	3	NPTEL	Linear algebra, multivariable calculus, ML
39	VLSI Physical Design	12	3	NPTEL	Logic design, spanning combinational and sequential logic, analog electronic ckt
40	Randomized Algorithms	12	3	NPTEL	Data structure, discrete probability theory
41	Embedded System Design with ARM	8	2	NPTEL	Digital electronics, c programming
42	Python for Data Science and AI	5	2	Coursera	Understanding of programming
43	Improving Deep Neural networks: Hyper parameter tuning, regularization and optimization	3	1	Coursera	Linear algebra, calculus, statistics, ML
44	Deep learning Specialization	5	2	Coursera	Linear algebra, calculus, statistics, ML
45	TensorFlow in Practice Specialization	4	1	Coursera	ML, python programming
46	Statistics with Python Specialization	3	1	Coursera	Basic programming
47	Fuzzy Logic and Neural Networks	8	2	NPTEL	Set theory
48	GPU Architectures and Programming	12	3	NPTEL	Basic CUDA programming using C
49	Google Cloud Computing Foundation Courses	8	2	NPTEL	None
50	Privacy and Security in Online Social Media	8	2	NPTEL	Knowledge in social media like facebook, linkedin, instagram, whats app etc.

Note:

1. Students can pursue these courses from standard course providers such as NPTEL / Edureka / Coursera etc. on the given topics from any IITs/IISC or other standard institutes of repute.
2. The given list is not exhaustive. Students can also pursue courses on relevant topics **after proper consultation with the department / mentor.**
3. In a semester students can choose the course from the MOOCs list without coinciding with the subjects from Professional Core Course (PCC) / Professional Elective Course (PEC) in that semester.

**Semester-V**

Course Code	ESC-EC 501				
Category	Engineering Science Courses (ESC)				
Course Title	Signals and Systems				
Scheme and Credits	L	T	P	Credit	Semester-V
	3	0	0	3	
Pre-requisites (if any)					

**Theory Syllabus**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<b>Introduction Signals and Systems:</b> Definition of Signal, Classification of signals: Continuous & Discrete time, Even & Odd, Periodic & Aperiodic, Deterministic & Random, Energy & Power Signals. Discussion about elementary signal forms: Exponential, Sinusoidal, Unit Step, Unit Impulse, Unit Ramp etc. Transformation of independent variables: Time Shifting, Time Scaling & Time Inversion. Introduction to System and basic System Properties.	<b>8L</b>
<b>2.</b>	<b>Fourier Analysis of Continuous and Discrete Time Signals:</b> Introduction, Fourier series representation of continuous time periodic signals, Convergence of the Fourier series, Properties of Continuous time Fourier series, Aperiodic signal representation by Fourier Transform, Fourier Transform of some useful functions, Properties of Fourier Transform, Convolution: Time and Frequency Convolution, Parseval's theorem for energy and power signals, Energy and Power. Spectral Density Functions, Properties of ESD and PSD. Auto and Cross correlation properties of Energy and Power signals. Concept of distortion less transmission through LTI systems. Introduction, Discrete Time Fourier Transform of Aperiodic signals, Properties of Discrete Time Fourier Transform (DTFT). Discrete Time Fourier Transform of Periodic signals. Discrete Time LTI systems characterized by Linear Constant-Coefficient Difference.	<b>16L</b>



<b>3.</b>	<b>Sampling :</b> Sampling theorem, impulse train sampling, zero order hold, interpolation, and aliasing. Discrete time sampling.	<b>4L</b>
<b>4.</b>	<b>Continuous and Discrete Time LTI System:</b> Introduction, Continuous time Unit Impulse response and Convolution integral, Convolution sum for discrete time LTI systems. Properties of LTI Systems. Static & Dynamic LTI Systems, Invertibility of LTI Systems, Causality & Stability of LTI Systems, Paley-Wiener Criteria. Z Transform: Introduction, The Z Transform, The Region of Convergence (ROC) for the z Transform, Properties of Z Transform. The Inverse Z Transform. Analysis and Characterization of continuous and discrete time LTI systems.	<b>14L</b>
	<b>Total:</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of Week Reserved:</b>	<b>02</b>

### **Text/Reference Books:**

1. Signals and Systems: Alan V. Oppenheim & Alan S. Willsky, P.H.I.
2. Signals and Systems: P. Ramesh Babu, R.Anandanatarajan, Scitech Pub.
3. Signals and Systems: Simon Haykin & Barry Van Veen, Wiley.
4. Signals and Systems: T K Rawat, Oxford Publication
5. Signals and Systems: V.Krishnaveni, A.Rajeswari, Wiley.
6. Principles of Signal Processing and Linear Systems: B.P.Lathi, Oxford Pub.
7. Signals and Systems: John Alan Stuller, Cengage Learning.
8. Digital Signal Processing: J.G.Proakis and Manolakis Pearson Edu.

### **Course Outcomes:**

After successful completion of the course student will be able to

- Understand about various types of signals and systems, classify them, analyses them, and perform various operations on them.
- Understand the use of transforms in analysis of signals and system in continuous and discrete time domain.
- Evaluate the time and frequency response of Continuous and Discrete time systems which are useful to understand the behavior of electronic system.

Course Code	PCC-IT 501				
Category	Professional Core Course (PCC)				
Course Title	Database Management Systems				
Scheme and Credits	L	T	P	Credits	Semester - V
	3	0	0	3	
Pre-Requisites (if any)	PCC-IT 402, PCC-IT 403				

### Theory Syllabus:

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<p><b>Introduction:</b> Database system vs. file system, DBMS applications, When not to use a DBMS, Three-schema architecture and data independence, components of a DBMS, structure of a DBMS, Database languages (DCL, DDL, DML).</p> <p><b>Database Design and the Entity Relationship (E-R) Model:</b> Overview of the database design process: Requirements collection and analysis, conceptual design, Logical design, Physical Design.</p> <p>E-R Model: Entity Sets, Relationship Sets, Attributes, Constrains: Mapping Cardinalities, Participation Constraints, Keys. Roles, Weak Entity Sets, Relationship Attributes, Binary versus <i>n</i>-ary Relationship Sets, Specialization, Generalization, Aggregation.</p> <p><b>Relational Model:</b> Relation, Tuples, Domains, Relational integrity constraints, E-R-to- Relational mapping algorithm (9 steps), The relational algebraic operations- selection, projection, Cartesian product, union, intersection, join, division.</p>	<b>14L</b>
<b>2.</b>	<p><b>Structured Query Language (SQL):</b> Domain types, Basic structures, set operations, null values, aggregate functions, nested sub queries, Modifications of database, join expressions, relations, views, transaction, integrity constraints, Authorization, Functions and procedures, Triggers.</p> <p><b>Relational Database Design:</b> Decomposition and Synthesis approach of database design, Functional dependencies (FDs), closure, cover, Atomic domains and first normal form (NF) , Decomposition using FDs, NFsbased on primary keys, second and third NFs, Boyce-Codd NF, Multivalued dependency and fourth NF, Join dependencies and fifth NF, domain-key normal form (DKNF).</p>	<b>8L</b>
<b>3.</b>	<p><b>Storage, File Structure, Indexing and Hashing:</b> Redundant arrays of independent disks (RAID), tertiary storage.</p> <p>File structures: Organization of records in files, database buffer, ordered indices ,</p>	<b>10L</b>

	index definition in SQL <b>Query Processing and Optimization:</b> Steps in query processing, Building Query Graph, Determining cost of evaluating Selection, Join, Projection, Set Theoretic Operation, Aggregate and Join, Combining operations using pipelining, Using heuristics in query optimization.	
4.	<b>Transaction:</b> Properties of the transactions, States of transactions, Transaction Definition in SQL <b>Concurrency Management and Deadlock Handling:</b> Concurrency Control Mechanisms, Conflict and View Serializability, Recoverable schedules, Cascading Rollbacks, Cascade less Schedules, Lock-Based Protocols, Granularity of locking, Timestamp-Based Protocols. Deadlock detection strategies, wait-for graph <b>Recovery system:</b> Types of failure in DBMS, log-based recovery, write-ahead log strategy, recovery-using checkpoint, shadow page scheme, Database backup and recovery from catastrophic failures.	10L
	<b>TOTAL:</b>	42L
	<b>Total Week Required:</b>	14
	<b>No. Of Week Reserved:</b>	02

#### Suggested Text books/ reference books:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2. "An Introduction to Database Systems" by B. C. Desai, Galgotiapublications.
3. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.
4. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education.
5. "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley.

#### Course Outcomes

Upon Completion of the course, the students will be able to perform the following-

- For a given query write relational algebra expressions for that query and optimize the developed expressions.
- For a given specification of the requirement design the databases using E-R method and normalization.
- For a given specification construct the SQL queries for Open source and Commercial DBMS - MYSQL, ORACLE, and DB2.
- For a given query optimize its execution using Query optimization algorithms.
- For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
- Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

Course Code	PCC-IT 551				
Category	Professional Core Course (PCC)				
Course Title	Database Management Systems Laboratory				
Scheme and Credits	L	T	P	Credits	Semester – V
	0	0	4	2	
Pre-Requisites (if any)	PCC-IT 501				

### Laboratory Syllabus:

<b>Module</b>	<b>Detailed Description</b>	<b>Practical Period</b>
1.	Creating table, inserting data, updating table data, data record deletion, Viewing data, modifying table structure, renaming and destroying table.	<b>6P</b>
2.	Arithmetic, logical operator, range searching, pattern matching, numeric function- scalar & group functions, string functions, Date function, table conversion functions.	<b>6P</b>
3.	Null value concept, primary key, and foreign key, unique, creating constraints, creating Indexes.	<b>4P</b>
4.	Grouping data, join, sub-queries, union, intersection, minus clause, indexing, view, granting and revoking permissions.	<b>8P</b>
5.	Introduction to PL/SQL – data type, branching, looping, simple problem solving using PL/SQL, Transaction concepts –commit, rollback, save point, introduction to cursor, parameterized cursor, locking.	<b>16P</b>
6.	Stored procedure and functions, package, trigger.	<b>8P</b>
7.	Use of host language interface with embedded SQL.	<b>4P</b>
8.	Use of user interfaces and report generation utilities typically available with RDBMS products.	<b>4P</b>
	<b>TOTAL:</b>	<b>56P</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

### Books: Text and/or Reference:

1. SQL, PL/SQL The Programming Language of ORACLE- Ivan Bayross ( BPB Publications)
2. Oracle Complete Reference, OraclePress.

## Course Outcomes

Upon Completion of the course, the students will be able to

- Design database for a real world problem.
- Construct and implement complex SQL queries.
- Write PL/SQL codes for solving problems.
- Implement host-language programs using EMBEDDED SQL.
- Design and develop a complete database application.

Course Code	PCC-IT 502				
Category	Professional Core Course (PCC)				
Course Title	Formal Language & Automata Theory				
Scheme and Credits	L	T	P	Credits	Semester – V
	3	0	0	3	
Pre-Requisites (if any)	PCC-IT 301, PCC-IT 401				

## Theory Syllabus:

Module	Detailed Description	Lecture / Tutorial Period
1.	<b>Theory of Automata:</b> Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages Automaton, Transition System, Mealy and Moore machines. <b>Regular languages and Finite Automata:</b> Regular Languages and Regular Expressions, Recognition by Finite Automata, Deterministic and Non-deterministic Finite Automata, Equivalence of DFA and NFA, Minimization of FA. The pumping lemma for regularity, Closure properties of regular sets.	12L
2.	<b>Context-Free languages:</b> Context-Free grammars and context-free languages. Closure properties of CFLS, derivation trees and ambiguity, Empty production and useless symbol elimination from context free grammar, Simplified forms and Normal forms (CNF, GNF), Pumping lemma for CFLs.	10L
3.	<b>Push-Down Automata:</b> Deterministic and Non-deterministic Push down Automata, Acceptance by PDA, Correspondence between PDA and CFG.	10L
4.	<b>Turing Machines:</b> Models of computation and Church-Turing Thesis, Turing Machine and its variations, Universal Turing Machines, Recursively enumerable and recursive languages, Unrestricted grammars and TMs.	10L

	<b>Context-sensitive languages:</b> Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.	
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. J. E. Hopcroft, R. Motwani and J. D. Ullman, Introduction to Automata Theory, Languages & Computation, Pearson
2. K. L. P. Mishra and N. Chandrasekaran, Theory of Computer Science: Automata, Languages and Computation, Prentice Hall India Learning Private.
3. H.R. Lewis and C.H. Papadimitriou, Elements of the Theory of Computation, Prentice-Hall.
4. R. Y. Kain, Automata theory : machines and languages, McGraw-Hill
5. P. Linz, An Introduction to Formal Languages and Automata, Narosa Publishing House.

**Course Outcomes:**

Upon Completion of the course, students will be to:

- Write a formal notation for strings, languages and machines.
- Design finite automata to accept a set of strings of a language.
- Design context free grammars to generate strings of context free language.
- Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars
- Write the hierarchy of formal languages, grammars and machines.
- Distinguish between computability and non-computability and Decidability and undecidability.

