Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Curriculum Structure for B. Tech in Computer

PROGRAM OUTCOME (POs):

Engineering Graduates will be able to:

PO-1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Educational Objectives (PEOs):

PEO-1: To provide students with a strong foundation in applied science and Computer Science & Engineering fundamentals necessary to analyze the requirements of the software, understand the technical specifications, design and create innovative computing products and solutions for real life problems.

PEO-2: To provide exposure to emerging technologies, adequate training and opportunities to work as teams on multidisciplinary projects with effective communication skills and leadership qualities.

PEO-3: To prepare the students for a successful professional career as engineer, scientist, teacher, technocrat, administrator or an entrepreneur and work with values & social concern bridging the digital divide and meeting the requirements of Indian and multinational companies.

Program Specific Outcomes (PSOs)

PSO-1: Demonstration of Basic Knowledge: Ability to understand the principles & working of computer systems; demonstrate, analyze, apply management principles, mathematical foundations in the development of computational solutions.

PSO-2: Problem Solving Skills: Ability to design and develop computer programs and computer based systems of moderate complexity in the areas pertaining to database, networking, web-design, artificial intelligence and information security.

PSO-3: Professional Skills: Ability to apply standard practices and methods in software project management and software development using suitable programming environments to deliver quality product for the industry.

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Curriculum Structure for B. Tech in Computer Science and Engineering

Second Year - Third Semester

Semester III							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Engineering Science Course	ESC 301	Digital Logic Design	3	0	0	3
2	Professional Core Courses	PCC-CS301	Data Structure & Algorithms	3	0	0	3
3	Professional Core Courses	PCC-CS302	Formal Language & Automata Theory	3	0	0	3
4	Basic Science course	BSC 301	Mathematics-III (Probability and Statistics)	3	0	0	3
5	Humanities & Social Sciences including Management courses	HSMC 301	Economics for Engineers (Humanities-II)	3	0	0	3
Practical							
6	Engineering Science Course	ESC 391	Digital Logic Design Lab	0	0	4	2
7	Professional Core Courses	PCC-CS391	Data Structure Algorithms Lab	0	0	4	2
8	Professional Core Courses	PCC-CS392	IT Workshop (Sci Lab/MATLAB/Python /R)	0	0	4	2
Total credit of the Semester							**21**

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Curriculum Structure for B. Tech in Computer Science and Engineering

Second Year - Fourth Semester

Semester IV							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Core Courses	PCC- CS401	Discrete Mathematics	3	1	0	4
2	Professional Core Courses	PCC-CS 402	Computer Organization & Architecture	3	0	0	3
3	Professional Core Courses	PCC- CS403	Object Oriented Programming	3	0	0	3
4	Professional Core Courses	PCC- CS404	Design & Analysis of Algorithms	3	0	0	3
5	Basic Science courses	BSC 401	Biology	2	1	0	3
6	Mandatory Courses	MC401	Environmental Sciences	1	-	-	
Practical							
7	Engineering Science Course	PCC-CS 492	Computer Organization & Architecture Lab	0	0	4	2
	Professional Core Courses	PCC-CS 493	Object Oriented Programming Lab	0	0	4	2
8	Professional Core Courses	PCC- CS494	Design & Analysis of Algorithms Lab	0	0	4	2
Total credit of the Semester							**22**

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Curriculum Structure for B. Tech in Computer Science and Engineering

Third Year - Fifth Semester

Semester V							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Engineering Science Course	ESC 501	Compiler design	3	0	0	3
2	Professional Core Courses	PCC- CS 501	Database Management Systems	3	0	0	3
3	Professional Core Courses	PCC- CS502	Operating Systems	3	0	0	3
4	Professional Core Courses	PCC- CS503	Machine Learning	3	0	0	3
5	Humanities & Social Sciences including Management courses	HSMC-501	Introduction to Industrial Management (Humanities III)	3	0	0	3
6	Professional Elective courses	PEC-CS 501 A/B/C	(Elective-I) Artificial Intelligence/ Advanced Computer Architecture/ Computer Graphics	3	0	0	3
7	Mandatory Courses	MC- CS501	Constitution of India/ Essence of Indian Knowledge Tradition	2	-	-	0
Practical							
8	Professional Core Courses	PCC- CS591	Database Management Systems Lab		0	4	2
9	Professional Core Courses	PCC- CS592	Operating Systems Lab		0	4	2
10	Professional Core Courses	PCC- CS593	Machine Learning Lab		0	4	2
Total credit of the Semester							**24**

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Curriculum Structure for B. Tech in Computer Science and Engineering

Third Year - Sixth Semester

Semester VI							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Core Courses	PCC- CS601	Software Engineering	3	0	0	3
2	Professional Core Courses	PCC- CS602	Computer Networks	3	0	0	3
3	Professional Core Courses	PCC – CS 603	Introduction to Cyber Security & Blockchain Technology	3	0	0	3
4	Professional Elective courses	PEC- CS601 A/ B/C/D	(Elective-II) Advanced Algorithms/ Distributed Systems/ Signals & Systems/Image Processing	3	0	0	3
5	Professional Elective courses	PEC- CS602A/B/ C/D	(Elective-III) Parallel and Distributed Algorithms/ Data Mining/Human Computer Interaction/ Pattern Recognition	3	0	0	3
6	Open Elective courses	OEC- CS601A/B	(Open Elective-) Numerical Methods/ Human Resource Development and Organizational Behavior	3	0	0	3
Practical							
6	Professional Core Courses	PCC- CS691	Software Engineering Lab	0	0	4	2
7	Professional Core Courses	PCC- CS692	Computer Networks Lab	0	0	4	2
Total credit of the Semester							**22**

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Curriculum Structure for B. Tech in Computer Science and Engineering

Fourth Year - Seventh Semester

Semester VII							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Elective courses	PEC-CS701A/B/ C/D/E/F	(Elective-IV) Quantum Computing/ Cloud Computing/ Neural Networks and Deep Learning/ Soft Computing/Ad-Hoc and Sensor Networks/Information Theory and Coding	3	0	0	3
2	Open Elective courses	OEC-CS701A/B/ C	(Open Elective-II) Operations Research/Multimedia Systems/ Introduction to Philosophical Thoughts	3	0	0	3
3	Humanities & Social Sciences including Management courses	HSMC 701	Project Management and Entrepreneurship	2	1	0	3
4	Industrial Internship/Training	TR-CS 771	Industry Internship	0	0	0	3
5	Project	PROJ- CS781	Project-I	0	0	12	6
Total credit of the Semester							**18**

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Curriculum Structure for B. Tech in Computer Science and Engineering

Fourth Year - Eighth Semester

Semester VIII							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Elective courses	PEC-CS801A/B/C/D/E	(Elective-VI) Signals and Networks/Cryptography & Network Security/ Speech and Natural Language Processing/ Web and Internet Technology/Internet of Things	3	0	0	3
2	Open Elective courses	OEC- CS 801A/B/C/D/E	Open Elective-III Big Data Analysis/Cyber Law and Ethics/ Mobile Computing/Robotics/Soft Skill & Interpersonal Communication	3	0	0	3
3	Industrial Internship/ Training	TR-CS 871	Industry Internship	0	0	0	3
4	Project	PROJ- CS881	Project-II	0	0	12	6
Total credit of the Semester							**15**

Department of Computer Science and Engineering
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Detailed Syllabus for B. Tech in Computer Science & Engineering

Second Year - Third Semester

(Semester III)

Digital Logic Design

Code: ESC-301

Contact: 3L

Theory: 3 hrs. /Week

Credit point: 3

Objective:	
1.	To familiar with the digital signal, positive and negative logic, Boolean algebra, logic gates, logical variables, and number systems.
2.	To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
3.	To prepare students to perform the analysis and design of various digital electronic circuits

Pre-Requisite:	
1.	Basic Electronics Parts I & II learned in the First year, semesters 1 & 2. Basic BJTs
2.	Basic concept of the working of P-N diodes, Schottky diodes,
3.	Basic FETs and OPAMP as a basic circuit component. Concept of Feedback

Unit	**Content**	**Hrs./Unit**
1	Binary Number System & Boolean Algebra(recapitulation); BCD, ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic, Venn diagram, Boolean algebra (recapitulation); Representation in SOP and POS forms; Minimization of logic.	9
2	Analysis and synthesis of combinational logic circuits: Adder and substructures (look-ahead adders), Multiplexers, de multiplexers,	11