Course code	PCC-IT 503				
Category	Professional Core Course				
Course title	Object Oriented Programming				
Scheme and Credits	L	T	P	Credits	Semester – V
	2	0	0	2	
Pre-requisites (if any)	ESC-CSE 201				

## Theory Syllabus:

Module	Detailed Description	Lecture / Tutorial Period
1.	Concepts of object-oriented programming system (oops) and its feature, benefits of OOPs. Object oriented languages, platform independency, bytecode, JVM, Data types- Variables, Loops, Decisions, Functions-call by value, call by reference parameters, Inline functions, Default arguments, const arguments, Function overloading, Friend Function.	4L
2.	<p><b>Classes and objects:</b> Class fundamentals, Access Specifier, Declaring objects, new operator, Constructor, Assigning Object Reference Variables, Methods, Constructors, this keyword, Garbage Collection/Destructor, Overloading, Using Objects as Parameters, Returning Objects, Static members, final, nested &amp; inner classes, String class, Using Command –line Arguments, Variable-Length Arguments</p> <p><b>Inheritance:</b> Super class Variable Referencing Subclass Object, Use of super, Dynamic Method Dispatch, Overriding, Abstract Classes, Virtual base classes, The Object Class</p> <p><b>Operator Overloading and Virtual Function for C++:</b>  Unary operator overloading (prefix and postfix cases), Binary operator overloading- using member function and friend function, Difference between Assignment operator overloading and copy constructor, Manipulation of strings using operators, Type conversation.  Pointer to object, this pointer, Compile time, run time polymorphism, virtual function, Virtual table, VPTR, pure virtual function.</p>	10L
3.	<p><b>Packages &amp; Interfaces:</b>  Defining a Package, Accessing a package, Adding a class to a package, Defining an interface, Implementing Interfaces, Applying Interfaces, Variables in Interfaces, Interfaces can be extended.</p> <p><b>Exception handling:</b>  Types of errors, Exception Types, Uncaught Exception, Using try-catch-throw, throws, finally, creating own exception subclasses</p> <p><b>Threading:</b> Java thread model, Creating single &amp; multiple thread, Thread priorities, Thread synchronization, Inter thread Communication, Suspending Resuming and stopping threads.</p> <p><b>Enumerations, Autoboxing and Annotations:</b> Enumeration Fundamentals, Type Wrappers, Autoboxing and Methods, Annotation, Closures.</p>	8L
4.	<p><b>Generics and Java Structures:</b> General Form, Bounded Types, Wildcard Arguments, Generic Method, Generic Interfaces, Erasure, Generic Restrictions, Iterator, Bit Set, Array List, Looping through Data Structures, Map, Hash Map</p> <p><b>Input/ Output:</b> I/O Basics-Streams, Byte Streams, Character Streams, Reading and writing console Input/Output, Reading and writing files, Object serialization.</p> <p><b>Abstract Window Toolkit (AWT):</b> AWT Classes. Window Fundamentals: Component, container, Panel, Window, Frame, designing interface using Labels, Buttons, Check Boxes, Lists, TextField, TextArea, Layout Managers, Event handling.</p>	6L

	<b>Total</b>	<b>28L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. H. Schildt, Java: The Complete Reference, McGraw Hill Education
2. H. Schildt, C++: The Complete Reference, McGraw Hill Education
3. B. Stroustrup, The Design and Evolution of C++, Addison-Wesley.
4. H. M. Deitel and P. J. Deitel, Java How To Program, Prentice Hall
5. H. M. Deitel and P. J. Deitel, C++ How To Program, Prentice Hall
6. E. Balagurusamy, Object Oriented Programming with C++, McGraw Hill Education
7. E. Balagurusamy, Programming with Java: A Primer, McGraw Hill Education
8. R. Lafore, Object Oriented Programming in Turbo C++, Galgotia Publications Pvt Ltd
9. D. T. Editorial Service, Java 8 Programming Black Book, Dreamtech Press
10. Y. Daniel Liang, Introduction to Java programming, Pearson education.
11. C. S. Horstmann and G. Cornell, Core Java, Volume I :Fundamentals, Pearson Education.
12. C. S. Horstmann and G. Cornell, Core Java(TM) 2, Volume II--Advanced Features, Pearson Education.

**Course Outcome:**

Upon Completion of the course, students will be able to:

- Understand the fundamental principle of Object Oriented concept.
- Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
- Familiar to map real world problems into the Object Oriented Programming language using C++ or Java
- Efficiently implement linear, nonlinear data structures and different algorithms.
- Design applications with an event-driven graphical user interface.

Course code	PCC-IT 553				
Category	Professional Core Course				
Course title	Object Oriented Programming Laboratory				
Scheme and Credits	L	T	P	Credits	Semester - V
	0	0	4	2	
Pre-requisites (if any)	PCC-IT 503				



**Laboratory Syllabus:**

UNIT	Detailed Description	Practical Period
1.	Programs to build class, constructor, doing overloading, inheritance, overriding	6P
2.	Programs on Function overloading, Friend Function, wrapper class, vectors, arrays	6P
3.	Programs on developing interfaces, inheritance, extending interfaces	6P
4.	Programs on creating and accessing packages	3P
5.	Polymorphism, Virtual Functions and related problems.	3P
6.	Thread programming	6P
7.	Programs on handling errors and exceptions	6P
8.	Programs on Enumerations, Autoboxing and Annotations	6P
9.	Generic class programming	6P
10	Programming on Input/ Output	4P
11.	AWT programming	4P
	<b>TOTAL:</b>	<b>56P</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books: Text and/ or Reference:**

1. H. Schildt, Java: The Complete Reference, McGraw Hill Education
2. H. Schildt, C++: The Complete Reference, McGraw Hill Education
3. B. Stroustrup, The Design and Evolution of C++, Addison-Wesley.
4. H. M. Deitel and P. J. Deitel, Java How To Program, Prentice Hall
5. H. M. Deitel and P. J. Deitel, C++ How To Program, Prentice Hall
6. E. Balagurusamy, Object Oriented Programming with C++, McGraw Hill Education
7. E. Balagurusamy, Programming with Java: A Primer, McGraw Hill Education
8. R. Lafore, Object Oriented Programming in Turbo C++, Galgotia Publications Pvt.Ltd
9. D. T. Editorial Service, Java 8 Programming Black Book, Dreamtech Press
10. Y. Daniel Liang, Introduction to Java programming, Pearson education.
11. C. S. Horstmann and G. Cornell, Core Java, Volume I :Fundamentals,Pearson Education.
12. C. S. Horstmann and G. Cornell, Core Java(TM) 2, Volume II--Advanced Features, Pearson Education.

**Course Outcome:**

After completion of the course, students will be able to:

- Understand the fundamental principle of Object Oriented concept.
- Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
- Familiar to map real world problems into the Object Oriented Programming language using C++ or Java
- Implement efficiently linear, nonlinear data structures and different algorithms.

Course Code	PEC-IT 511(a)				
Category	Professional Elective Course (PEC)				
Course Title	Advanced Algorithm				
Scheme and	L	T	P	Credits	Semester – V
Credits	3	0	0	3	
Pre-Requisites (if any)	PCC-IT 301, PCC-IT 404				

### Theory Syllabus:

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture/Tutorial Period</b>
<b>1.</b>	<b>Sorting</b> Stable Sort, Heap Sort	<b>4L</b>
<b>2.</b>	<b>Tree</b> Binary Search tree, AVL tree, Red Black Tree, M-way search tree, B-tree, B+ tree, B* tree, Splay tree, KD tree- point location problem.	<b>10L</b>
<b>3.</b>	<b>Priority Queue</b> Models and simple implementation, Double ended priority queues	<b>4L</b>
<b>4.</b>	<b>Hashing</b> Hash function, Different types of hash table - Universal hashing and perfect hashing	<b>4L</b>
<b>5.</b>	<b>Heap</b> Balanced search tree as heaps, Array based heaps, Heap-ordered trees and half ordered trees, Leftist Heaps, Skew Heaps, Binomial heaps, Changing keys in heaps, Fibonacci heaps	<b>4L</b>
<b>6.</b>	<b>String</b> Various data structure for string – tries, patricia, suffix trees	<b>8L</b>
<b>7.</b>	<b>Data Structure for disjoint sets</b> Disjoint set data structure, representation of disjoint sets, disjoint set forest, application of disjoint set data structure	<b>3L</b>
<b>8.</b>	<b>Graph</b> Various graph representation methods, representation of Di-graph, DAGs (Directed Acyclic Graphs)	<b>5L</b>
	<b>TOTAL:</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of week reserved</b>	<b>02</b>

### Text Books / References:

1. Fundamentals of Data Structure in C++ : Horowitz, Sahani&Mehata
2. Introduction to Algorithms, 2nd Edition: Coreman, Leiserson, Rivest, Stein., PHI
3. Data Structures Using C and C++: Langsam, Augenstein, Tenenbaum, TMH
4. Computer Algorithms: Horowitz, Sahani, Rajasekaran, PHI
5. Advanced Data Structure: Peter Brass, Cambridge

**Course Outcome:**

After completion of this course students will be able to:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis. Synthesize efficient algorithms in common engineering design situations.

Course code	PEC-IT 511(b)				
Category	Professional Elective Course (PEC)				
Course title	Advanced Computer Architecture				
Scheme and Credits	L	T	P	Credits	Semester – V
	3	0	0	3	
Pre-requisites (if any)	ESC-CSE 302, PCC-IT 402				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<b>Introduction:</b> Evolution of computer architecture, Flynn's classification, System performance. <b>Parallelism, Partitioning and Flow Mechanism:</b> Conditions of parallelism – Data, Control and Resource dependencies, Bernstein's Conditions, Hardware & Software parallelism; Program Partitioning & Scheduling – Grain Sizes & Latency, Grain Packing & Scheduling, Static Multiprocessor Scheduling; Program Flow Mechanisms - Control Flow, Data Flow, Demand Driven Mechanisms, comparisons.	<b>10L</b>
<b>2.</b>	<b>Advanced Processor Technology:</b> RISC, CISC, Symbolic Processor and characteristics, Difference between RISC and CISC. <b>Pipelining - An Instruction Level Parallelism (ILP):</b> Linear pipelining – Speedup, Efficiency, Throughput; Non-linear pipelines – Reservation tables & Latency Analysis; Instruction pipelines – phases, mechanisms, pipeline hazards - structural, data and control hazards, dynamic branch prediction; Dynamically Scheduled pipelines with Scoreboard, Collision free scheduling, Minimal Average Latency (MAL);	<b>12L</b>

3.	<b>Vector Processing:</b> Vector Instructions, Architecture of a Vector processor. <b>Array Processors:</b> SIMD machines, Loosely and Tightly Coupled SIMD machines, Masking schemes, Components of a SIMD Processing Element (PE), SIMD Interconnection networks - Static and Dynamic networks, Multistage Dynamic networks - Crossbar Switches.	10L
4.	<b>Multiprocessors - Exploiting Thread Level Parallelism (TLP):</b> Loosely Coupled Multiprocessors: Message Transfer System (MTS); Tightly Coupled Multiprocessors: Shared Memory Processors, UMA machines, NUMA machines, Cache coherence - cache coherence problem, snooping protocol and directory based protocol, Interconnections – time shared or common bus, multiport memory; <b>Memory Interleaving:</b> Low-Order Interleaving, High-Order Interleaving techniques, Increase in Memory Bandwidth, Interleaving and fault tolerance.	10L
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. “Computer Organization and Design: The Hardware/Software Interface”, 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
2. “Computer Organization and Embedded Systems”, 6th Edition by Carl Hamacher, McGraw Hill Higher Education.
3. “Computer Architecture and Organization”, 3rd Edition by John P. Hayes, WCB/McGraw-Hill
4. “Computer Organization and Architecture: Designing for Performance”, 10th Edition by William Stallings, Pearson Education.
5. “Parallel processing and Computers Architecture” by K.Hwang, F.Briggs, Tata McGraw Hill
6. “Advanced Computer Architecture” by Kai Hwang, McGraw Hill International.

**Course Outcomes:**

After completion of this course students will be able to:

- Being acquainted with the features of Pipelined Processors.
- Understanding the Properties and Routing Patterns of Interconnection Network Architectures.
- Conceptualize Vector Processors and operations of vector instructions.
- Design of memory interleaving techniques.
- Illustrations on Loosely and Tightly coupled Multiprocessor systems and different data access mechanisms.

Course code	PEC-IT 511(c)				
Category	Professional Elective Course (PEC)				
Course title	Artificial Intelligence				
Scheme and Credits	L	T	P	Credits	Semester – V
	3	0	0	3	
Pre-requisites (if any)	BSC-M 202, Data Analytics Skills				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<b>Introduction:</b> Introduction to Artificial Intelligence, Problems of AI, AI technique, problem solving as State space search.	<b>6L</b>
<b>2.</b>	<b>Search Techniques:</b> Uninformed search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uninformed search strategies. Heuristic Search Strategies: Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, Constraint satisfaction problems, Searching AND/OR Graphs.	<b>16L</b>
<b>3.</b>	<b>Knowledge Representation and Reasoning-I:</b> Introduction to knowledge representation, propositional logic, First order logic-I, logic-II, Inferences	<b>8L</b>
<b>4.</b>	<b>Reasoning under Uncertainty:</b> Reasoning under Uncertainty, Bayesian Network, Decision Network	<b>6L</b>
<b>5.</b>	<b>Learning:</b> Forms of learning, inductive learning, learning decision trees, neural net learning, back propagation.	<b>6L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP

5. Logic & Prolog Programming, Saroj Kaushik, New Age International
6. Expert Systems, Giarranto, VIKAS
7. Artificial Intelligence, Russel, Pearson

### Course outcomes

Upon completion of this course, students will be able to:

- Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
- Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, artificial neural networks and other machine learning models.
- Demonstrate proficiency developing applications in an 'AI language', expert system.
- Demonstrate proficiency in applying scientific method to models of machine learning.
- Demonstrate an ability to share in discussions of AI, its current scope and limitations.

Course code	PEC-IT 511(d)				
Category	Professional Elective Course (PEC)				
Course title	Computer Graphics				
Scheme and Credits	L	T	P	Credits	Semester – V
	3	0	0	3	
Pre-requisites (if any)	PCC-IT 401				

### Theory Syllabus:

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	Introduction to Computer Graphics, Survey of computer graphics, Overview of graphics systems – Video display devices, Raster scan systems, Random scan systems, Graphics monitors and Workstations, Input devices, Hard copy Devices, Graphics Software; Output primitives – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.	<b>6L</b>

2.	Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; window-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.	9L
3.	Three dimensional graphics concepts; Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations – Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces. Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.	10L
4.	Illumination and Color Models, Light sources – basic illumination models – halftone patterns and dithering techniques; Properties of light – Standard primaries and chromaticity diagram; Intuitive colour concepts – RGB colour model – YIQ colour model – CMY colour model – HSV colour model – HLS colour model; Colour selection.	7L
5.	Animation Graphics, design of Animation sequences – animation function – raster animation – key frame systems – motion specification – morphing – tweening.  Computer graphics realism concept, tiling the plane – Recursively defined curves – Koch curves – C curves – Dragons – space filling curves – fractals – Grammar based models – fractals – turtle graphics – ray tracing.	10L
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books:** **Text**and/or**Reference:**Books:

1. John F. Hughes, Andries Van Dam, Morgan Mc Guire ,David F. Sklar , James D. Foley, Steven K. Feiner and Kurt Akeley ,”Computer Graphics: Principles and Practice”, , 3rd Edition, Addison- Wesley Professional,2013. (UNIT I, II, III, IV).
2. Donald Hearn and Pauline Baker M, “Computer Graphics”, Prentice Hall, New Delhi, 2007 (UNIT V).
3. Donald Hearn and M. Pauline Baker, Warren Carithers,“Computer Graphics With Open GL”, 4th Edition, Pearson Education, 2010.
4. Jeffrey McConnell, “Computer Graphics: Theory into Practice”, Jones and Bartlett Publishers, 2006.
5. Hill F S Jr., “Computer Graphics”, Maxwell Macmillan” , 1990.

## Course outcomes

After completion of the course, students will be able to:

- Design two dimensional graphics.
- Apply two dimensional transformations.
- Design three dimensional graphics.
- Apply three dimensional transformations.
- Apply Illumination and color models.
- Apply clipping techniques to graphics.
- Design animation sequences.

Course code	MC-HU501				
Category	Mandatory Course (MC)				
Course title	Constitution of India				
Scheme and Credits	L	T	P	Credits	Semester V
	3	0	0	0	
Pre-requisites (if any)					

## Theory Syllabus:

Module	Detailed Description	Lecture / Tutorial Period
1.	<b>Introduction and Basic Information about Indian Constitution:</b> Constitution meaning of the term, Indian Constitution: Sources and constitutional history, The Role of the Constituent Assembly. <b>Features:</b> Citizenship, Preamble and Salient features of the Constitution of India, Fundamental Rights and its Restriction and limitations in different Complex Situations, Fundamental Duties and its Scope and significance in Nation building, Directive Principles of State Policy (DPSP) & it's present relevance in our society with examples.	8L
2.	<b>Union Government and its Administration:</b> Structure of the Indian Union: Federalism, Centre-State relationship, President: Role, power and position, Prime Minister and Council of ministers, Union Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.	8L



<b>3.</b>	<b>State Government and its Administration:</b> Governor: Role and Position, Chief Minister State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Article 370,371,371J) for some States. State Secretariat: Organization, Structure and Functions	<b>8L</b>
<b>4.</b>	<b>Constitutional Provisions/ Local Administration/Human Rights:</b> Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward Classes. Institute and Bodies for the welfare of SC/ST/OBC and women. <b>District's Administration head:</b> Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, <b>Panchayati raj:</b> Introduction, PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy <b>Human Rights/values:</b> Meaning and Definitions, Legislative Specific Themes in Human Rights and Functions/ Roles of National Human Rights Commission of India. Human Rights (Amendment Act) 2006.	<b>9L</b>
<b>5</b>	<b>Elections, Amendments and Emergency Provisions:</b> <b>Election Commission:</b> Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning Elections, Electoral Process, and Election Commission of India, Election Laws. <b>Amendments</b> - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments - 7,9,10,12,42,44, 61, 73,74, 75, 86, and 91,94,95,100,101,118 and some important Case Studies. Recent Amendments with explanation. Important Judgments with Explanation and its impact on society (from the list of Supreme Court Judgments). Emergency Provisions, types of Emergencies and its consequences.	<b>9L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total week required</b>	<b>14</b>
	<b>No. of week reserved</b>	<b>02</b>

**Books: Text and/or Reference/Web Links and Video Lectures:**

1. Durga Das Basu (DD Basu): "Introduction to the Constitution on India", (Students Edition.)Prentice –Hall EEE, 19th / 20th Edn., (Latest Edition) or 2008.
2. Shubham Singles, Charles E. Haries, and Et al : "Constitution of India and Professional Ethics" by Cengage Learning India Private Limited, Latest Edition – 2018.
3. M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice – Hall of India Pvt. Ltd. New Delhi, 2004
4. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
5. Latest Publications of NHRC - Indian Institute of Human Rights, New Delhi.

**Course Outcomes:**

At the end of this course, students will be able to

- Have general knowledge and legal literacy about Indian Constitution and thereby it helpsto take up competitive examinations & to manage/face complex societal issues in society.
- Understand state and central policies (Union and State Executive), fundamental Rights & their duties.
- Understand Electoral Process, Amendments and special provisions in Constitution.
- Understand powers and functions of Municipalities, Panchayats and Co-operative Societies, with Human Rights and NHRC.

Course code	HSM-HU 581 (For Laboratory)				
Category	Humanities Science & Management (HSM)				
Course title	Grooming & Personality Development				
Scheme and Credits	L	T	P	Credits	Semester V
	0	0	2	1	
Pre-requisites (if any)	Basic knowledge of speaking and writing in English				

**Laboratory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Practical Period</b>
<b>1.</b>	<b>Self-Development Skills:</b> Introduction to personality; Self-Esteem and Self-Confidence; problem solving; Stress Management; Goal-Setting	<b>5P</b>
<b>2.</b>	<b>Public Speaking:</b> Importance; Types, Mechanics; Pillars of Public Speaking; Overcoming fear of Public Speaking	<b>5P</b>
<b>3.</b>	<b>Oral presentation and professional speaking:</b> Basics of English pronunciation public preparing for a speech.; Elements of effective presentations, Body language and use of voice during presentation; connecting with the audience during presentation; projecting a positive image while speaking; planning and preparing a model presentation; Organizing the presentation to suit the audience and content	<b>6P</b>

<b>4.</b>	<b>Career Oriental Communication:</b> Design and Style applying for a job: Language and format of job application; Resume & bio-data	<b>5P</b>
<b>5</b>	<b>Job Interview:</b> Purpose and process, language and style to be used, types of interview question and how to answer them	<b>7P</b>
	<b>Total:</b>	<b>28P</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Development and Soft Skills. Barun K. Mitra. Oxford University Press, New Delhi: 2016.
2. Personality Development: Transform Yourself. Rajiv K. Mishra. Rupa Publications, India: 2012.
3. Hurlock. Personality Development. Elizabeth B. McGraw Hill Education, 2017.
4. Personality Development and Career management. R. M. Onkar. S. Chand Publication, India: 2010.
5. Managing Soft Skills for Personality Development. Ed. by B. N. Ghosh. McGraw Hill, India: 2012.

**Course outcomes:**

On completion of the course students will be able to:

- Groom themselves through the knowledge of personality development attributes self-confidence, problem solving and stress management skills etc.
- Deliver confidently an organized, refined, professional and credible speech for better suit the audience.
- Acquire the basic concepts of English pronunciation and elements of effective presentations, body language and use of voice during presentation.
- Connect with the audience during presentation and exhibit the art of projecting a positive image while speaking and preparing a model presentation.
- Learn the effective language for writing job application, resume and bio-data.
- Familiar with common interview questions and the techniques to answer them.

### Semester-VI

Course Code	PCC-IT 601				
Category	Professional Core Course (PCC)				
Course Title	Software Engineering				
Scheme and Credits	L	T	P	Credits	Semester VI
	3	0	0	3	
Pre-Requisites (if any)	ESC-CSE 201, PCC-IT 501				

#### Theory Syllabus:

Module	Detailed Description	Lecture / Tutorial Period
1.	<b>Introduction:</b> What is Software engineering, Introduction to the notion of software engineering as a product, Characteristics of good software products, Introduction to the Engineering aspects of Software Products, Necessity of automation, and Job responsibilities of programmers and Software Engineers as Software Developers, Software development process models. <b>Software Development Life Cycle and Process Models:</b> Requirement analysis, Software Design, Coding, Testing, Maintenance. Code and Fix Model, Waterfall Model, Prototyping model, Iterative Enhancement Model, RAD Model, Evolutionary process Model, Unified process Model, Spiral Model, Selection of Life Cycle Models, Role of Management in Software Development. <b>Software certification:</b> Requirement of certification, Types, Certification of: Product, Process, Person, Third party certification.	14L
2.	<b>Software Requirement Specification:</b> Problem analysis, Requirement Specification, Requirement Types, Requirement Gathering Techniques, feasibility Study Validation, metrics, Use Case diagram, ER Diagram. <b>Techniques for Software Size and Cost Estimation: Software Project Planning:</b> Line of Codes method, Function Point Analysis for size estimation, Static Single variable and Static Multi Variable models for Cost Estimation. COCOMO and COCOMO-II.	8L
3.	<b>System Design:</b> Problem Partitioning, Abstraction, Top-down and bottom-up design, Structured approach, Modularity, Coupling and cohesion, DFD and Structure chart.	9L

	<b>Coding:</b> Top-down and Bottom up approach, Structured Programming, program style and internal documentation ,Verification, Validation, Metrics, Types of metrics, Token Count methodology, Data Sharing among modules, Information flow metrics, Basic and revised information flow model.Implementation of three address statements (Quadruples, Triples, Indirect triples).	
4.	<b>Testing:</b> Levels of testing, Alpha Testing, Beta Testing, Functional Testing, Boundary Value Analysis, Introduction to the technique for testing real time systems, Test case specification. <b>Software Reliability:</b> Software reliability, Reliability Curve, failure, Fault, Risk Management, Software quality ,Software quality assurance models :McCall Software Quality model, Boehm Software Quality model, ISO 9000,ISO 9126 <b>Software Maintenance:</b> Categories of maintenance, problems during maintenance, Maintenance Process, Maintenance models: Quick and Fix model, Iterative Enhancement model, Reuse oriented model, Boehm’s model, Taute Maintenance model.	11L
	<b>Total</b>	42L
	<b>Total Week Required:</b>	14
	<b>No. of Week Reserved:</b>	02

**Books: Text and/or Reference:**

1. R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
2. R. Mall, Fundamentals of Software Engineering, PHI Publication.
3. K. K. Aggarwal and Y. Singh, Software Engineering, New Age International Publishers.
4. C. Ghezzi, M. Jarayeri, D. Manodrioli, Fundamentals of Software Engineering, PHI Publication.
5. I. Sommerville, Software Engineering, Addison Wesley.
6. P. Jalote, Software Engineering, Narosa Publication
7. S. L. Pfleeger, Software Engineering: The Production of Quality Software, Macmillan Publication.

**Course Outcomes:**

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

- Understand the software engineering methodologies involved in the phases for project development.
- Gain knowledge about open source tools used for implementing software engineering methods.
- Exercise developing product-startups implementing software engineering methods.

Course Code	PCC-IT 651				
Category	Professional Core Course (PCC)				
Course Title	Software Engineering Laboratory				
Scheme and Credits	L	T	P	Credits	Semester VI
	0	0	4	2	
Pre-Requisites (if any)	ESC-CSE 201, ESC-CSE 251, PCC-IT 501, PCC-IT 551, PCC-IT 553				

### Laboratory Syllabus:

Prepare the following documents and develop the software project startup, prototype model, using software engineering methodology for real time scenarios or for the sample experiments viz Course management system (CMS), E-Bidding, Hospital Management System(HMS), Library Management System(LMS), Shopping Mall Management System(SMMS), Multiplex Ticket Booking System(MTBS), Railway Reservation System(RRS) etc.

<b>Module</b>	<b>Detailed Description</b>	<b>Practical Period</b>
<b>1.</b>	<b>Problem Analysis and Project Planning</b> -Thorough study of the problem, Identify Project scope, Objectives and Infrastructure.	<b>8P</b>
<b>2.</b>	<b>Software Requirement Analysis</b> – Describe the individual Phases / modules of the project and Identify deliverables. Identify functional and non-functional requirements.	<b>8P</b>
<b>3.</b>	<b>Data Modeling</b> – Use work products – data dictionary.	<b>6P</b>
<b>4.</b>	<b>Software Designing</b> - Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.	<b>8P</b>
<b>5.</b>	<b>Prototype model</b> – Develop the prototype of the product.	<b>20P</b>
<b>6.</b>	<b>Testing-</b> Test the developed model with sample data set.	<b>6P</b>
	<b>Total</b>	<b>56P</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. R. Mall, Fundamentals of Software Engineering, PHI Publication.
2. P. Jalote, Software Engineering, Narosa Publication
3. S. L. Pfleeger, Software Engineering: The Production of Quality Software, Macmillan Publication.