	Encoders, decoders, code convertors, magnitude comparators, parity generators and checkers. Binary Adder: Serial and Parallel Adders. CPA, CLA, CSA.	
3	Sequential Circuits - Basic Flip-flop & Latch, Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops, Registers (SISO, SIPO, PIPO, PISO) Ring counter, Johnson counter Basic concept of Synchronous and Asynchronous counters (detail design of circuits excluded),Design of Mod N Counter	10
4	A/D and D/A conversion techniques – Basic concepts (D/A :R-2-R only, A/D: successive approximation) Logic families- TTL, ECL, MOS and CMOS – basic concepts.	6

Text book and Reference books:

1. Microelectronics Engineering –Sedra & Smith-Oxford.
2. Principles of Electronic Devices & circuits—B L Thereja & Sedha—S Chand
3. Digital Electronics – Kharate – Oxford
4. Digital Electronics – Logic & Systems by J.Bigmell&R.Donovan; Cambridge Learning.
5. Digital Logic and State Machine Design (3rd Edition) – D.J.Comer, OUP
6. Electronic Devices & Circuit Theory – Boyelstad&Nashelsky – PHI
7. Bell-Linear IC & OP AMP—Oxford
8. P.Raja- Digital Electronics- Scitech Publications
9. Morries Mano- Digital Logic Design- PHI
10. R.P.Jain—Modern Digital Electronics, 2/e ,McGraw Hill
11. H.Taub&D.Shilling, Digital Integrated Electronics- McGraw Hill.
12. D.RayChaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers
13. Tocci, Widmer, Moss- Digital Systems,9/e- Pearson
14. J.Bignell&R.Donovan-Digital Electronics-5/e- Cenage Learning.
15. Leach & Malvino—Digital Principles & Application, 5/e, McGraw Hill
16. Floyed & Jain- Digital Fundamentals-Pearson.

Course Outcome:	
On completion of the course students will be able to	
ESC 301.1	Understand the fundamental concepts and techniques used in digital logic.
ESC 301.2	Illustrate binary arithmetic, code conversion and solve Boolean logic minimization.

ESC 301.3	Design the fundamental combinational logic circuits.
ESC 301.4	Demonstrate the principles of flip-flops
ESC 301.5	Implement the sequential circuit design of counters and registers.
ESC 301.6	Discuss the basic concepts of elementary A/D and D/A conversion techniques.

Data Structure & Algorithm

Code: PCC-CS301

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To learn the basics of abstract data types.
2.	To learn the principles of linear and nonlinear data structures.
3.	To build an application using sorting and searching.

Pre-Requisite:	
1.	CS 201 (Basic Computation and Principles of C)
2.	M101 & M201 (Mathematics), basics of set theory

Unit	Content	Hrs/Unit
1	Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.	10
2	Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	9
3	Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular	10

	Linked Lists: all operations their algorithms and the complexity analysis. Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis	
4	Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	9

Text book and Reference books:

1. "Data Structures and Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Fundamentals of Data Structures of C" by Ellis Horowitz, SartajSahni, Susan Andersonfreed.
3. "Data Structures in C" by Aaron M. Tenenbaum.
4. "Data Structures" by S. Lipschutz.
5. "Data Structures Using C" by ReemaThareja.
6. "Data Structure Using C", 2/e by A.K. Rath, A. K. Jagadev.
7. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
8. "Data Structure through C" by Yaswant Kanetkar, BPB Publications.

Courses Outcomes:	
On completion of the course student will be able to	
PCC-CS301.1	Define and understanding introductory concepts of data structure, time and space analysis of algorithms using different asymptotic notations.
PCC-CS301.2	Understanding linear data structures with its applications and operations.
PCC-CS301.3	Illustrate the concept and implementation of stack, queue, dequeue, circular queue, and applications using linked list.
PCC-CS301.4	Understanding and build non-linear data structure such as trees, its traversal, insertion, deletion, height-balanced and B-trees.
PCC-CS301.5	Analyze and evaluate various searching and sorting algorithms, problem analysis and representation of graphs such as BFS and DFS.
PCC-CS301.6	Analyze and evaluate the importance of data structure and be able to correlate future programming structure, and its market issues specific to complex engineering problems.

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Formal Language & Automata Theory

Code: PCC-CS302

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Be able to construct finite state machines and the equivalent regular expressions.
2.	Be able to prove the equivalence of languages described by finite state machines and regular expressions
3.	Be able to construct pushdown automata and the equivalent context free grammars. And Be able to prove the equivalence of languages described by pushdown automata and context free grammars.
4.	Be able to construct Turing machines and Post machines. Be able to prove the equivalence of languages described by Turing machines and Post machines

Pre-Requisite:	
1.	Basic set theory

Unit	Content	Hrs/Unit
1.	Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.	3
2.	Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata)	10
3.	Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFLs.	8
4.	Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.	4
5.	Turing machines: The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines,	8

	nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMsas enumerators.	
6.	Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages	4

Text book and Reference books:

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.
2. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
3. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
4. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
5. John Martin, Introduction to Languages and the Theory of Computation, Tata McGraw Hill., PEARSON.
6. Dr. R. B. Patel, Theory of Computation, Khanna Publishing House.

Course Outcomes:	
On completion of the course students will be able to	
PCC-CS302.1	Define automata theory as the basis of all computer languages and recall set, graph, tree, principle of mathematical induction.
PCC-CS302.2	Explain Finite State Machine, its behaviour and how to minimize the machine.
PCC-CS302.3	Demonstrate Finite Automata, regular expression and check equivalence between regular grammar and FA.
PCC-CS302.4	Examine context free grammar (CFG), minimize CFG and check equivalence of CFL and PDA.
PCC-CS302.5	Apply pumping lemma to disprove the language is regular language or context free language.
PCC-CS302.6	Design Turing machines for languages and realize limitations in computing.

Mathematics III (Probability & Statistics)

Course: BSC 301

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Unit	Content	Hrs/Unit
1.	Probability spaces, Axiomatic definition of Probability, Conditional probability, Independent events, Bayes theorem (Proof not required). Probability Distributions: Discrete and continuous and their properties, Distribution functions and densities, Expectation and Variance, Binomial, Poisson, Uniform, Exponential, Normal distributions. Binomial and Poisson approximation to Normal distribution. t, χ^2 and F-distribution (Definition only). Transformation of random variables. Central Limit Theorem, Law of large numbers (statement only) and their applications. Tchebychev inequalities (statement only) and its application.	12
2.	Bivariate Distributions: Two dimensional random variable, Distribution function and its properties: Discrete and continuous, Marginal distribution, Conditional distribution, Mathematical expectation of bi-variate distribution, Conditional expectation , Correlation and regression - Rank correlation coefficient, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.	10
3.	Random sampling, Parameter, Statistic and its Sampling distribution. Standard error of statistic. Sampling distribution of sample mean and variance in random sampling from a normal distribution (statement only) and related problems. Estimation of parameters: Unbiased and consistent estimators. Point estimation. Interval estimation. Maximum likelihood estimation of parameters (Binomial, Poisson and Normal). Confidence intervals and related problems.	8
4.	Simple and Composite hypothesis. Critical region. Level of significance. Type I and Type II errors. One sample and two sample tests for means and proportions. χ 2 - test for goodness of fit.	6

Text book and Reference books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Kapoor, V. K and Gupta, S.C.: Fundamental of Mathematical Statistics, Sultan Chand and Sons.
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

(vii) Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

7. Spiegel M R., Schiller J.J. and Srinivasan R.A. : Probability and Statistics (Schaum's Outline Series), TMH.

Course Outcomes:	
On completion of the course students will be able to	
BSC 301.1	Recite concept of permutation and combination, concept of statistics.
BSC 301.2	Discuss the concept probability distribution, statistical inference and hypothesis testing.
BSC 301.3	Demonstrate computational modelling of biological phenomena and applies techniques from areas such as artificial intelligence, data base, software engineering, machine learning, image processing.
BSC 301.4	Illustrate physical scenario and classify them to recognize the best fit physical and logical models.
BSC 301.5	Compare different mathematical results during the process of problem analysis.
BSC 301.6	Design models to demonstrate industrial problem for emerging trend in information technology.