**Course Outcomes:**

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

- Implement the software engineering methodologies involved in the phases for project development.
- Implement different software engineering methods using open source tools.
- Develop product-startups implementing software engineering methods

Course Code	PCC-IT 602				
Category	Professional Core Course (PCC)				
Course Title	Computer Networks				
Scheme and Credits	L	T	P	Credits	Semester – VI
	3	0	0	3	
Pre-Requisites (if any)	Primary knowledge of computer fundamentals.				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture/ Tutorial Period</b>
<b>1.</b>	<p><b>Overview Of Data Communication And Networking:</b> Overview on the term Computer Network, Distributed System, Client-Server model; Main features of computer network. Terminologies- Protocol Standards, Host, Medium/Channel, direction of data flow(simplex, half duplex, full duplex), Network types - LAN, MAN, WAN; Inter-network.</p> <p><b>Network Models:</b> Layered architecture: Advantage and Disadvantages, Service, function. Network design issues; Peer-to-Peer communication in layered architecture. ISO OSI model- layers, Functions of each layer, communication through OSI. TCP/IP model- layers, Functions of each layer, Similarities and Differences between OSI and TCP/IP model, Connection-oriented and connection-less service, Physical and logical address.</p> <p><b>Network Topology:</b> Mesh, Bus, Tree, Ring, Star, Hybrid; Transmission Modes- Simplex, Half-duplex, Full-duplex</p>	<b>10L</b>

2.	<b>Physical Layer:</b> Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital) & transmission media (guided & non-guided); TDM, FDM, WDM; Switching Techniques- Circuit switching, Packet Switching, Message Switching; ISDN, ATM. <b>Data link Layer:</b> Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC;	10L
3.	<b>Medium Access Sub Layer:</b> Point to point protocol, LCP, NCP, FDDI, token bus, token ring; Reservation, polling, concentration; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA; Traditional Ethernet, Fast Ethernet: <b>Network Layer:</b> Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: Internet address, Classful address, sub netting; Routing : techniques, static vs. dynamic routing , routing table for Classful address; Routing algorithms: shortest path algorithm, flooding, distance vector routing, link state routing; Protocols: ARP, RARP, IP, ICMP, IPV6; Unicast and multicast routing protocols.	12L
4.	<b>Transport Layer:</b> Process to process delivery: UDP, TCP, Client-server communication, different types of ports, Socket. <b>Application Layer:</b> DNS; SMTP, SNMP, FTP, HTTP & WWW <b>Security:</b> Encryption and Decryption methods, user authentication, Firewalls.	10L
	<b>Total:</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. B. A. Forouzan , Data Communications and Networking, McGraw Hill Education
2. A. S. Tanenbaum , Computer Networks , Pearson Education
3. W. Stallings, Data and Computer Communications , Pearson Education
4. Y. Zheng, S. Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI
6. M.A. Michael, Data Communication & Network, Vikas Publishing
7. J. F Kurose, K.W. Rose , Computer Networking -A Top Down Approach Featuring The Internet, Pearson Education
8. A. L. Garica, I. Widjaja , Communication Network, McGraw Hill Education
9. J. Walrand , Communication Networks , McGraw Hill Education
10. D. E. Comer , Internetworking with TCP/IP, vol. 1, 2, 3, Pearson Education

**Course Outcomes:**

On completion of the course students will be able to:

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation,



it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Code	PCC-IT 652				
Category	Professional Core Course (PCC)				
Course Title	Computer Network Laboratory				
Scheme and Credits	L	T	P	Credits	Semester VI
	0	0	4	2	
Pre-Requisites (if any)	PCC –IT 602				

#### **Laboratory Syllabus**

<b>Unit</b>	<b>Detailed Description</b>	<b>Period</b>
<b>1.</b>	NIC Installation & Configuration (Windows/Linux),Familiarization with Networking Cables, Connectors Hubs, Switches, Gateway	<b>10P</b>
<b>2.</b>	Inter Process Communication using Message and Pipes.	<b>8P</b>
<b>3.</b>	Introduction Socket Programming, Implementation of simplex, duplex chatting, daytime server, echo server etc.	<b>12P</b>
<b>4.</b>	Study of Different Routing Protocols using Network Simulator.	<b>14P</b>
<b>5.</b>	Study of Network Congestion Control Algorithms Using Network Simulator.	<b>10P</b>
	<b>Total</b>	<b>56P</b>
	<b>Total Week Required</b>	<b>14</b>
	<b>No. of reserved week</b>	<b>02</b>

#### **Books: Text and/or Reference:**

1. B. A. Forouzan , Data Communications and Networking,McGraw Hill Education
2. J. Walrand ,Communication Networks ,McGraw Hill Education
3. D. E. Comer ,Internetworking with TCP/IP, vol. 1, 2, 3,Pearson Education
4. W. R. Stevens, UNIX Network Programming(Vol I and II),Pearson Education
5. Kernighan and Ritchie, The UNIX programming environment , PHI

#### **Course Outcomes:**

After completion of this course the students will be able to:

- Apply mathematical foundations to solve computational problems in **Computer Networking**
- Analyse performance of various communication protocols.
- Compare routing algorithms
- Practice packet /file transmission between nodes.

Course Code	PCC-IT 653 (For Laboratory)				
Category	Professional Core Course (PCC)				
Course Title	Programming with Python Laboratory				
Scheme and Credits	L	T	P	Credits	Semester – VI
	0	0	4	2	
Pre-Requisites (if any)	ESC-CSE 201, ESC-CSE 251, BSC-M 202				

### Laboratory Syllabus:

<b>Module</b>	<b>Detailed Description</b>	<b>Practical Period</b>
<b>1.</b>	<b>Python Basics</b> -data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; Conditions, boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation; String manipulations; manipulating files and directories, os and sys modules; creating and reading a formatted file (csv or tab-separated).	<b>8P</b>
<b>2.</b>	<b>Lists and Functions</b> -Lists, tuples, and dictionaries; Design with functions: arguments and return values; formal vs. actual arguments, named arguments.	<b>8P</b>
<b>3.</b>	<b>Classes and OOP</b> - classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects.	<b>8P</b>
<b>4.</b>	<b>Use of some Important Packages</b> - Numpy, Matplotlib, Pandas	<b>8P</b>
<b>5.</b>	<b>Working with Linear Algebra using Python</b> - Vectors, matrices, product of matrix & vector, vectors, distance, eigenvalue decomposition.	<b>8P</b>
<b>6.</b>	<b>Statistical problem solving using Python</b> - probability, distributions, mean, variance, covariance, covariance matrix	<b>8P</b>
<b>7.</b>	<b>Python programming for Linear Regression</b> - Univariate and multivariate linear regression Model assessment (including cross validation)	<b>8P</b>
	<b>Total</b>	<b>56P</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. TanejaSheetal, Kumar Naveen: Python Programming: A modular approach (Pearson Publications)
2. Lubanovic Bill: Introducing Python ( Shroff Publishers) Isaac D. Cody : Data Analytics and Python Programming 2 Bundle Manuscript(United Computer
3. GeeksPublications)
4. Introduction to Data Science by Laura Laugal, Santi Segui, Sringer International.
5. The Statistical Analysis of Experimental Data by John Mandel, Dover Books on Mathematics
6. Hands-On Data Science and Python Machine Learning by Frank Kane , Packt
7. Practical Data Science with R by Nina Zumel , John Mount, Manning.

**Course Outcomes:**

Students should demonstrate the ability to:

1. Write, Test and Debug Python Programs.
2. Implement Conditionals and Loops for Python Programs.
3. Use functions and represent Compound data using Lists, Tuples and Dictionaries
4. Read and write data from & to files in Python.
5. Use different applications using packages of Python.
6. Solve different Algebraic problems using Python
7. Solve different Statistical problems using Python
8. Implement Linear Regression using Python

Course code	PEC- IT 611(a)				
Category	Professional Elective Course (PEC)				
Course title	Parallel and Distributed Algo rithm				
Scheme and Credits	L	T	P	Credits	Semester VI
	3	0	0	3	
Pre-requisites (if any)	PCC-IT 402, PCC- IT 404				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	Basic Techniques, Parallel Computers for increase Computation speed, Parallel & Cluster Computing.	<b>8L</b>
<b>2.</b>	Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples.	<b>8L</b>
<b>3.</b>	Pipelining- Techniques computing platform, pipeline programs examples.	<b>8L</b>
<b>4.</b>	Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelism sharing data parallel programming languages and constructs, open MP.	<b>10L</b>
<b>5.</b>	Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms – sorting and numerical algorithms.	<b>8L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Parallel Programming, Barry Wilkinson, Michael Allen, Pearson Education, 2nd Edition.
2. Introduction to Parallel algorithms by Jaja from Pearson, 1992.
3. Michael J Quinn, Parallel Computing, TMH

**Course outcomes:**

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

- Perform computation faster, than can be done with a single processor, by using a number of processors concurrently.
- Develop faster solutions, solutions for large-size problems arise from many applications.
- Understand the concepts and issues related to distributed systems.
- Design and develop the programs for distributed environment.
- Manage performance, reliability and other issues while designing in distributed environment.

Course Code	PEC-IT 611(b)				
Category	Professional Elective Course (PEC)				
Course Title	Compiler Design				
Scheme and Credits	L	T	P	Credits	Semester VI
	3	0	0	3	
Pre-Requisites (if any)	ESC-CSE 201				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture /Tutorial Period</b>
<b>1</b>	<p><b>Introduction :</b>  Overview of the Translation Process, design of assembler, object file formats, linker-its Input and output, phases of linker design, loader and its type, binary image format.  Types of Compiler, Analysis of the Source Program, The Phases of a Compiler design.</p> <p><b>Lexical Analysis :</b>  Introduction to Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, A Language for Specifying Lexical Analyzers, Finite Automata From a Regular Expression, Design of a Lexical Analyzer Generator, Optimization of DFA</p>	<b>10L</b>
<b>2</b>	<p><b>Syntax Analysis :</b>  The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Error Recovery strategies for different parsing techniques.</p> <p><b>Syntax Directed Translation:</b>  Syntax-Directed Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S-Attributed Definitions, L-Attributed Definitions, syntax directed definitions and translation schemes. Specification of a simple type checker, Equivalence of type expressions.</p>	<b>15L</b>

<b>3</b>	<b>Run Time Environments :</b> Source Language Issues, Storage Organization, Storage-Allocation Strategies, and Access to Non local Names, Parameter Passing, Symbol Tables, and Language Facilities for Dynamic Storage Allocation, Dynamic Storage Allocation Techniques. <b>Intermediate Code Generation:</b> Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).	<b>9L</b>
<b>4</b>	<b>Code optimization:</b> 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. <b>Code generations:</b> Issues in the design of code generator, a simple code generator, Register Allocation & assignment.	<b>8L</b>
	<b>TOTAL:</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Reserved Week</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Alfred Aho, V. Ravi Sethi, D. Jeffery Ullman, "Compilers Principles, Techniques and Tools", Addison Wesley, 2nd edition.
2. Holub Allen. Compiler Design in C, PHI, 1993.
3. Chattopadhyay, Santanu. Compiler Design. PHI Learning Pvt. Ltd., 2005
4. Tremblay and Sorenson Compiler Writing-McGraw-Hill International

**Course Outcomes:**

Students will demonstrate the ability to:

- Understand grammar specification develop the lexical analyser
- Understand parser specification design top-down and bottom-up parsers
- Determine for a given language whether the given language is regular or not.
- Develop syntax directed translation schemes
- Develop algorithms to generate code for a target machine
- Design context free grammars to generate context free language.

Course Code	PEC-IT 611(c)				
Category	Professional Elective Course(PEC)				
Course Title	Data Mining				
Scheme and Credits	L	P	T	Credits	Semester – VI
	3	0	0	3	
Pre-Requisites (if any)	PCC-IT 403, PCC-IT 501				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<b>Introduction to Data Mining:</b> Process of Knowledge Discovery, Types of Data, Data Mining Functionalities. <b>Describing Data:</b> Data Objects and Attribute Types, Measuring Data Similarity and Dissimilarity, Data Visualization Techniques. <b>Data Preprocessing:</b> Data Summarization, Data Cleaning, Data Integration, Data Transformation, Data Reduction, Data Discretization, Concept Hierarchy Generation.	<b>8L</b>
<b>2.</b>	<b>Frequent Pattern Mining, Association Rule Generation, Correlation Analysis:</b> Frequent Item set Mining methods – Apriori Algorithm, FP-Tree Growth. Association Rules & their types, Association to Correlation.	<b>8L</b>
<b>3.</b>	<b>Classification and Prediction:</b> Decision trees, Bayesian Classifier, Rule-Based Classification, k-Nearest-Neighbor Classifiers, Associative Classifier, Model Evaluation-Cross-Validation, Comparing Classifiers Based on Cost–Benefit and ROC Curves. <b>Cluster Analysis:</b> Categories of Clustering Methods: Partitioning, Hierarchical, Density-based, Grid-based methods, Clustering of High-Dimensional Data, Evaluation of Clustering-Measuring Clustering Quality.	<b>12L</b>

<b>4.</b>	<b>Outlier Detection:</b> Basic concepts and types of Outliers, Statistical Methods, Proximity-Based Methods- Distance-Based Outlier Detection and a Nested Loop Method, Grid-Based and Density-Based Outlier Detection methods, Clustering-Based Outlier Detection Methods, Modeling High-Dimensional Outliers. <b>Data Warehousing:</b> Basic Concepts of Data Warehousing, OLAP and Data Cube, overview of design and implementation of a Data Ware house.	<b>14L</b>
	<b>TOTAL:</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books:Text and/or Reference:**

1. J. Han and M. Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers.
2. M. H. Dunham, Data Mining Introductory and Advanced Topics, Printice Hall.
3. I. H. Written and E. Frank, Data Mining: Practical Machine Learning Tools and Techniques, Elsevier.

**Course Outcomes**

Upon Completion of the course, the students will be able to

- Understand Data Mining principles.
- Preprocess the data for mining applications.
- Compare and evaluate different classification, prediction, clustering and association rule mining techniques.
- Identify appropriate data mining algorithms to solve real world problems.
- Apply different outlier detection techniques in solving data mining problems.
- Understand the basic concepts of data warehousing and design data warehouse with high dimensional modeling.

Course code	PEC-IT 611(d)				
Category	Professional Elective Course (PEC)				
Course title	Image Processing				
Scheme and Credits	L	T	P	Credits	Semester VI
	3	0	0	3	
Pre-requisites (if any)	PEC-IT 302				



## Theory Syllabus

Module	Detailed Description	Lecture / Tutorial Period
1.	<p><b>Introduction:</b> Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.</p> <p><b>Digital Image Formation:</b> A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling &amp; Quantization - Uniform &amp; Non uniform.</p> <p><b>Mathematical Preliminaries</b> :Neighbor of pixels, Connectivity, Relations, Equivalence &amp; Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine, Wavelet Transform.</p>	12L
2.	<p><b>Image Enhancement</b> :Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear &amp; Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering;</p> <p>Enhancement in the frequency domain - Low pass filtering, High pass filtering.</p> <p><b>Image Restoration:</b> Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained &amp; Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.</p>	10L
3.	<p><b>Image Segmentation:</b> Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking &amp; Boundary Detection- Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting &amp; Merging.</p> <p><b>Image Representation and Description:</b> Representation schemes, Chain codes, Polygonal approximations, Signatures, Boundary segments, The skeleton of a region, Line segmented encoding, Boundary descriptors, Basic descriptors, Fourier descriptors, Regional descriptors: Basic descriptors, Topological descriptors, Texture.</p>	10L

4.	<b>Image Compression:</b> Image Compression Models, Elements of Information Theory, Lossy and Error-Free Compression, Huffman Coding, Image Compression Standards  <b>Morphological Image Processing:</b> Introduction, Basic Definitions: Dilation, Erosion, Concept of structuring elements, Opening and closing operations, Boundary extraction, concept of hit or miss transformation, Thinning and thickening transformation, Skeletonization, Pruning, Image Classification.	<b>10L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Digital Image Processing, Gonzalez and Woods, Pearson Education
2. Digital Image Processing, Jahne, Springer India
3. Digital Image Processing and Analysis, Chanda & Majumder, PHI
4. Fundamentals of Digital Image Processing, Jain, PHI
5. Fundamentals of Digital Image Processing, S. Annadurai, Pearson Education
6. Introduction to digital image processing with Matlab- Alasdair McAndrew

**Course outcomes:**

Upon completion of the course, students will be able to:

- Analyze general terminology of digital image processing.
- Examine various types of images, intensity transformations and spatial filtering.
- Develop Fourier transform for image processing in frequency domain.
- Evaluate the methodologies for image segmentation, restoration etc.
- Implement image process and analysis algorithms.
- Apply image processing algorithms in practical applications

Course Code	PEC-IT 612(a)				
Category	Professional Elective Course (PEC)				
Course Title	Computational Number Theory				
Scheme and Credits	L	T	P	Credits	Semester – VI
	3	0	0	3	
Pre-Requisites (if any)	BSC-M 102, PCC-IT 401, PCC-IT 404, PCC-IT 502				

## Theory Syllabus

Module	Detailed Description	Lecture / Tutorial Period
1.	<b>Arithmetic of Integers</b> : multi-precision arithmetic, divisibility, gcd, modular arithmetic, modular exponentiation, linear congruences, Chinese remainder theorem, polynomial congruences and Hensel lifting, orders and primitive roots, quadratic residues, modular square roots.	7L
2.	<b>Representation of finite fields</b> : Prime and extension fields, representation of extension fields, polynomial basis, primitive elements, normal basis, optimal normal basis, irreducible polynomials.	7L
3.	<b>Algorithms for polynomials</b> : root-finding and factorization, polynomials over finite fields, Lenstra-Lenstra-Lovasz algorithm.	5L
4.	<b>Elliptic curves</b> : The elliptic curve group, elliptic curves over finite fields, Schoof's point counting algorithm.	5L
5.	<b>Primality testing algorithms</b> : Fermat test, Miller-Rabin test, Solovay-Strassen test, AKS test.	5L
6.	<b>Integer factoring algorithms</b> : Trial division, Pollard Rho method, p-1 method, CFRAC method, quadratic sieve method, elliptic curve method.	5L
7.	<b>Computing discrete logarithms over finite fields</b> : Baby-step-giant-step method, Pollard rho method, Pohlig-Hellman method, index calculus methods, linear sieve method, Coppersmith's algorithm.	4L
8.	<b>Applications</b> : Algebraic coding theory, cryptography.	4L
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of week reserved</b>	<b>02</b>

### **Books: Text and/or Reference:**

1. A. Das, Computational Number Theory, CRC Press. [Main Text]
2. V. Shoup, A computational introduction to number theory and algebra, Cambridge University Press.
3. H. Cohen, A course in computational algebraic number theory, Springer-Verlag.
4. J. von zur Gathen and J. Gerhard, Modern computer algebra, Cambridge University Press.
5. J. H. Silverman and J. Tate, Rational points on elliptic curves, Springer International Edition.
6. I. Niven, H. S. Zuckerman and H. L. Montgomery, An Introduction to the Theory of Numbers, John Wiley and Sons.
7. G. H. Hardy and E. M. Wright, An Introduction to the Theory of Numbers, Oxford University Press.

**Course Outcomes:**

Upon completion of this course, students will be able to:

- State and understand the basic theorems of integer congruences.
- State and understand the basic ideas of cryptology.
- Perform calculations, both by hand and using a computer algebra system, related to elementary number theory.

Course Code	PEC-IT 612(b)				
Category	Professional Elective Course (PEC)				
Course Title	Advanced Operating System				
Scheme and Credits	L	T	P	Credits	Semester – VI
	3	0	0	3	
Pre-Requisites (if any)	PCC-IT 301, PCC-IT 402, PCC-IT 403				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<b>Introduction</b> Review of centralized operating systems, Network and Distributed operating systems, Hardware concepts, Software concepts and design issues.	<b>6L</b>
<b>2.</b>	<b>Synchronization</b> Synchronization in distributed systems, Concept of clock, event ordering, Leader election algorithms, Distributed mutual exclusion algorithms for different topologies etc.	<b>8L</b>
<b>3.</b>	<b>Global state Detection</b> Global state reordering algorithms, Cuts of a distributed computation, termination detection	<b>7L</b>
<b>4.</b>	<b>Deadlock</b> Deadlock detection in distributed systems, centralized algorithms, distributed algorithms.	<b>6L</b>
<b>5.</b>	<b>Failure Recovery</b> Failure recovery and fault tolerance: classification of failures, Checkpoints, Synchronous check pointing and recovery, Asynchronous check pointing and recovery, Commit protocols, Voting protocols.	<b>7L</b>
<b>6.</b>	<b>Introduction to Real Time System</b> Introduction to real time systems and it's characteristics, basic issues, modeling timing constraint etc.	<b>4L</b>

7.	<b>Mobile OS</b> Introduction, Design Principles, Structure, Platform and Features of Mobile Operating Systems (Android, IOS, Windows Mobile OS).	4L
	<b>Total</b>	42L
	<b>Total Week Required:</b>	14
	<b>No. of week reserved</b>	02

**Books: Text and/or Reference:**

1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter galvin, Greg Gagne, Wiley Asia Student Edition.
2. Advanced Concepts in operating Systems - Mukesh Singhal and Niranjana G. Shivaratri, TMH
3. Distributed Algorithms –NancyLynch, Morgan Kaufmann
4. Introduction to Distributed Algorithms-Gerard Tel, Cambridge University Press
5. Distributed Operating System:Concept of Design-P.K.Sinha, PHI
6. Real-Time Systems: Theory and Practice-Rajib Mal, Pearson Education India
7. Mobile Operating Systems and Programming, by Arash Habibi Lashkari , Import

**Course Outcomes:**

Upon completion of this course, students will be able to:

- Understand the potential benefits of distributed systems
- Summarize the major security issues associated with distributed systems along with the range of techniques available for increasing system security
- Apply standard design principles in the construction of these systems.
- Select appropriate approaches for building a range of distributed systems, including some that employ middleware

Course code	PEC-IT 612(c)				
Category	Professional Elective Course (PEC)				
Course title	Machine Learning				
Scheme and Credits	L	T	P	Credits	Semester VI
	3	0	0	3	
Pre-requisites (if any)	PEC-IT 511(c)				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<b>Introductory Topics:</b> Introduction to machine intelligence; Problems, data, and tools; Visualization <b>Regression and Feature Selection:</b> Different types of regression analysis-simple, multiple, polynomial, logistic; SSE; gradient descent; feature selection techniques, normal equations; features Over fitting and complexity; training, validation, test data.	<b>12L</b>
<b>2.</b>	<b>Decision Trees:</b> Introduction, Decision Trees for Pattern Classification, Construction of Decision Trees, Splitting at the Nodes, Over fitting and pruning : Pruning by Finding Irrelevant Attributes, Use of Cross-Validation, Random forest. <b>Maximum Likelihood AND Bayesian Parameter Estimation:</b> Bayesian Estimation, Problems of Dimensionality, Independent Component Analysis; Principle Component Analysis (PCA), Fisher Linear Discriminator, Multiple Discriminator Analysis, Expectation-Maximization (EM) Algorithm. <b>Clustering:</b> K-means, Agglomerative Hierarchical Clustering	<b>12L</b>
<b>3.</b>	<b>Classifications:</b> Bayes Theorem, Minimum Error Rate Classifier, Estimation of Probabilities, Naïve Bayes Classifier, The Naïve Bayes Probabilistic Model ,Parameter estimation, Linear Discriminant Functions, Learning the Weight Vector, Multi-class Problems, Linearly Separable Case, Non-linearly Separable Case, ANN model, Mathematical model, perceptron, back propagation, Introduction to SVM; maximum margin, nonlinear SVM, Convolution neural network(CNN)	<b>8L</b>
<b>4.</b>	<b>Ensemble Methods:</b> Bagging, random forests, boosting, Introduction to Reinforcement Learning. Introduction to Deep learning.	<b>10L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Pattern recognition principles--Tou& Gonzalez, Addison Wesley.
2. Pattern classification-- Duda, Hart, Stork, John Willey& Sons, 2001.
3. Deep Learning (Adaptive Computation and Machine Learning series) by Ian Goodfellow (Author), YoshuaBengio (Author), Aaron Courville
4. Pattern Recognition and Machine Learning by Christopher Bishop
5. Bayesian Reasoning and Machine Learning by David Barber
6. Understanding Machine Learning: From Theory to Algorithms by Shai Ben-David and ShaiShalev-Shwartz
7. Machine Learning: A Probabilistic Perspective by Kevin R Murphy
8. Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms by Aoife D'Arcy, Brian Mac Namee, and John D. Kelleher

## Course outcomes

Upon completion of this course, students will be able to:

- Gain knowledge about basic concepts of Machine Learning
- Identify machine learning techniques suitable for a given problem
- Solve the problems using various machine learning techniques
- Apply Dimensionality reduction techniques.
- Design application using machine learning techniques.

Course Code	PEC-IT 612(d)				
Category	Professional Elective Course (PEC)				
Course Title	Web & Internet Technology				
Scheme and Credits	L	T	P	Credits	Semester -VI
	3	0	0	3	
Pre-Requisites (if any)	PCC-IT 602				

## Theory Syllabus:

Module	Detailed Description	Lecture / Tutorial Period
1.	<b>An Overview on Internet:</b> Need for an Internet, Evolution of Internet, Concept of Internet, Intranet and Extranet, URI, URL, URN, Concept of Search Engine, Types of Search Engine, Search Engine Optimization. <b>TCP/IP Protocol Suite:</b> HTTP, FTP, SMTP, DNS, TCP, UDP, ICMP, IP, Concept of Unicast Routing and Multicast Routing, Multicast Routing Protocols. <b>Mobile IP:</b> Definition of Mobile IP, Stationary Hosts, Mobile Host, Three Phases of Remote host to Mobile Host Communication, Inefficiency of Mobile IP, Double Crossing, Triangle Routing.	12L
2.	<b>Internet of Things:</b> Concept of IoT, Machine to Machine, Remote Monitoring, Sensing, and Controlling, IoT protocols Architecture, Brief Introduction to IoT Hardware Platform.  <b>Introduction to Web:</b> Web Architecture, Web Applications, Web servers, Web Browsers, Internet standards.  <b>Hyper Text MarkupLanguage:</b> Elements, Attributes, Tags, Tables, Forms, Frames.  <b>Cascading Style Sheets:</b> Advantages, Rules, CSS and page Layout	8L