Economics for Engineers (Humanities-II)

Code: HSMC-301

Contacts: 3L

Theory: 3 hrs./ Week

Credit Points: 3

Objective:	
1.	Understand the role and scope of Engineering Economics and the process of economic decision making
2.	Understand the different concepts of cost and different cost estimation techniques
3.	Familiarization with the concepts of cash flow, time value of money and different interest formulas
4.	Appreciation of the role of uncertainty in future events and using different concepts from probability to deal with uncertainty
5.	Understand the concepts of Depreciation and Replacement analysis along with their

	methods of calculation
6.	Familiarization with the phenomenon of inflation and the use of price indices in engineering Economics
7.	Introduction to basic concepts of Accounting and Financial Management

Pre-Requisite:	
1.	Mathematics

Unit	Content	Hrs/Unit
1.	Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	9
2.	Cash Flow, Interest and Equivalence: Cash Flow –Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal& Effective Interest. Cash Flow & Rate of Return Analysis –Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing an Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity and Breakeven Analysis. Economic Analysis In The Public Sector -Quantifying And Valuing Benefits & drawbacks.	9
3.	Inflation and Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic	9

	Decision Trees, Risk, Risk vs Return, Simulation, Real Options.	
4.	Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax RegulationsFor Depreciation And Capital Allowances. Replacement Analysis - Replacement AnalysisDecision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. Accounting – Function, Balance Sheet, IncomeStatement, Financial Ratios Capital Transactions,Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	9

Text book and Reference books:

1. James L.Riggs,David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
2. Donald Newnan, Ted Eschembach, Jerome Lavelle: Engineering Economics Analysis, OUP
3. John A. White, Kenneth E.Case,DavidB.Pratt : Principle of Engineering Economic Analysis, John Wiley
4. Sullivan and Wicks: Engineering Economy, Pearson
5. R. PaneerSeelvan: Engineering Economics, PHI
6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub

Course Outcome:	
On completion of the course students will be able to	
HSMC-301.1	Make different economic decisions and estimate engineering costs by applying different cost estimation models.
HSMC-301.2	Create cash flow diagrams for different situations and use different interest formulae to solve associated problems.
HSMC-301.3	Take decisions regarding different engineering projects by using various criteria like rate of return analysis, present worth analysis, cost-benefit analysis etc.
HSMC-301.4	Incorporate the effect of uncertainty in economic analysis by using various concepts like expected value, estimates and simulation. They will also understand the process of inflation and use different price indices to adjust for its effect.

HSMC-301.5	Understand the concepts of depreciation and replacement analysis and solve associated problems.
HSMC-301.6	Apply the various concepts of Accounting like balance sheet and ratio analysis. Also they will understand the scope of Finance and the role of financial planning and management.

Digital Logic Design Lab

Code: ESC-391

Contacts: 4P

Practical: 4 hrs./ Week

Credit points: 2

Pre-Requisite:	
1.	Pre-requisites as in ESC-301

Laboratory Experiments:	
1	Design a Full Adder using basic gates and verify its output / Design a Full Subtractor circuit using basic gates and verify its output.
2	Construction of simple Decoder & Multiplexer circuits
3	Design BCD Adder circuit
4	Design CPA circuit
5	Design CLS and CSA circuit
6	Realization of RS / JK / D flip flops using logic gates
7	Design of Shift Register using J-K / D Flip Flop
8	Realization of Synchronous Up/Down counter
9	Design of MOD- N Counter
10	Study of DAC

Course Outcome:	
On completion of the course students will be able to	
ESC-391.1	Realization of basic logic gates.
ESC-391.2	Design basic combinational circuits and verify their truth tables
ESC-391.3	Examine the behavior of sequential circuits using flip flops

ESC-391.4	Apply knowledge of flip flops to design counters
ESC-391.5	Understand and implement the concept of registers
ESC-391.6	Learn the principles of DAC

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Data Structure & Algorithm Lab

Code: PCC-CS391

Contacts: 4P

Practical: 4 hrs./ Week

Credit Points: 2

Pre-Requisite:	
1.	Pre-requisites as in PCC-CS301

Laboratory Experiments:	
Linear Data Structure	
1	Implementation of array operations.
2	Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting Elements.
3	Merging Problem: Evaluation of expressions operations on Multiple stacks & queues:
4	Implementation of linked lists: inserting, deleting and inverting a linked list. Implementation of stacks & queues using linked lists.
5	Polynomial addition, Polynomial multiplication.
Non Linear Data Structure	
6	Recursive and Non-recursive traversal of Trees.
7	Threaded binary tree traversal. AVL tree implementation.
8	Application of Trees. Application of sorting and searching algorithms.
9	Hash tables implementation: searching, inserting and deleting, searching & Sorting techniques.

Course Outcome:
On completion of the course students will be able to

PCC-CS391.1	Define different operations on data structure such as insertion, deletion, merging using arrays.
PCC-CS391.2	Demonstrate implementation of stacks and queues: insertion, deletion of elements, circular queue: insertion, deletion of elements using array.
PCC-CS391.3	Solve expressions operations using multiple stacks & queues.
PCC-CS391.4	Construction and implementation of linked lists: inserting, deleting, and inverting a linked list. Analyze implementation of stacks & queues using linked lists, polynomial addition, polynomial multiplication, sparse matrices multiplication, addition using linked list.
PCC-CS391.5	Evaluate recursive and non-recursive traversal of trees and implementation of recursive binary tree traversal and AVL tree.
PCC-CS391.6	Design and implement of different searching and sorting algorithms.

(Detailed instructions for Laboratory Manual to be followed for further guidance)

IT Workshop (Sci Lab/MATLAB/Python/R)

Code: PCC-CS392

Contacts: 4P

Practical: 4 hrs./ Week

Credit Points: 2

Course Objective:	
1.	To master an understanding of scripting & the contributions of scripting languages.
2.	Design real life problems and think creatively about solutions.
3.	Apply a solution in a program using R/Matlab/Python.
4.	To be exposed to advanced applications of mathematics, engineering and natural sciences to program real life problems.

Pre-Requisite:	
1.	Knowledge of Programming Logic
2.	Experience with a high level language (C/C++,) is suggested.
3.	Prior knowledge of a scripting language and Object-Oriented concepts is helpful but not mandatory.

Practical Syllabus:

Programming in R:

1. Introduction to mechanism for statistics, data analysis, and machine learning; Introduction of R Programming, How to install and run R, Use of R help files, R Sessions, R Objects – Vectors, Attributes, Matrices, Array, Class, List, Data Frames etc. Operators in R.
2. R Programming Structures, Control Statements, Loops, Repeat and Break, R-Function, R Vector Function, Recursive Function in R.
3. R Packages (Install and Use), Input/output Features in R, Reading or Writing in File. Data Manipulation in R. Rearranging data, Random Number and Simulation, Statistical methods like min, max, median, mean, length, Linear Regression, Normal Distribution, Decision tree
4. Graphics, Creating Graphs, The Workhorse of R Base Graphics, Graphical Functions – Customizing Graphs, Saving Graphs to Files, Pie chart, Bar Chart, Histogram.

Text book and Reference books:

Dr. Jeeva Jose, Beginner's Guide for Data Analysis Using R Programming, Khanna Publishing House, New Delhi

Programming in Matlab:

Introduction

Why MATLAB? History, Its strengths, Competitors, Starting MATLAB, Using MATLAB as a calculator, Quitting MATLAB

Basics

Familiar with MATLAB windows, Basic Operations, MATLAB-Data types, Rules about variable names, Predefined variables

Programming-I

Vector, Matrix, Array Addressing, Built-in functions, Mathematical Operations, Dealing with strings (Array of characters), Array of array (cell) concept

Programming-II

Script file, Input commands, Output commands, Structure of function file, Inline functions, Feval command, Comparison between script file and function file

Conditional statements and Loop

Relational and Logical Operators, If-else statements, Switch-case statements, Forloop,

While loop, Special commands (Break and continue), Import data from large database,

Export data to own file or database

2D Plotting

In-built functions for plotting, Multiple plotting with special graphics, Curve fitting, Interpolation, Basic fitting interface

3D Plotting

Use of meshgrid function, Mesh plot, Surface plot, Plots with special graphics

Text book and Reference books:

Programming with Python:

Introduction

History, Features, Setting up path, working with Python, Basic Syntax, Variable and Data Types, Operator

Conditional Statements

If, If- else, Nested if-else, Looping, For, While, Nested loops

Control Statements

Break, Continue, Pass

String Manipulation

Accessing Strings, Basic Operations, String slices, Function and Methods

Lists

Introduction, Accessing list, Operations, Working with lists, Function and Methods

Tuple

Introduction, Accessing tuples, Operations, Working, Functions and Methods

Dictionaries

Introduction, Accessing values in dictionaries, working with dictionaries, Properties

Functions

Defining a function, calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables

Modules

Importing module, Math module, Random module, Packages, Composition, Input-Output Printing on screen, Reading data from keyboard, Opening and closing file, Reading and Writing files, Functions

Exception Handling

Exception, Exception Handling, except clause, Try? Finally clause, User Defined Exceptions.