3.	<p><b>JavaScript and DHTML:</b> Regular Expression, Event Handling, W3C Event Handling Model, HTML DOM, JavaScript and HTML DOM, JavaScript and HTML Forms, AJAX.</p> <p><b>XML Technologies:</b> XML, Namespace, DTD, W3C XML Schema, XPath, XQuery, Parsing XML, XML DOM, XSLT, XSL-FO.</p> <p><b>Applets:</b> Client-side Java, Life Cycle, Writing an Applet, Compiling an Applet, The Applet Tag, Security, Utility Methods, Using Status Bar, Applet Context Interface, Document Base and Code Base, Passing Parameter, Event Handling, Communication between Two Applets, Loading Web Pages.</p>	11L
4.	<p><b>Servlets:</b> Server-side Java, Advantages Over Applets, Alternatives, Strengths, Architecture, Life Cycle, GenericServlet and HttpServlet, Passing and Retrieving Parameters, Server-Side Include, Cookies, Filters, Problems with Servlet, Security Issues</p> <p><b>Java Server Pages:</b> JSP and HTTP, JSP Engines, How JSP Works, JSP and Servlet, Anatomy of a JSP Page, JSP Syntax, JSP Components, Beans, Session Tracking, Users Passing Control and Data between Pages, Sharing Session and Application Data, Database Connectivity,</p> <p><b>JDBC:</b>JDBC Drivers, Basic Steps, Loading a Driver, Making a Connection, Execute an SQL Statement, SQL Statements, Retrieving Result, Getting Database Information, Scrollable and Updatable Result Set, Result Set Metadata.</p>	11L
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required</b>	<b>14</b>
	<b>No. of week reserved</b>	<b>02</b>

**Books: Text and/or Reference:**

1. B. A. Forouzan, TCP/IP Protocol Suite, McGraw Hill Higher Education
2. D. Minoli, Internet & Intranet Engineering, McGraw-Hill Education (India) Pvt Limited
3. E. Enge, S. Spencer, J. Stricchiola, R. Fishkin, The Art of SEO: Mastering Search Engine Optimization, O'REILLY
4. Web Technologies HTML, Javascript, PHP, Java, JSP, ASP.NET, XML and AJAX BLACK BOOK, Dreamtech Press
5. D. Goodman, Dynamic HTML: The Definitive Reference, O'REILLY
6. D. Flanagan, JavaScript: The Definitive Guide, O'REILLY
7. E. R. Harold, W. S. Means, XML in a Nutshell: A Desktop Quick Reference, O'REILLY
8. A. Moller, M. Schwartzbach, An Introduction to XML and Web Technologies, Pearson Education India
9. H. Bergsten, Java Server Pages: Help for Server-Side Java Developers, O'REILLY
10. M. Wutka, Special Edition Using Java Server Pages and Servlets, Que Publishing
11. R. Barton, J. Henry, P. Grossetete, R. Trollope, G. Salgueiro, D. Hanes, IoT Fundamentals : Networking Technologies, Protocols and Use Cases for the Internet of Things, Pearson Education



**Course Outcome:**

After completion of the course, the students will be able to:

- Develop a web application using java technologies.
- Analyze a web page and identify its elements and attributes.
- Create web pages using XHTML and Cascading Style Sheets.
- Build dynamic web pages using JavaScript (Client side programming).
- Create XML documents and Schemas.

Course code	HSM-HU 681				
Category	Humanities Science & Management (HSM)				
Course title	Group Discussion & Personal Interview				
Scheme and Credits	L	T	P	Credit	Semester VI
	0	0	2	1	
Pre-requisites (if any)	Basic knowledge of oral & technical communication				

**Laboratory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Practical Period</b>
<b>1.</b>	<b>Advanced Techniques in Technical Communication:</b> using e-mail for business communication; standard e-mail practices; language in e-mail, using internet for collecting information; referencing while using internet materials for project reports; writing for media	<b>5P</b>
<b>2.</b>	<b>Presentation:</b> Techniques of effective presentations by using various audiovisual aids	<b>5P</b>
<b>3.</b>	<b>Interview:</b> Methods and Etiquettes; practice of mock interview; interview through telephone/ video-conferencing	<b>8P</b>
<b>4.</b>	<b>Group Discussion:</b> Model group discussion through the choice of appropriate programmers	<b>7P</b>
<b>5</b>	<b>Interaction with experts</b>	<b>3P</b>
	<b>Total:</b>	<b>28P</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. How to Prepare for Group Discussion & Interview. Hari Mohan Prasad, Rajnish Mohan. Tata McGraw Hill Education, New Delhi: 2012.
2. Mastering Interviews and Group Discussions. Dinesh Mathur. CBS Publication, New Delhi: 2017.
3. Technical Interviews: Excel with Ease. Anil Kumar Maini. Pearson, Chennai: 2011.
4. Group Discussions and Interviews. Anand Ganguly. RPH, New Delhi: 2014.
5. The Interview Book: Your Definite Guide to the Perfect Interview Technique. James Innes. Prentice Hall Business, New Jersey: 2009.

**Course Outcomes:**

On completion of the course students will be able to:

- Structure and format advanced techniques for effective communications.
- E-mail using standard language for business communication.
- Use internet for collecting information, referencing and writing for media.
- Deliver effective power-point presentation.
- Take part in Interview through telephone/video-conferencing.
- Proficient to face interviews and model group discussions.

Course code	PROJ-IT 691				
Category	Project				
Course title	Project-I				
Scheme and Credits	L	T	P	Credits	Semester VI
	0	0	6	3	
Pre-requisites (if any)	As per the technical requirements of the Project, the concerned Project Guide may prepare the pre-requisites.				

- The department should form project groups each comprising of few Students (depending on total batch strength and number of faculty members) where, each of these project groups shall be under the guidance of a faculty member. They need to complete the project work spanning through 3 semesters (Semester VI, VII & VIII). Project-I is the first part covered in Semester-VI.
- Students must maintain regularity in their project work.
- Students shall try to acquire thorough knowledge on the topics as guided by the concerned faculty member. Each project groups may conduct literature surveys on the said topics. At the end of Semester-VI students have to submit an Initial Project Report comprising on findings of the literature survey and a synopsis of their proposed work. Each group should submit at least two extra copy of Initial Project Report other than their individual copy, one for their Project guide and one for the departmental record.

### Semester-VII

Course code	PEC-IT 711(a)				
Category	Professional Elective Course (PEC)				
Course title	Pattern Recognition				
Scheme and Credits	L	T	P	Credits	Semester VII
	3	0	0	3	
Pre-requisites (if any)	PEC-IT 611(d)				

#### Theory Syllabus:

Module	Detailed Description	Lecture / Tutorial Period
1.	<b>Introduction</b> – Definitions, data sets for Pattern Recognition, Different Paradigms of Pattern Recognition, Representations of Patterns and Classes, Metric and non-metric proximity measures.	6L
2.	<b>Feature extraction:</b> Different approaches to Feature Selection; Nearest Neighbor Classifier and variants; Efficient algorithms for nearest neighbor; Classification	12L
3.	<b>Different Approaches to Prototype Selection:</b> Bayes Decision Theory, Maximum Likelihood Estimation, Probability Density Estimation, Dimensionality Problem, Linear Discriminator	8L
4.	<b>Neural Networks</b> for pattern recognition, RBF neural network, Hyper box classifier, Fuzzy Min max Neural network	10L
5.	<b>Unsupervised Learning:</b> Clustering, Clustering using minimal spanning tree, Temporal pattern recognition, Hidden Markov model	6L
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

#### Books: Text and/or Reference:

1. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.

## Course outcomes

After completing this course, the students should be able to:

- Understand basic concepts in pattern recognition
- Gain knowledge about state-of-the-art algorithms used in pattern recognition.
- Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.
- Apply pattern recognition techniques in practical problems

Course code	PEC- IT 711(b)				
Category	Professional Elective Course (PEC)				
Course title	Internet of Things				
Scheme and Credits	L	T	P	Credits	Semester –VII
	3	0	0	3	
Pre-requisites (if any)	ESC-EC 301, PCC-IT 602, Sensors, Cloud Computing, Network Security				

## Theory Syllabus:

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<b>Introduction to IoT:</b> Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT	<b>8L</b>
<b>2.</b>	<b>Elements of IoT:</b> Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.	<b>8L</b>
<b>3.</b>	<b>IoT Application Development:</b> Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices	<b>12L</b>

<b>4.</b>	<b>IoT Case Studies:</b> IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation	<b>14L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of weeks reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Vijay Madiseti, Arshdeep Bahga, Internet of Things, “A Hands on Approach”, University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
3. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press
4. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi
5. Adrian McEwen, “Designing the Internet of Things”, Wiley
6. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill
7. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media

**Course outcomes**

After the completion of this course, the students will be able to:

- Understand internet of Things and its hardware and software components
- Interface I/O devices, sensors & communication modules
- Remotely monitor data and control devices
- Develop real life IoT based projects

Course code	PEC-IT 711(c)				
Category	Professional Elective Course				
Course title	Data Analytics				
Scheme and Credits	L	T	P	Credits	Semester - VII
	3	0	0	3	
Pre-requisites (if any)	PCC-IT 403, PCC-IT 651				

### Theory Syllabus:

Module	Detailed Description	Lecture / Tutorial Period
1.	<b>Introduction:</b> Introduction to Data Analytics, Descriptive Statistics, Probability Distributions, Inferential Statistics through hypothesis tests.	8L
2	<b>Regression:</b> Introduction to Regression- Ordinary Least Squares, Analysis of Variance, Ridge Regression, Lasso Regression.	8L
3.	<b>Regression and Classification techniques:</b> Logistic Regression, Training a Logistic Regression Classifier, Classification and Regression Trees, Bias-Variance Dichotomy, Model Assessment and Selection, Linear Discriminant Analysis, Ensemble Methods: Random Forest.	12L
4.	<b>Introduction to Big data:</b> Fundamentals of Big Data, Examining Big Data Types, Big Data Technology Components, Map Reduce Fundamentals. <b>Big Data Analytics:</b> Defining Big Data Analytics, Big Data Analytics Applications.	14L
	<b>TOTAL:</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

### Books:Textand/orReference:

1. Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons,2010.
3. Manoochchri, Murthy, Lander, Big Data Analytics, PearsonEducation.
4. Dr. ArvindSathi, Big Data Analytics: Disruptive Technologies for Changing the Game, MC Press.

### Course Outcomes

Upon Completion of the course, the students will be able to

- Think critically in making decisions based on data and analytics.
- Apply the concepts of probability in data analytics.
- Perform predictive modeling and apply them in business decision-making.
- Identify applications of bigdata.
- Apply computing techniques and technologies in bigdata paradigm.

Course code	PEC-IT 711(d)				
Category	Professional Elective Course				
Course title	Natural Language Processing				
Scheme and Credits	L	T	P	Credits	Semester VII
	3	0	0	3	
Pre-requisites (if any)	BSC-M 202, PCC-IT 502, PCC-IT 653				

### Theory Syllabus:

Module	Detailed Description	Lecture / Tutorial Period
1.	Introduction and Basic Text Processing	2L
2	<b>Words:</b> Structure spell-check, morphology using FSTs.	2L
3.	<b>Words:</b> Semantics Basic ideas in Lexical Semantics, Word Net and Word Net based similarity measures, Distributional measures of similarity, Concept Mining using Latent Semantic Analysis	4L
4.	<b>Words:</b> Parts of Speech POST using Brill's Tagger and HMMs	4L
5.	<b>Sentences:</b> Basic ideas in compositional semantics, Classical Parsing (Bottom up, top down, Dynamic Programming: CYK parser)	4L
6.	<b>Sentences:</b> Parsing using Probabilistic Context Free Grammars and EM based approaches for learning PCFG parameters.	4L
7.	Language Modeling (basic ideas, smoothing techniques)	4L
8.	Machine Translation (rule based techniques, Statistical Machine Translation (SMT), parameter learning in SMT (IBM models) using EM)	4L
9.	Information Extraction: Introduction to Named Entity Recognition and Relation Extraction	4L
10	Text Summarization, Text Classification	6L
11	Sentiment Analysis and Opinion Mining	4L
	<b>TOTAL:</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books:Textand/orReference:**

1. Daniel Jurafsky and James H.Martin.2009.Speech and Language Processing: An Introduction to Natural Language Processing, Speech Recognition, and Computational Linguistics. 2<sup>nd</sup> edition. Prentice-Hall.
2. Christopher D.Manning and Hinrich Schutze.1999.Foundation of Statistical Natural Language Processing. MIT Press.

**Course Outcomes**

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

- Understand approaches to syntax and semantics in NLP.
- Understand approaches to discourse, generation, dialogue and summarization within NLP.
- Understand current methods for statistical approaches to machine translation.
- Understand machine learning techniques used in NLP
- clustering and unsupervised methods, , and the EM algorithm as applied within NLP

Course Code	PEC-IT 712(a)				
Category	Professional Elective Course (PEC)				
Course Title	Quantum Computing				
Scheme and Credits	L	T	P	Credits	Semester – VI
	3	0	0	3	
Pre-Requisites (if any)	Quantum Mechanics, Probability and Stochastic Process, Linear Algebra, Cryptography, PCC-IT 401, PCC-IT 404				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture Period</b>
<b>1.</b>	<p><b>Introduction to Quantum Computing:</b> Need for Quantum Computing, Basic Principles Of Quantum Mechanics, The Postulates Of Quantum Theory, Dirac Notation, Quantum Information, No cloning theorem &amp; Quantum Teleportation, Classical vs Quantum Computation.</p> <p><b>Quantum Gates and Circuits:</b> Qubit, Bloch Sphere, Measuring the State of Qubit, The Quantum Circuit Model, The Single Qubit Gates, Rotations of the Bloch sphere, Controlled Gates, The Bell basis, Universal Quantum Gates, Preparation Of The Initial State, Designing of Quantum Different circuits.</p>	<b>14L</b>



2.	<b>Quantum Algorithms:</b> Introduction to Quantum Algorithm ,Deutsch Algorithm, Deutsch-Jozsa Algorithm, Simon's Algorithm ,Quantum Phase Estimation and Quantum Fourier Transform, Shor's Algorithm, Grover's Search Algorithm, Quantum Counting, Quantum Search, Quantum Sort.	12L
3.	<b>Quantum Communication &amp; Cryptography:</b> Density Matrix & Bloch Sphere, Schmidt Decomposition, Measurement of The Density Matrix for a Qubit , POVM Measurements, Introduction to Quantum Cryptography,BB84 Protocol,E91 Protocol, Quantum teleportation.	8L
4.	<b>Quantum Computing Implementation:</b> Idea of Physical Realization of Quantum Computers using Photon based Technology, Nuclear Magnetic Resonance, Ions in Traps, Implementation of Different Quantum Algorithms and Circuits using Software Tools, Study of Quantum Programming Languages. <b>Quantum Inspired Machine Learning Algorithms:</b> Importance of Hybridization, Concept of Quantum Inspired Algorithm, Quantum Inspired Evolutionary Algorithms, Quantum Inspired Neural Networks and Quantum Inspired Clustering Algorithms.	8L
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required</b>	<b>14</b>
	<b>No. of week reserved</b>	<b>02</b>

**Books: Text and/or Reference:**

1. M. A. Nielsen, I. L. Chuang, Quantum Computation and Quantum Information,Cambridge University Press.
2. P. Kaye, R. Laflamme, and M. Mosca, An introduction to Quantum Computing, Oxford University Press.
3. V. Sahni, Quantum Computing, Tata McGraw-Hill Publishing Company
4. S. Bhattacharyya, U. Maulik and P. Dutta, Quantum Inspired Computational Intelligence: Research and Applications,Elsevier
5. E. Hassanien, M. Elhoseny and J. Kacprzyk ,Quantum Computing: An Environment for Intelligent Large Scale Real Application,Springer

**Course Outcome:**

After completion of the course the student will be able to:

- Compare specific properties of quantum computing with randomized computing;
- Perform basic experiments and principles of quantum physics;
- Design the basic quantum arithmetical circuits,
- Design the efficient quantum algorithms for several basic promise problems
- Apply quantum cryptographic protocols to increase the security of a cryptographic system.

Course Code	PEC-IT 712(b)				
Category	Professional Elective Course				
Course Title	Distributed System				
Scheme and Credits	L	T	P	Credits	Semester – VI
	3	0	0	3	
Pre-Requisites (if any)	PCC-IT 402, PCC-IT 403, PCC-IT 602				

### Theory Syllabus:

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture/ Tutorial Period</b>
<b>1.</b>	<p><b>Introduction to Distributed System:</b> GOALS: Making Resources Accessible, Distribution Transparency, Openness, Scalability, Pitfalls, Types Of Distributed Systems-distributed Computing Systems, Distributed Information Systems, Distributed Pervasive Systems, System Architectures-centralized Architectures, Decentralized Architectures, and Hybrid Architectures</p> <p><b>Middleware:</b> Architectures Versus Middleware-Interceptors, General Approaches to Adaptive Software, CLIENTS-Networked User Interfaces, Client-Side Software for Distribution Transparency, SERVERS-General Design Issues, Server Clusters , Managing Server Clusters.</p>	<b>10L</b>
<b>2.</b>	<p><b>Clock Synchronization:</b> Physical Clocks, Global Positioning System, Clock Synchronization Algorithms, LOGICAL CLOCKS, Lamport's Logical Clocks Vector Clocks, Centralized and Decentralized Algorithms.</p> <p><b>Code Migration:</b> Approaches to Code Migration, Migration and Local Resources, Migration in Heterogeneous Systems, Application of Code Migration using Agent.</p>	<b>10L</b>
<b>3.</b>	<p><b>Java RMI &amp; Mobile Agent:</b> Client side, Server Side, object registry, Remote Interface, Server side software, client side software, Client callback, stub downloading. Basic architecture of Mobile Agent, advantages, mobile agent framework systems, design, implementation using Java RMI.</p> <p><b>Distributed File System:</b> Architecture of NFS, communication in NFS, synchronization, Security in NFS.</p>	<b>12L</b>

<b>4.</b>	<b>Introduction To Fault Tolerance:</b> Basic Concepts, Failure Models, Failure Masking by Redundancy PROCESS RESILIENCE-Design Issues, Failure Masking and Replication Agreement in Faulty Systems Failure Detection DISTRIBUTED COMMIT-Two-Phase Commit, Three-Phase Commit. <b>Distributed coordination-based systems JINI:</b> Runtime Environment, Architecture, Discovery Protocol, Join Protocol, Lookup Service, Distributed Event, Distributed Leasing, Transactions, Surrogate Architecture. <b>Case Study:</b> GARUDA Project, WLHC Grid.	<b>10L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required</b>	<b>14</b>
	<b>No. of Week Reserved</b>	<b>02</b>

**Books: Text and/or Reference:**

1. M. L. Liu, Distributed Computing: Principles and Applications, Pearson Education
2. S. Tanenbum and M. V. Steen, Distributed Systems-Principles and Paradigms, PHI
3. G. Coulouris, J. Dollimore and T. Kindberg, Distributed Systems, Concepts and Design, Pearson Education.
4. K. McNiff, E. Pitt, Java.rmi: The Remote Method Invocation Guide, Addison-Wesley Professional
5. T. B. Downing, Java RMI: Remote Method Invocation, Wiley.
6. W. K. Edwards, Core JINI, Prentice Hall.

**Course Outcomes**

Upon Completion of the course, the students will be able to

- Identify the characteristics of distributed systems and their structure.
- Identify types of distribution transparencies and code migration strategies required for designing a distributed system.
- Analyze Synchronization algorithms for distributed systems.
- Implement RPC, RMI.
- Learn the importance of fault tolerance in distributed systems and some implementations.
- Analyze some existing distributed systems like GARUDA, WLHC Grid.

Course code	PEC-IT 712(c)				
Category	Profession Elective Course (PEC)				
Course title	Soft Computing				
Scheme and Credits	L	T	P	Credits	Semester – VII
	3	0	0	3	
Pre-requisites (if any)	PEC-IT 511(c)				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<b>Introduction:</b> Introduction to soft computing; introduction to fuzzy sets and fuzzy logic systems; introduction to biological and artificial neural network; introduction to Genetic Algorithm.	<b>4L</b>
<b>2.</b>	<b>Fuzzy Sets and Logic:</b> Fuzzy versus Crisp; Fuzzy sets-- membership function, linguistic variable, basic operators, properties, extension principle; Fuzzy relations-- Cartesian product, operation on relations; Geometry of fuzzy sets, fuzzy entropy theorem, Fuzzy rule based system—possibility theory, graphical techniques of inference (Mamdani, Sugeno- Takagi model); Defuzzification, Fuzzy Clustering <b>Rough Set:</b> Introduction, Indiscernibility, Set Approximation, Reducts and Core, Rough Membership, Dependency of Attributes, discernibility Matrix, Rough membership, Discretization, Rough sets and reasoning from data, Rough based Clustering	<b>14L</b>
<b>3.</b>	<b>Neural Network</b> <b>Introduction to Neural Networks:</b> Advent of Modern Neuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron. <b>Learning Methods :</b> Hebbian, competitive, Boltzman etc., <b>Neural Network models:</b> Perceptron, Adaline and Madaline networks; single layer network; Back-propagation and multi layer networks. <b>Competitive learning networks:</b> Kohonen self organizing networks, Hebbian learning; Hopfield Networks; Neuro-Fuzzy modeling	<b>10L</b>
<b>4.</b>	<b>Genetic Algorithm (GA) :</b> Basic concept, Role of GA in optimization, Fitness function, Selection of initial population, Cross over, Mutation, Selection, Constraints handling, Binary coded and real coded GA, Multi objective optimization in GA, Pareto front, Non Dominated Solution, Elitist Selection.	<b>10L</b>
<b>5.</b>	<b>Other Soft Computing techniques:</b> Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).	<b>4L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI

3. Principles of Soft Computing , S N Sivanandam, S. Sumathi, John Wiley & Sons
4. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg
5. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI
6. Neural Networks: A Classroom Approach, 1/e by Kumar Satish, TMH,
7. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg, Pearson/PHI
8. A beginners approach to Soft Computing, Samir Roy & Udit Chakraborty, Pearson
9. Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan, Prentice Hall
10. Neural Networks: A Comprehensive Foundation (2nd Edition), Simon Haykin, Prentice Hall.

### Course outcomes

- Ability to analyze and appreciate the applications which can use fuzzy logic.
- Ability to design inference systems.
- Ability to understand the difference between learning and programming and explore practical applications of Neural Networks (NN).
- Ability to appreciate the importance of optimizations and its use in computer engineering fields and other domains.
- Students would understand the efficiency of a hybrid system and how Neural Network and fuzzy logic can be hybridized to form a neuro-fuzzy network and its various applications.

Course Code	PEC-IT 712(d)				
Category	Professional Elective Course (PEC)				
Course Title	Cryptography and Network Security				
Scheme and Credits	L	T	P	Credits	Semester VI
	3	0	0	3	
Pre-Requisites (if any)	PCC-IT 401, PCC-IT 602				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture/ Tutorial Period</b>
<b>1.</b>	<b>Overview and Security Attacks:</b> Security Approaches, Principals of security, Types of attacks: Active attack - interruption, modification, fabrication; Passive attack – release of message contents, traffic analysis; Viruses, Worms, Trojan horse <b>Symmetric Ciphers:</b> Classical Encryption Techniques, Block Ciphers and the Data Encryption Standard, Introduction to Finite Fields, Advanced Encryption Standard, RC4, Confidentiality Using Symmetric Encryption	<b>12L</b>
<b>2.</b>	<b>Public-Key Encryption and Hash Functions:</b> Introduction to Number Theory, Public-Key Cryptography and RSA, Key Management; Diffie-Hellman, ECC <b>Message Authentication and Hash Functions:</b> Hash and MAC Algorithms, Digital Signatures and Authentication Protocols	<b>12L</b>
<b>3.</b>	<b>Database Security:</b> Database Access Control, Inference, Statistical Database, Database Encryption <b>Internet Security Protocols and Standards:</b> IPSec, SSL and TLS, PGP and S/MIME	<b>9L</b>
<b>4.</b>	<b>Internet Authentication Applications:</b> Kerberos, X.509, Public Key Infrastructure <b>Security Appliances:</b> Intrusion Detection Systems, Firewalls and Intrusion Prevention Systems	<b>9L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. of weeks reserved:</b>	<b>02</b>

**Books:**Text and/or Reference:

1. “Cryptography and Network Security”, William Stallings, 2nd Edition, Pearson
2. Education Asia
3. “Network Security private communication in a public world”, C. Kaufman, R. Perlman and M. Speciner, Pearson
4. Cryptography & Network Security: AtulKahate, TMH.
5. “Network Security Essentials: Applications and Standards” by William Stallings, Pearson
6. “Designing Network Security”, MerikeKaeo, 2nd Edition, Pearson Books
7. “Building Internet Firewalls”, Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2<sup>nd</sup> Edition, Oreilly
8. “Practical Unix & Internet Security”, Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly

**Course Outcome:**

Students will be able to:

- Classify the symmetric encryption techniques
- Illustrate various Public key cryptographic techniques
- Evaluate the authentication and hash algorithms
- Summarize the intrusion detection and its solutions to overcome the attacks

Course code	HSM-HU 702				
Category	Humanities and Social Sciences including Management courses				
Course title	Values and Ethics				
Scheme and Credits	L	T	P	Credits	Semester VII
	2	0	0	2	
Pre-requisites (if any)	Students are expected to have some basic understanding of moral values and some sense of right or wrong activities with some practical examples which they learn from their childhood and from the family, friends, school, society etc.				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	Nature of professional ethics:-Introduction, definition, morals & ethics sources of ethics, sources of ethics, relationship between ethics and management. Nature of professional ethics, importance of ethics in profession, nature and objectives of ethics, need for ethics.	<b>3L</b>
<b>2.</b>	Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. Valuing Time Co-operation Commitment Nature of Engineering Ethics, Profession and Professionalism, Professional Ethics, Code of Ethics, Sample Codes IEEE, ASCE, ASME and CSI.	<b>6L</b>

3.	Effects of technological growth:- Energy Crisis, Rapid technological growth, environmental degradation and pollution, human operator in Engineering projects and industries, problems of man, machine, interaction. Impact of assembly line and automation.	4L
4.	Ethics in profession:-Engineering profession, ethical issues in engineering practice, conflicts between business demands and professional ideals, social and ethical responsibilities of technologists, code of professional Ethics, Whistleblowing and beyond, effects of globalization in modern organization, case study.	5L
5.	Ethical decision making:- Values, morals, standards, corporate social responsibility, attitude and beliefs, ethical values and dimensions dilemmas- decision making, organization and power politics.	5L
6.	Managing ethics:- Building a value system, role of law enforcement, training in ethics, ethics in commercial and operational profession, ethics in finance, ethics in HRM, ethics in Global Business, ethics and IT.	5L
	<b>Total</b>	<b>28L</b>
	<b>Total week required</b>	<b>14</b>
	<b>No. of week reserved</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Blending the best of the East & West, Dr. Subir Chowdhury, EXCEL
2. Ethics & Mgmt. & Indian Ethos, Ghosh, VIKAS
3. Business Ethics, Pherwani, EPH
4. Ethics, Indian Ethos & Mgmt., Balachandran, Raja, Nair, Shroff Publishers
5. Business Ethics: concept and cases, Velasquez, Pearson
6. Engineering Ethics: Charles D, Fleddermann, Pearson / PHI, New Jersey 2004 (Indian Reprint)
7. Engineering Ethics Concepts and Cases: Charles E Harris, Michael S. Protchard and Michael J Rabins, Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
8. Ethics and the Conduct of Business: John R Boatright, Pearson Education, New Delhi, 2003.
9. Fundamentals of Ethics for Scientists and Engineers: Edmund G Seebauer and Robert L Barry, Oxford University Press, Oxford, 2001.