TEXT BOOKS

1. Learning Python, Mark Lutz, Orielly, 3 Edition 2007.

2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson, 2017.

REFERENCE BOOKS

1) Think Python, 2 Edition, 2017 Allen Downey, Green Tea Press

2) Core Python Programming, 2016 W.Chun, Pearson.

3) Introduction to Python, 2015 Kenneth A. Lambert, Cengages

4) https://www.w3schools.com/python/python_reference.asp

5) https://www.python.org/doc/

Course Outcome:	
On completion of the course students will be able to	
Course Code : PCC-CS392	Course Name : **IT Workshop (Sci Lab/MATLAB/Python/R)**
PCC-CS392.1	Master an understanding of scripting & the contributions of scripting languages.
PCC-CS392.2	Design real life problems and think creatively about solutions.
PCC-CS392.3	Identify the usages of methods and classes to meet different scientific objectives
PCC-CS392.4	Identify the usages of plot functions to represent data in better form
PCC-CS392.5	Apply a solution in a program using R/Matlab/Python.
PCC-CS392.6	Be exposed to advanced applications of mathematics, engineering and natural sciences to program real life problems.

Department of Computer Science and Engineering
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Syllabus for B. Tech in Computer Science & Engineering

CSE

Second Year - Fourth Semester

(Semester IV)

Discrete Mathematics

Code: PCC-CS401

Contacts: 3L+1T

Theory: 4 hrs. / Week

Credit points: 4

Objective:	
1.	Use mathematically correct terminology and notation.
2.	Construct correct direct and indirect proofs.
3.	To know Syntax, Semantics, Validity and Satisfiability, Graphs and Trees.
4.	Use counterexamples. Apply logical reasoning to solve a variety of problems.

Pre-Requisite:	
1.	Some concepts from basic math – algebra, graph theory, permutation and combination

Unit	Content	Hrs/Unit
1	**Sets, Relation and Function:** Operations and Laws of Sets, Cartesian Products, Relation, Partial Ordering Relation, PO Set, HasseDiagram, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function. **Number Theory:**Principles of Mathematical Induction: The Well-Ordering Principle, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic, Diophantine Equations. Congruence, Properties of Congruence, Residue Classes Solution of Linear Congruence.	12

2	**Counting Technique:** Permutation and Combination, Pigeon-hole principle, Principal of inclusion and exclusion.	5
3	**Propositional Logic:**Proposition, Logical connectives, Truth Table: Conjunction, Disjunction, Negation. Conditional and bi-conditional connectives, Implication, converse, contrapositive, inverse. Logical Equivalence, Tautology, Normal forms- CNF, DNF. Predicates and logical Quantification of Propositions.	8
4	**Algebraic Structures and Morphism:** Binary Operation, Semi Groups, Monoids, Groups, Order of an element of a group, Congruence Relation.Subgroup and cyclic Group, Normal Subgroups, Permutation Groups, QuotientGroup. Homomorphism, Isomorphism, Rings, Integral Domain and Fields.	12
5	**Graphs and Trees:**Definition and properties of Tree, Binary Tree, Spanning Tree, Minimal Spanning Tree- Kruskal's and Prim's Algorithm, Dijkstra's algorithm for shortest path, BFS and DFS algorithm. PlanarGraphs, theorems on Planarity, Kuratowski's Graph, Dual of Graph. Graph Colouring, Vertex Colouring, Chromatic Number, Perfect Graph, Chromatic Polynomial, Edge Colouring, Map Colouring, Four and Five Colours theorem. Matching, The Marriage Problem, Hall's Marriage Theorem.	11

Text book and Reference books:

1. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation

2. J.K. Sharma, Discrete Mathematics, Macmillan

3. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.

4. N. Deo, Graph Theory, Prentice Hall of India, 1974.

5. Robin J. Willson, Introduction to Graph Theory, 4th Ed. Longman Publication,

6. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 1999.

Course Outcomes:	
On completion of the course students will be able to	
PCC-CS401.1	Demonstrate an understanding of relations and functions and be able to determine their properties.
PCC-CS401.2	Apply counting principles to determine probabilities
PCC-CS401.3	Express a logic sentence in terms of predicates, quantifiers, and logical connectives. Upon completion of the course, the student will be able to use logical notations to define and reason about fundamental mathematical

	concepts such as sets relations and functions.
PCC-CS401.4	Classify its algebraic structure for a given a mathematical problem. Apply algebraic structure like Group, Ring, Field to understand a basic structure of an Algorithm. Classify its algebraic structure for a given mathematical problem.
PCC-CS401.5	Develop the given problem as graph networks and solve with techniques of graph theory.
PCC-CS401.6	Able to model and solve real world problems using graphs and trees.

Computer Organization & Architecture

Code: PCC-CS402

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1	To study how a digital computer works.
2	To understand how a computer can be designed.
3	To explain an instruction can be executed by a computer.

Pre-Requisite:	
1	Number systems
2	Basic programming skills
3	Basics of Digital Electronics

Unit	Content	Hrs./Unit
1	Von-Neumann Computer. Data Types, Fixed-Point and Floating-Point Representation. IEEE Standard for Floating-Point Numbers. Arithmetic Operations on Floating-point Numbers, Overflow. Multiplication – Booth multiplier. Register and its types, RTL. Bus Transfer, Construction of a common bus using MUXs, Construction of a common bus using tri-state buffers. Shifter Unit. Arithmetic unit, Logic unit, Simple ALU Design.	10
2	Computer Instruction Set Design: Introduction, Instruction Formats.CPU classification: Single accumulator organization, General register organization, Stack organization. 0-,1-,2-,3-Address	9

	computers and examples. Instruction Cycle. Addressing modes. RISC Vs CISC.	
3	Memory Organization: Memory Parameters, Memory Hierarchy. Main Memory, Large Memory Construction Using Small Chips. Internal Organization of Main Memory Chips, Memory Cell (SRAM, DRAM & ROM). Secondary Memory (Magnetic Tape, Magnetic Disk, Optical Disc). Cache Memory, Performance of Cache Memory. Cache Mappings. Input-output subsystems. I/O device interface, I/O transfers – program controlled, interrupt driven and DMA.	10
4	Flynn's Classification of computers. Pipelining: Introduction, Definition, Space time diagram, Clock period. Performance measurement: Speed-up, Efficiency and Throughput, Example; Classification of pipelined processors. Design of arithmetic pipelines: Floating point adder pipeline, Multiplier pipeline. Issues in pipeline design: Pipeline hazards. Multiple issue processors: Super-pipelining, Super-scalar and VLIW. Vector processing: Introduction, Characteristics. SIMD array processor: Introduction, Classification. Multiprocessor: Introduction, Classification.	9

Text book and Reference books:

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 CarlHamacher, McGraw Hill Higher Education.
3. Computer Architecture and Organization, 3rd Edition by John P. Hayes, WCB/McGraw-Hill
4. Computer Architecture and Parallel Processing by Hwang and Briggs (Mc-Graw Hill).
5. Computer Organization and Architecture: Designing for Performance, 10th Edition by William Stallings, Pearson Education.
6. Computer System Architecture by Moris Mano, PHI
7. Computer Organization by Ghosh, 2nd Ed. McGraw Hill Education.
8. Computer System Design and Architecture, 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

Course Outcomes:	
On completion of the course students will be able to	
PCC-CS402.1	Understanding of data representation and memorize of basic arithmetic operations.
PCC-CS402.2	Describe of various functional units of CPU such as ALU, control unit and register file.
PCC-CS402.3	Demonstrate of memory hierarchy and sketch different types of memory.

PCC-CS402.4	Design of instruction set architecture, instruction formats and instruction cycle.
PCC-CS402.5	Examine various modes of I/O operations and summarize working principles of I/O interface circuits.
PCC-CS402.6	Develop pipeline architecture and its related issues and array processor

Object Oriented Programming

Code: PCC-CS 403

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Introduce the principles of object-oriented programming in a higher-level programming language.
2.	Analyze a problem statement to develop a mental model of objects necessary to create software architecture.
3.	Utilize object-oriented programming to frame software architectures, with care towards separation of concerns and abstraction.
4.	Gain skills in designing, and programming software for reuse of code.
5.	Establish development methods in object-oriented programming to qualify students for teaching the language in other settings.

Pre-Requisite:	
	Programming Fundamentals

Unit	Content	Hrs./Unit
1.	**Object oriented concepts** Class, object, Abstraction, encapsulation, Inheritance, Encapsulation Polymorphism, Difference between OOP and Procedural approach.	3
2.	**Overview of Java language** Java Tokens, Constants, Variables and Data types, Operators and Expressions, Decision making and Branching, Looping, Array.	3
3.	**Object-oriented programming using Java** Java Environment, Platform independence, Creation of Class, Objects and Methods, Constructors, Method Overloading, Use of Static , this	8

	keyword,super keyword, instanceOf, final, extends keyword, Object class, wrapper class	
4.	**Basic String handling in Java** (All relevant methods from String class and StringBuffer class) Concept of mutable and immutable string, command line arguments, Basic I/O operations using BufferedReader and Scanner class.	5
5.	**Reusability Properties and Packages** Inheritance (Simple, multilevel, hierarchical) concept, Static and Dynamic polymorphism, creation of abstract class and interface. Creation of package, detailed discussion on access specifiers. Defining packages, Member access, Importing packages. Creation of packages etc.	6
6.	**Exception Handling and Multithreading** Exception handling basics, different types of Exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter thread communication, deadlocks for threads, suspending & resuming threads.	4
7.	**AWT and Layout Managers** AWT classes, Frame Windows, Graphics, Working with color and font labels, Buttons, boxes, List, Text field, Understanding Layout managers, Border layout, Grid Layout.	4
8.	**Event Handling** Event Delegation Model,Window Event, Mouse Event, Key Event etc.	2
9.	**Collections** Java Collection Framework Interfaces SET, LIST, Queue etc., Classes ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHastSet etc.The software development process, Model-view-controller pattern.	3

Text book and Reference books:

1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India

2. Ali Bahrami – "Object Oriented System Development" – Mc Grew Hill

3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH

4. R.K Das – "Core Java for Beginners" – VIKAS PUBLISHING

5. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson

6. Ivor Horton's Beginning Java 2 SDK – Wrox

7. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Course Outcomes:	
On completion of the course students will be able to	
PCC-CS403.1	Explain the principal of Object Oriented Programming (OOP) using programming syntaxes of JAVA programming language.
PCC-CS403.2	Identify the requirements to the solution of complex engineering problems by proper analysis of classes with their relationships and interpretation of data/objects.
PCC-CS403.3	Construct algorithms with computer programs to implement the major OOP concepts related to Data Encapsulation, Polymorphism, Code Reusability, Robustness, Multi-processing (Thread), etc.
PCC-CS403.4	Design different system components like Graphical User Interfaces with AWT and develop small applications using object oriented design approach.
PCC-CS403.5	Develop OOP based applications using modern tools following the professional OOP based engineering solutions, ethics and management techniques.
PCC-CS403.6	Assess the need and utility for different OOP components and their role-play to produce huge distributed data driven software to contribute to lifelong learning.

Design and Analysis of Algorithms

Code: PCC-CS 404

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objectives:	
1.	The aim of this module is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them.
2.	Through the complexity measures, different range of behaviours of algorithms and the notion of tractable and intractable problems will be understood.

Pre-Requisite:	
1.	To know data-structure and basic programming ability.

Unit	**Content**	**Hrs/Unit**

1.	Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behaviour; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations:Substitution method, Recursion tree method and Masters' theorem.	8
2.	Divide and Conquer: Basic method, use, Examples – Binary Search, Merge Sort, Quick Sort and their complexity , Strassen's matrix manipulation algorithm;Dynamic Programming: Basic method, use, Examples – Matrix Chain Manipulation, All pair shortest paths, single source shortest path. Backtracking: Basic method, use, Examples – 8 queens problem, Graph coloring problem. Greedy Method: Basic method, use, Examples – Knapsack problem, Job sequencing with deadlines, Minimum cost spanning ree by Prim's and Kruskal's algorithm.	14
3.	Graph traversal algorithm: Breadth First Search(BFS) and Depth First Search(DFS) – Classification of edges - tree, forward, back and cross edges – complexity and comparison, topological sorting. Network Flow: Ford Fulkerson algorithm, Max-Flow Min-Cut theorem (Statement and Illustration).	10
4.	Notion of NP-completeness: P class, NP class, NP hard class, NP complete class – their interrelationship, Satisfiability problem, Cook's theorem (Statement only), Clique decision problem, vertex cover problem and independent set problem.	4
5.	Approximation Algorithms: Necessity of approximation scheme, performance guarantee, polynomial time approximation schemes, vertex cover problem, travelling salesman problem.	3

Text book and Reference books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.
3. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA

Course Outcomes:	
On completion of the course students will be able to	
PCC-CS 404.1	Understanding the basic relation for analyzing the performance of an algorithm.

PCC-CS 404.2	Understand and analyse the performance of recursive algorithm using recurrence relation.
PCC-CS 404.3	Able to explain important algorithmic design paradigm (Divide and Conquer, Greedy method, dynamic programming and back tracking) and apply when an algorithmic design solution calls for it.
PCC-CS 404.4	Able to explain major graph algorithm and employ graphs to model engineering problems.
PCC-CS 404.5	Able to describe the classes of P, NP and NP complete and be able to prove certain problem is NP complete.
PCC-CS 404.6	Explain approximation algorithm and analyse the approximation factor for an algorithm.

Biology

Code: BSC 401

Contacts: 2L+1T

Theory: 3 hrs./ Week

Credit Points: 3

Objective:	
1.	Bring out the fundamental differences between science and engineering.
2.	Discuss how biological observations of 18th Century that lead to major discoveries.

Pre-Requisite:	
1.	Basic knowledge of Physics ,Chemistry and mathematics

Unit	Content	Hrs./Unit
1	To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific	2

	inquiry.	
2	The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus	3
3	To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.	4
4	Biomolecules: To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA.Two carbon units and lipids.	4
5	Enzymes: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	4
6	Information Transfer:The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination	4
7	Macromolecular analysis: How to analyse biological processes at the reductionist level Proteins- structure and function. Hierarch in protein	5

	structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	
8	Metabolism: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keqand its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	4
9	Microbiology Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	3

Text book and Reference books:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Course Outcomes:	
On completion of the course students will be able to	
BSC 401.1	Understand the biological concepts from an engineering perspective
BSC 401.2	The structure and function of various Biomolecules
BSC 401.3	Explain basic concepts in enzyme kinetics, function and different mechanisms of enzyme action
BSC 401.4	Discuss different aspects of molecular biology including DNA Replication, Transcription and RNA Translation
BSC 401.5	Identify and classify microorganisms
BSC 401.6	Integrate biological principles for developing next generation technologies

Department of Computer Science and Engineering
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Environmental Sciences

Code: MC-401

Contacts: 1L

Theory: 1hrs. /week

Objective:	
1.	Be able to understand the natural environment and its relationships with human activities.
2.	Be able to apply the fundamental knowledge of science and engineering to assess environmental and health risk.
3.	Be able to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues.
4.	Be able to solve scientific problem-solving related to air, water, noise & land pollution.

Pre-Requisite:	
1.	Basic knowledge of Environmental science

Unit	**Content**	**Hrs./Unit**
1.	Basic ideas of environment, basic concepts, man, society & environment, their interrelationship, Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development, Environmental degradation, Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol. Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem-components types and function. Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain [definition and one example of each food chain], Food web. Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.	4
2.	Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. Greenhouse effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global	4

	warming and its consequence, Control of Global warming. Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes. Definition of pollutants and contaminants, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green-house gases, effect of ozone modification. Control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).	
3.	Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, ph. Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic.	4
4.	Lithosphere; Internal structure of earth, rock and soil. Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and biomedical waste, hazardous solid wastes; Recovery and disposal method. Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighborhood noise]. Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L10 (18hr Index) ,n Ld. Noise pollution control.	3

Text books/ reference books:

1. M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House (AICTE Recommended Textbook – 2018)

2. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.