**Course Outcomes:** At the end of this course, students will be able to

- Apply the concept of values and ethics and its application in engineering field.
- Make themselves aware about various factors influencing ethical decisions.
- Develop some practical views and skills, and still in their mind certain basic points of ethical decision making with the help of case studies.
- Convince and resolve a moral dilemma and to take an ethical decision in case of Conflicting interests.
- Develop about the social and ethical responsibilities of an engineer and his role in nation building and inclusive growth.
- Develop the basics on when and how to play a whistle-blowers role if it is essential as a social responsibility to save the public and the nation.



Course code	PROJ-IT 791				
Category	Project				
Course title	Project-II				
Scheme and Credits	L	T	P	Credits	Semester VII
	0	0	12	6	
Pre-requisites (if any)	PROJ-IT 691 and as per the technical requirements of the Project, the concerned Project Guide may prepare the pre-requisites.				

1. Project-II is in continuation of Project-I started in the previous semester. It holds 7 credit points.
2. Students must maintain regularity in their project work.
3. Students shall try to devote sufficient time and effort towards performing their project work. At the end of Semester-VII students have to submit an Intermediate Project Report comprising on progress of their proposed work. Each group should submit at least two extra copy of Intermediate Project Report other than their individual copy, one for their Project guide and one for the departmental record.

Course code	PROJ-INT 791				
Category	Project				
Course title	Internship				
Scheme and Credits	L	T	P	Credits	Semester VII
	0	0	***	2	
Pre-requisites (if any)					

\*\*\* An Internship of 40 hours per week to be done after 2<sup>nd</sup> / 4<sup>th</sup> / 6<sup>th</sup> semester examination (during semester gap)

Details of the rules and norms of Internship shall be fixed by the institute in tune with the AICTE rules in this regard.

**Semester-VIII**

Course Code	PEC-IT 811(a)				
Category	Professional Elective Course (PEC)				
Course Title	Cyber Security and Computer Forensics				
Scheme and Credits	L	T	P	Credits	Semester VIII
	3	0	0	3	
Pre-Requisites (if any)	PEC-IT 612(d), PEC-IT 712(d)				

**Theory Syllabus**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<b>Introduction of Cybercrime:</b> What is cybercrime? Forgery, Hacking, Software Piracy, Computer Network intrusion.	<b>6L</b>
<b>2.</b>	<b>Category of Cybercrime:</b> How criminals plan attacks, passive attack, Active attacks, Cyberstalking.	<b>6L</b>
<b>3.</b>	<b>Cybercrime Mobile &amp; Wireless devices:</b> Security challenges posted by mobile devices, cryptographic security for mobile devices, Attacks on mobile/cellphones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop.	<b>10L</b>
<b>4.</b>	<b>Tools and Methods used in Cybercrime:</b> Proxy servers, password checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: Buffer over flow.	<b>10L</b>
<b>5.</b>	<b>Phishing &amp; Identity Theft:</b> Phishing methods, ID Theft; Online identity method.	<b>4L</b>
<b>6.</b>	<b>Cyber-crime&amp; Cyber-security:</b> Legal aspects, Indian laws, IT act, Public key certificate	<b>6L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required</b>	<b>14</b>
	<b>No. of weeks Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Cybersecurity: An Essential Guide to Computer and Cyber Security for Beginners, Including Ethical Hacking, Risk Assessment, Social Engineering, Attack and Defense Strategies, and Cyber warfare: Lester Evans
2. Cyber Security: A Starter Guide to Cyber Security for Beginners, Discover the Best Strategies for Defense Your Devices, Including Risk Management, ... and Information Security. (Hacking) Paperback – November 17, 2019: Kelvin Kali

**Course Outcomes:**

After completion of the course Students will be able to:

- Develop an understanding of security policies (such as confidentiality, integrity, and availability) as well as protocols to implement such policies
- Gain knowledge about securing both clean and corrupted systems, protect personal data, and secure Computer Networks.
- Demonstrate expertise in configuring host and network level technical security controls, to include Host firewalls, user access controls, host logging, network filtering, intrusion detection, and prevention and encryption at all levels.

Course Code	PEC-IT 811 (b)				
Category	Professional Elective Course (PEC)				
Course Title	Multimedia Technology				
Scheme and Credits	L	T	P	Credits	Semester VIII
	3	0	0	3	
Pre-Requisites (if any)	PCC- IT 301, PEC-IT 511(d), PEC-IT 611 ( d )				

**Theory Syllabus:**

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture / Tutorial Period</b>
<b>1.</b>	<b>Introduction to Multimedia:</b> Multimedia presentation and production, Multimedia and hypermedia, Digital Representation, Types of Multimedia Components (static and time variant), Hardware and software requirements, Uses of multimedia.	<b>2L</b>

2.	<b>Text:</b> Representation of textual information, Design considerations, Character stand codes, Text types – Plain Text, Rich Text, Formatted and unformatted Text, Hypertext, Text formats (ASCII, RTF, and HTML). Different Text compression Techniques.	4L
3.	<b>Image:</b> Concept of image, Image Representation (Pixel mapping and Vector Graphics techniques), Different Color models, Image Resolution, Image enhancement and filtering techniques, Image compression (Lossless and Lossy Image Compression Techniques), Image encoding (RLE, Huffman, Arithmetic), Image formats (BMP, JFIF/JPEG, GIF, TIFF). <b>Audio:</b> Fundamental concepts of sound, Dynamic range of human hearing, Modulation and demodulation techniques, Digital representation of Sound, (Sampling Rate, Sampling Size, Quantization), Audio compression standards (Subband Encoding, MP3, WAV, RIFF, RM), MIDI protocol, MIDI file format, Audio Transmission	14L
4.	<b>Video:</b> Analogue and digital video, Raster scanning technique, Interlaced and non-interlaced scanning, Transmission of video signals, Color video signals, Video Coding standards (MJPEG, MPEG, AVI), Video Editing.	6L
5.	<b>Animation:</b> Definition of animation, Tools and techniques, Animation control techniques, Double buffering, Warping and Morphing, 3D animation techniques-Basic concepts, Polygonal/NURBS modeling.	4L
6.	<b>Multimedia Devices:</b> Input devices–Scanner, CCD Camera, Microphone, Output devices – Printer, CDROM, DVD, Woofer; Architecture of Sound Card and Frame Grabber Card.	3L
7.	Virtual Reality Techniques: Immersive and non-immersive VR, VR devices, Virtual Reality Modeling Language (VRML), Distributed VR	3L
8.	<b>Multimedia Architecture:</b> User Interface, Windows Multimedia Support, Distributed Multimedia Applications, Real Time Protocols, Playback Architectures, Streaming Technologies, Temporal Relationships, Synchronization, Multimedia Database System.	3L
9	<b>Multimedia Application Development:</b> Multimedia application development life cycle, Authoring tools and metaphors, Windows/Windows multimedia application programming.	3L
	<b>Total</b>	<b>42L</b>
	<b>Total week required</b>	<b>14</b>
	<b>No. of week reserved</b>	<b>02</b>

**Books: Text and/or Reference:**

1. R. Steinmetz and K. Nahrstedt , Multimedia: Computing, Communications & Applications, Pearson Ed.
2. N. K. Sharda, Multimedia Information System, PHI.
3. F.Halsall, Multimedia Communications, Pearson Ed.

4. K. Buford, Multimedia Systems, Pearson Ed.
5. F. Hoffstetter, Multimedia Literacy, McGraw Hill.
6. R. Steinmetz and K. Nahrstedt, Multimedia Fundamentals: Vol. 1 - Media Coding and Content Processing, PHI.
7. J. Jeffcoate, Multimedia in Practice: Technology and Application, PHI.
8. P. K. Andleigh & K. Thakrar, Multimedia Systems Design, PH

### Course Outcomes:

After completion of this course, Students will be able to:

- Identify the essential features of graphics/image data types, file formats, and colour models in images and video.
- Explain the technical details of multimedia data representations.
- Perform a comparative analysis of the major methods and algorithms for multimedia data compression.
- Configure and manage multimedia content delivery platforms.
- Identify the essential issues of quality of service in multimedia networking.
- Explain technical aspects of popular multimedia web applications, including VoD and VoIP.

Course code	PEC-IT 811(c)				
Category	Professional Elective Course (PEC)				
Course title	Neural Networks and Deep Learning				
Scheme and Credits	L	T	P	Credits	Semester VIII
	3	0	0	3	
Pre-requisites (if any)	PCC-IT 612( c)				

**Theory Syllabus:**

Module	Detailed Description	Lecture / Tutorial Period
1.	<b>Basics:</b> Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm. <b>Feedforward Networks:</b> Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.	10L
2.	<b>Deep Neural Networks:</b> Different types of Deep neural network, CNN architecture, Difficulty of training deep neural networks. <b>Better Training of Neural Networks:</b> Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization). <b>Recurrent Neural Networks:</b> Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.	14L
3.	<b>Generative models:</b> Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.	8L
4.	<b>Recent trends:</b> Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning. <b>Applications:</b> Computer Vision, Object recognition NLP, Speech <b>Tools:</b> Tensor flow, Torch	10L
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required:</b>	<b>14</b>
	<b>No. Of Week Reserved:</b>	<b>02</b>

**Books: Text and/or Reference:**

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.
2. Neural Networks: A Comprehensive Foundation: Simon Haykin
3. Pattern Recognition and Machine Learning, Christopher Bishop, 2007.
4. Deep Learning for Vision System- Mohamed Elgendy, Manning Publications

**Course outcomes**

After completion of this course, students will be able to:

- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- Implement deep learning algorithms and solve real-world problems.
- Understand the foundation of generative models.
- Design and implement deep neural network systems, identify new application requirements in the field of computer vision.

Course code	PEC-IT 811(d)				
Category	Professional Elective Course				
Course title	Cloud Computing				
Scheme and Credits	L	T	P	Credits	Semester VIII
	3	0	0	3	
Pre-requisites (if any)	PCC-IT 402, PCC- IT 403, PCC-IT 602				

### Theory Syllabus:

<b>Module</b>	<b>Detailed Description</b>	<b>Lecture/ Tutorial Period</b>
<b>1.</b>	<b>Introduction to Cloud Computing:</b> Cloud Computing-History, Need for Cloud Computing, Basic Concepts & Terminology, Goals & Benefits, Risks & Challenges, Roles and Boundaries, Cloud Characteristics, Advantages and Disadvantages of Cloud Computing.	<b>8L</b>
<b>2.</b>	<b>Cloud Delivery Models:</b> Concept of Cloud Delivery Models, Infrastructure as a Service, Platform as a Service, Software as a Service, Comparing Cloud Delivery Models, Combining Cloud Delivery Model. <b>Cloud Deployment Models:</b> Concept of Cloud Deployment Models, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Other Models.	<b>12L</b>
<b>3.</b>	<b>Virtualization &amp; Data Center Technology:</b> Concept of Virtualization, Different Types of Virtualizations, Virtualization Management, Overview of Data Center Technology, Multitenant Technology.	<b>10L</b>
<b>4.</b>	<b>Cloud Security &amp; Risk:</b> Different Security Issues in Cloud Environment, Different Types of Threats, Cloud Security Threats, Cloud Security Services, Risks in Cloud Computing, Risk Management. <b>Cloud Computing Tools and Applications:</b> Introduction to Different Cloud Computing Tools (CloudSim, OpenNebula, Nimbus), Case Study on different Cloud Applications (Microsoft Cloud Services, Amazon Cloud Services, Google Cloud Applications), Advanced Cloud Applications (Mobile Cloud, Multimedia Cloud, Green Cloud).	<b>12L</b>
	<b>Total</b>	<b>42L</b>
	<b>Total Week Required</b>	<b>14</b>
	<b>No. of Week Reserved</b>	<b>02</b>

**Books: Text and/or Reference:**

1. R. Puttini, T. Erl, and Z. Mahmood, Cloud Computing: Concepts, Technology & Architecture, PrenticeHall.
2. M. Miller, Cloud Computing: Web-Based Application That Change the Way You Work and Collaborate Online, QuePublishing.
3. T. Velte, Cloud Computing A Practical Approach, McGraw Hill Education.
4. A. Srinivasan, J. Suresh, Cloud Computing: A Practical Approach for Learning and Implementation, Pearson.

**Course Outcomes**

Upon Completion of the course, the students will be able to

- Articulate the main concepts and the possible applications of cloud computing.
- Analyze various cloud delivery and deployment models.
- Illustrate the role of virtualization in cloud computing.
- Explain security, privacy, and interoperability issues in cloud computing.
- Apply various cloud computing models to solve real world problems on the cloud.

Course code	PROJ-IT 891				
Category	Project				
Course title	Project-III				
Scheme and Credits	L	T	P	Credits	Semester VIII
	0	0	12	6	
Pre-requisites (if any)	PROJ-IT 791 and as per the technical requirements of the Project, the concerned Project Guide may prepare the pre-requisites				

- Project-III is in continuation of Project-II started in the previous semester. It also holds 7 credit points.
- Students must maintain regularity in their project work.
- The project work started during 6<sup>th</sup> semester must be completed within this semester. Each project group should prepare a Project Report by the end of this semester. Each group should submit at least three extra copy of Project Report other than their individual copy, one for their Project guide, one for the departmental library and one for Institute's main library.