3. De, A. K., "Environmental Chemistry", New Age International

Course Outcomes:	
On completion of the course students will be able to	
MC-401.1	Understand the concept of environment and elaborate the organization of ecosystem & its components
MC-401.2	Analyze the impact of population growth on environment and interpret the overall problems, prevention and sustainable development
MC-401.3	Identify, understand, and distinguish the different environmental pollution associated to environmental degradation
MC-401.4	Design, formulate and develop different control mechanisms, devices to minimize the environmental pollution
MC-401.5	Identify, analyze the industrial activities on environmental pollution and its control mechanism
MC-401.6	Adapt, illustrate the general idea about the laws, rules and regulations concerning environmental issues

Computer Organization & Architecture Lab

Code: PCC-CS492

Contacts: 4P

Practical: 4 hrs. / Week

Credit Points: 2

Pre-Requisite:	
1	Digital Design concepts - Boolean algebra, Logic Gates, Combinational and Sequential Circuits etc.
2	Foundation of Computer system design

Laboratory Experiments	
1.	Implement the logic gates (AND, OR, XOR, NOT, NAND, NOR, XNOR) in VHDL using Data Flow Architecture.
2.	Implement the logic gates (AND, OR, XOR, NOT, NAND, NOR, XNOR) in VHDL using Behavioural Architecture.
3.	Design and implement the Half Adder circuit in VHDL using Data Flow and Behavioural Architecture.
4.	Design and implement Full Adder circuit in VHDL using Data Flow and Behavioural

	Architecture.
5.	Design and implement the Half Subtractor & Full Subtractor circuit in VHDL using Data Flow and Behavioural Architecture.
6.	a. Design and implement a Decoder (2X4) b. Encoder (4X2) c. 1 bit Comparator using Data flow and Behavioural Architecture.
7.	Design a MUX and DeMUX in VHDL using Data Flow Architeture
8.	Design and implement T, D and SR Flip Flop in VHDL using Behavioural architecture.
9.	Design and implement a shift registers (4 bits) using Data Flow architecture.
10.	Design and implement up & down counters(4 bits) using Data Flow architecture
11.	Design and implement an ALU (8 bit) using Data Flow architecture
12.	Design and implement a full adder using half adder using structural architecture
13.	Design and implement 4 bit parity generator using XOR Gate using structural architecture.
14.	Design and implement 8:1 MUX using 4:1 MUX using structural architecture

Course Outcomes:	
On completion of the course students will be able to	
PCC-CS492.1	Remember the knowledge of all basic logic gates and define various basic logic circuits such as multiplexer, decoder, encoder and comparator. To demonstrate the results of logic and timing simulations and to use these simulation results to debug digital systems.
PCC-CS492.2	Explain with minimization techniques to solve adder, subtractor, and composite unit and extend various logic gates to design arithmetic logic circuits.
PCC-CS492.3	Demonstrate parallel adder, CLA (Carry Look-Ahead Adder) and test CLA which is relevant to the professional engineering practice.
PCC-CS492.4	Analyze multiplexer unit to design composite ALU and make use of ALU for modern engineering and IT tools and estimate decoder and encoder design practice.
PCC-CS492.5	To measure various skills, techniques and learn state-of-the art engineering tools (such as VHDL, Altera Max Plus II, Xilinx ISE simulator etc) to design, implement and test modern day digital systems on FPGAs.
PCC-CS492.6	To summarize Xilinx Foundation tools and Hardware Description Language (VHDL). To develop through hands-on experimentation the Xilinx tools for FPGA design as well as the basics of VHDL design and simulate digital systems.

Object Oriented Programming Lab

Code: PCC-CS493

Contacts: 4P

Practical: 4 hrs. / Week

Credit Points: 2

Pre-Requisite:	
1.	Programming Fundamentals

Laboratory Experiments:	
1.	Assignments on basic programming. Decision control, Loop Control, Array.
2.	Assignments on class, constructor, overloading, inheritance, overriding.
3.	Assignments on Strings.
4.	Assignments on developing abstract class interfaces- multiple inheritance, extending interfaces
5.	Assignments on creating and accessing packages
6.	Assignments on multithreaded programming, Exception handling programming.
7.	Assignments on AWT and Event handling programming
	Note: Use Java for programming

Any experiment specially designed by the college

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Outcomes:	
On completion of the course students will be able to	
PCC-CS493.1	Interpret the principal of Object Oriented Programming (OOP) using programming syntaxes of JAVA programming language by analyzing the problems.
PCC-CS493.2	Identify the requirements to the solution of complex engineering problems by proper analysis of classes with their relationships and interpretation of data/objects.
PCC-CS493.3	Construct computer programs to implement the major OOP concepts related to Class & Object, Polymorphism, Inheritance, Interface, Exception Handling, Multi-processing (Thread), etc using JAVA coding ethics by making use of modern tools like Notepad++, Netbeans or Eclipse IDE.

PCC-CS493.4	Develop Graphical User Interfaces using AWT, Layout manager, with event handling etc.
PCC-CS493.5	Build small OOP based applications working individually or in a team with proper documentations following the professional OOP based engineering solution techniques.
PCC-CS493.6	Determine the need for various OOP components and a collection framework to produce large distributed data-driven software that contributes to lifelong learning from an implementation standpoint.

Design and Analysis of Algorithm Lab

Code: PCC-CS 494

Contacts: 4P

Practical: 4 hrs. / Week

Credit Points: 2

Pre-Requisite:	
1.	Pre-requisites as in PCC-CS301

Laboratory Experiments:	
Divide and Conquer:	
1.	Implement Binary Search using Divide and Conquer approach Implement Merge Sort using Divide and Conquer approach
2.	Implement Quick Sort using Divide and Conquer approach Find Maximum and Minimum element from an array of integer using Divide and Conquer approach
3.	Find the minimum number of scalar multiplication needed for chain of matrix
4.	Implement all pair of Shortest path for a graph (Floyed- Warshall Algorithm) Implement Traveling Salesman Problem
5.	Implement Single Source shortest Path for a graph (Dijkstra , Bellman Ford Algorithm
Brunch and Bound:	
6.	Implement 15 Puzzle Problem
Backtracking:	
7.	Implement 8 Queen problem
8.	Graph Coloring Problem Hamiltonian Problem

Greedy method:	
9.	Knapsack Problem Job sequencing with deadlines
10.	Minimum Cost Spanning Tree by Prim's Algorithm Minimum Cost Spanning Tree by Kruskal's Algorithm
Graph Traversal Algorithm:	
11.	Implement Breadth First Search (BFS) Implement Depth First Search (DFS)

Any experiment specially designed by the college

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Outcomes:	
On completion of the course students will be able to	
PCC-CS 494.1	Recall and solve asymptotic notation, Time complexity of iterative and recursive algorithm.
PCC-CS 494.2	Explain divide and conquer method to implement binary search, merge sort, quick sort.
PCC-CS 494.3	Demonstrate principal of optimality and implement chain matrix multiplication, all pair shortest path, Prim's algorithm, Kruskal's algorithm, Dijkstra algorithm to minimize output.
PCC-CS 494.4	Implement knapsack algorithm, job sequencing with deadline to maximize output.
PCC-CS 494.5	Apply backtracking method to solve n-queens and n-coloring problems.
PCC-CS 494.6	Implement BFS & DFS.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Syllabus for B. Tech in Computer Science & Engineering

CSE

Third Year - Fifth Semester

(Semester V)

Compiler Design

Code: ESC 501

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Understand and list the different stages in the process of compilation.
2.	Design top-down and bottom-up parsers and construct LL, SLR, CLR, and LALR parsing table
3.	Acquire knowledge for the target machine's run time environment, its instruction set for code generation and techniques used for code optimization.

Pre-Requisite:	
1.	Knowledge of automata theory
2.	Computer architecture
3.	Data structures and simple graph algorithms, logic or algebra

Unit	Content	Hrs. / Unit
1.	**Introduction to Compiling:** Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.	4

2.	**Lexical Analysis:** The role of the lexical analyser, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, regular expression for lexemes, lexical-analyzer generator, LEX compiler.	5
3.	**Syntax Analysis:** The role of a parser, Context free grammars, Top down Parsing, Non recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR,LALR,CLR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.	10
4.	**Syntax directed translation and Type Checking:** Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes. Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions.	6
5.	**Run time environments:** Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.	5
6.	**Intermediate Code generation:** Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).	4
7.	**Code optimization and generation:** 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, Issues in the design of code generator, Register allocation & assignment.	6

Text book and Reference books:

1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" - Pearson Education.

2. Holub - "Compiler Design in C" - PHI.

3. K. Muneeswaran,CompilerDesign,FirstEdition,Oxford University Press.

4.J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, McGraw-Hill,2003.

5.Kenneth Louden," Compiler Construction", Cengage Learning.

Course Outcomes:	
On completion of the course students will be able to	
ESC 501.1	Understand and explain the concepts of different phases of compiler design.

ESC 501.2	Analyse the role of the lexical analyser and token recognizer using modern tools.
ESC 501.3	Construct parsing table for different types of parsers and semantic analyser.
ESC 501.4	Apply the optimization techniques to have a better code for code generation
ESC 501.5	Discuss design issues of a simple code generator, register allocation and assignment.
ESC 501.6	Design and develop a simple Compiler.

Database Management Systems

Code: PCC-CS501

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To understand the different issues involved in the design and implementation of a database system.
2.	To study the physical and logical database designs, database modelling, relational, hierarchical, and network models.
3.	To understand and use data manipulation language to query, update, and manage a database
4.	To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
5.	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modelling, designing, and implementing a DBMS.
6.	To understand the different issues involved in the design and implementation of a database system.

Pre-Requisite:	
1.	Proper understanding of data structures and algorithms
2.	Understanding of set theory
3.	Basic programming knowledge

Unit	Content	Hrs. / Unit
1.	**Database system architecture**: Introduction to DBMS,File based system versus Database System, 3 schema architecture, Data Abstraction, Data Independence, Administration roles, types of users.	4
2.	**Data models**: Relational model- definition and Properties, Key concepts, integrity constraints**. Codd's Rules.** ER Model to Relational model. (ER Diagram –Strong entity, weak entity, binary, ternary relationship, cardinality, participation, extended ER feature)	6
3.	**Relational query languages**: Relational algebra (operations, Codd's algebraic rules), Evaluation of relational algebra expressions	5
4.	**Relational database design**: Single valued functional dependency, Armstrong's axioms, Normal forms (up to BCNF), Properties of decomposition. Multivalued Functional dependency, 4NF. (Overview), , Join dependency and 5NF.	7
5.	**Storage strategies**: Storage structures (Sequential, indexed sequential) Types of single level index (Primary, secondary, clustering),multi-level index, Dynamic multilevel indices using B-trees and B+ tree (Creation, insertion, deletion)	6
6.	Introduction to Advanced PL/SQL • Stored Procedure and function • Cursor • Trigger	6
7.	**Transaction processing**: Concurrency control, ACID property, Serializability of scheduling (conflict and view), Locking (2PL)and timestamp-based schedulers, Database recovery techniques.	6

Text book and Reference books:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan,McGraw-Hill.

2."Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.

3. Database Management Systems, R.P. Mahapatra, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

4."Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe,

5.PearsonEducation "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley

Course Outcomes:	
On completion of the course students will be able to	
PCC- CS 501.1	Define and understand the fundamentals of Data base management System and traditional file system.
PCC- CS 501.2	Understand and explain the concepts of relational database management system.
PCC- CS 501.3	Make use ofthe tools to implement Entity Relationship diagrams.
PCC- CS 501.4	Utilize andtake part inthenormalization of the real world database to remove redundancies and able to apply the conversion of one Normal Form to Higher Normal Form.
PCC- CS 501.5	Elaborate the importance and rule on database management system concepts to minimize conflict in concurrent transactions.
PCC- CS 501.6	Discuss the importance of Database management system for storage of data in various formats and able to judge the environmental, societal and market issues specific to software development.

Operating Systems

Code: PCC-CS502

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To learn the mechanisms of OS to handle processes and threads and their communication.
2.	To learn the mechanisms involved in memory management in contemporary OS.
3.	To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols.
4.	To know the components and management aspects of concurrency management.

Pre-Requisite:	
1.	Computer Organization &Architecture

Unit	Content	Hrs. / Unit
1.	**Introduction**: Generations Concept of Operating systems, Systems architecture structure and operations, system calls, Concept of Virtual Machine, RTOS, Distributed OS, Brief study on UNIX and WINDOWS Operating System,	3
2.	**Processes**: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. **Thread**: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads. **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Real Time scheduling: RM and EDF.	10
3.	**Inter-process Communication**: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Peterson's Solution, The Producer Consumer Problem, Semaphores, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem.	5
4.	**Deadlocks**: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery and examples.	5
5.	**Memory Management**: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation –Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging, TLB and EMA time. **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), and Least Recently used(LRU), Belady's anomaly, thrashing, working set window.	8
6.	**I/O Hardware, File and Disk management**: I/O devices, Device controllers, Device drivers, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms, Disk formatting, Boot-block, Bad blocks, Concept of File, File types, Access methods: sequential, direct and indexed, Allocation methods (contiguous, linked, indexed). **Protection and Security:** Goals, security problems, authentication, threats, worms, viruses.	6

Text book and Reference books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.

2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

3. Operating System Concepts, Ekta Walia, Khanna Publishing House (AICTE Recommended Textbook – 2018)

4. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing

5. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, AddisonWesley

6. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India

7. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Course Outcomes:	
On completion of the course students will be able to	
PCC- CS502.1	Understand the resource-management and describe the basic principles used in the design of modern Operating Systems.
PCC- CS502.2	Illustrate various algorithms of CPU scheduling, process synchronization, deadlock avoidance and page replacement.
PCC- CS502.3	Apply avoiding, preventing and recovering mechanisms of deadlock toward solutions for given problems.
PCC- CS502.4	Evaluate different resource management and memory management schemes along with paging and segmentation.
PCC- CS502.5	Analyze various file and disk management strategies.
PCC- CS502.6	Demonstrate the issues in I/O management and security.

Machine Learning

Code: PCC-CS503

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Pre-Requisite:	
1.	Basic understanding of Linear algebra, Trigonometry, Statistics, calculus, probability
2.	Python Programming

Objective:	
1.	To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
2.	To design and analyses various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3.	Explore supervised and unsupervised learning paradigms of machine learning.
4.	To explore Deep learning technique and various feature extraction strategies.

Unit	**Content**	**Hrs. / Unit**
1.	Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-Neighbor's, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	9
2.	Unsupervised Learning Clustering: K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models)	7
3.	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6
4.	Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning, DL algorithms: CNN, RNN, LSTM etc.	9
5.	Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.	9

References:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)

2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007

3. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

4. Tom M.Mitchell, Machine Learning, McGraw-Hill,2017

5. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

Course Outcomes:	
On completion of the course students will be able to	
PCC- CS503.1	To understand a wide variety of learning algorithms.
PCC- CS503.2	To apply a variety of learning algorithms to data using various tools of Machine Learning.
PCC- CS503.3	To identify the strengths and weaknesses of many popular machine learning approaches.
PCC- CS503.4	To analyze the performance of learning algorithms and model selection
PCC- CS503.5	To evaluate mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
PCC- CS503.6	To design models using machine learning techniques in solving complex real world problems.

Introduction to Industrial Management (Humanities III)

Code: HSMC-501

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To make the students understand the fundamental principles and practices of management, its function, behavior, hierarchy and importance in an organization.
2.	To emphasize the different functional areas of management: finance, production, marketing, and human resource.
3.	To address the student the role of information technology in management

Unit	Content	Hrs. / Unit
1.	**Introduction** System- concept, definition, types, parameters, variables and behavior. Management – definition and functions. Organization structure: i. Definition. ii. Goals. iii. Factors considered in formulating structure. iv. Types. v. Advantages and disadvantages. vi. Applications. Concept, meaning and importance of division of labor, scalar & functional processes, span of control, delegation of authority, centralization and decentralization in industrial management. Organizational culture and climate – meaning, differences and factors affecting them. Moral-factors affecting moral. Relationship between moral and productivity. Job satisfaction- factors influencing job satisfaction. Important provisions of factory act and labor laws.	6
2.	**Critical Path Method (CPM) and Programme Evaluation Review Technique (PERT):** 2.1 CPM & PERT-meaning, features, difference, applications. 2.2 Understand different terms used in network diagram. Draw network diagram for a real life project containing 10-15 activities, computation of LPO and EPO. (Take minimum three examples). Determination of critical path on network. Floats, its types and determination of floats. Crashing of network, updating and its applications.	8

3.	**Materials Management**: Material management-definition, functions, importance, relationship with other departments. Purchase - objectives, purchasing systems, purchase procedure, terms and forms used in purchase department. Storekeeping- functions, classification of stores as centralized and decentralized with their advantages, disadvantages and application in actual practice. Functions of store, types of records maintained by store, various types and applications of storage equipment, need and general methods for codification of stores. Inventory control: i. Definition. ii. Objectives. iii. Derivation for expression for Economic Order Quantity (EOQ) and numeric examples. iv. ABC analysis and other modern methods of analysis. v. Various types of inventory models such as Wilson's inventory model, replenishment model and two bin model. (Only sketch and understanding, no derivation.). 3.6 Material Requirement Planning (MRP) - concept, applications and brief details about software packages available in market.	6
4.	Production planning and Control (PPC): Types and examples of production. i. Need and importance. ii. Functions. iii. Forms used and their importance. iv. General approach for each type of production. Scheduling- meaning and need for productivity and utilisation. Gantt chart- Format and method to prepare. Critical ratio scheduling-method and numeric examples. Scheduling using Gantt Chart (for at least 5-7 components having 5-6 machining operations, with processes, setting and operation time for each component and process, resources available, quantity and other necessary data), At least two examples. 4.7 Bottlenecking- meaning, effect and ways to reduce.	8

5.	Value Analysis (VA) and Cost Control: 5.1 VA-definition, terms used, process and importance. 5.2 VA flow diagram. DARSIRI method of VA. Case study of VA-at least two. Waste-types, sources and ways to reduce them. Cost control-methods and important guide lines.	4
6.	Recent Trends in IM: ERP (Enterprise resource planning) - concept, features and applications. Important features of MS Project. Logistics-concept, need and benefits. Just in Time (JIT)-concept and benefits. Supply chain management-concept and benefits.	4

Text book and Reference books:

1. L.S. Srinath– "CPM & PERT principles and Applications".

2. Buffa – "Modern Production Management".

3. N. Nair – "Materials Management".

4. O. P. Khanna – "Industrial Engineering & Management".

5. Mikes – "Value Analysis".

6. S.C. Sharma, "Engineering Management – Industrial Engineering & Management", Khanna Book Publishing Company, New Delhi

Course Outcomes:	
On completion of the course students will be able to	
HSMC-501.1	Interpret given organization structure, culture, climate and major provisions of factory acts and laws.
HSMC-501.2	Explain material requirement planning and store keeping procedure.
HSMC-501.3	Plot and analyse inventory control models and techniques.
HSMC-501.4	Prepare and analyse CPM and PERT for given activities.
HSMC-501.5	List and explain PPC functions.
HSMC-501.6	Understand the concept of Value Analysis and cost control by application of JIT and ERP

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Artificial Intelligence

Code: PEC-CS501A

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To provide a strong foundation of fundamental concepts in Artificial Intelligence
2.	To provide a basic exposition to the goals and methods of Artificial Intelligence
3.	To enable the student to apply these techniques in applications which involve perception, reasoning and learning

Pre-Requisite:	
1.	Discrete Mathematics
2.	Understanding of Probability
3.	Basic understanding of Programming Languages

Unit	Content	Hrs. / Unit
1.	**Introduction** [2] Overview of Artificial intelligence- Problems of AI, AI technique, History of AI, AI sub-domains, Tic - Tac - Toe problem. **Intelligent Agents** [2] Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. **Problem Solving** [2] Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	6
2.	**Search techniques** [4] Solving problems by searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. **Heuristic search strategies** [7] Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search,	15

	simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. **Adversarial search** [4] Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.	
3.	**Knowledge Representation & reasoning** [4] Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation. Ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.]	4
4.	**Using predicate logic** [2] Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. **Planning** [2] planning as search, partial order planning, construction and use of planning graphs **Probabilistic reasoning** [2] Representing knowledge in an uncertain domain, the semantics of Bayesian networks.	6
5.	**Natural Language Processing/ Text Analytics** [4] Introduction, Syntactic processing, semantic analysis, Information Retrieval, discourse & pragmatic processing. **Machine Learning** [3] Forms of learning, inductive learning, learning nearest neighbour, naïve Bayes, and decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning. **Expert Systems** [2] Representing and using domain knowledge, expert system shells, knowledge acquisition.	9

Text book and Reference books:

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

Course Outcomes:	
On completion of the course students will be able to	
PEC-CS 501A.1	Understand the informed and uninformed problem types and apply search strategies to solve them.
PEC-CS 501A.2	Apply difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing.
PEC-CS 501A.3	Design and evaluate intelligent expert models for perception and prediction from intelligent environment.
PEC-CS 501A.4	Formulate valid solutions for problems involving uncertain inputs or outcomes by using decision making techniques.
PEC-CS 501A.5	Demonstrate and enrich knowledge to select and apply AI tools to synthesize information and develop models within constraints of application area.
PEC-CS 501A.6	Examine the issues involved in knowledge bases, reasoning systems and planning

Advanced Computer Architecture

Code: PEC-CS501B

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To make students know about the Parallelism concepts in Programming
2.	To introduce the advanced processor architectures to the students.
3.	To study about data flow computer architectures
4.	To make the students know about the importance of multiprocessor and multicomputers.

Pre-Requisite:	
1.	Basic understanding of digital Electronics
2.	A basic understanding of Computer Organisation and Architecture or Microprocessors

Unit	Content	Hrs. / Unit
1.	Computer Architecture and Organization-Review, Fundamentals of Computer Design, Technology Trends Cost Performance Analysis Parallel Processing Architectures- Taxonomy- SISD, MISD, SIMD,MIMD, PRAM models	6
2.	Data and Resource Dependencies, Program Partitioning and Scheduling, Control Flow vs. Data Flow Network topologies-Static, Dynamic, Types of Networks RISC vs. CISC, Memory Hierarchy, Virtual Memory	10
3.	Concepts of Pipelining, Instruction Pipelining, dynamic pipelining, arithmetic pipelines. Multiprocessors- Multistage Networks, Cache Coherence, Synchronization, Message- passing Vector Processing Principles- Instruction types, Compound, Vector Loops, Chaining	12
4.	Array Processors- Structure, Algorithms Data Flow Architecture- Graphs. Petri Nets, Static and Dynamic DFA, VLSI Computations Parallel Programming Models, Languages, Compilers	11

Text book and Reference books:

1. Computer Architecture and Parallel Processing- Kai Hwang and A. Brigggs International Edition, McGraw Hill

2. Advanced Computer Architecture: D. Sima, T. fountain, P. Kacsuk, Pearson

3. Parallel Computer Architecture: D. Culler, J. P. Singh, A. Gupta, Elsevier

Course Outcomes:	
On completion of the course students will be able to	
PEC-CS 501B.1	Choose the attributes of computer architecture and elaborate the performance of a computer using various parameters.
PEC-CS 501B.2	Explain different parallel processing architectures.
PEC-CS 501B.3	Compare control flow vs. data flow, data dependencies vs. resource dependencies, RISC vs. CISC, static vs. dynamic network topologies, etc.
PEC-CS 501B.4	Demonstrate the pipelining technique and its related issues.
PEC-CS 501B.5	Discuss basic knowledge related to the vector processing, array processors and multiprocessors.

PEC-CS 501B.6	Demonstrate the data flow architecture and propose parallel programming models.

Computer Graphics

Code: PEC-CS501C

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	The main objective of the course is to introduce students with fundamental concepts and theory of computer graphics.
2.	It presents the important drawing algorithm, polygon fitting, clipping and 2D transformation curves and an introduction to 3D transformation.
3.	To make the students know about various curve and surface representation methods
4.	To make the students understand about various hidden surface removal algorithms, and lighting and shading models.

Pre-Requisite:	
1.	Knowledge of data structures and algorithm is preferable
2.	Knowledge of Linear Algebra

Unit	Content	Hrs. / Unit
1.	**Introduction to computer graphics & graphics systems**: Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB colour model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.	6
2.	**Scan conversion:** Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.	8

3.	**2D transformation & viewing**: Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse.	12
4.	Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method 3D transformation & viewing [5L]: 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing.	5
5.	**Curves [3L]:** Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves. **Hidden surfaces [3L]:** Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal - geometry. **Colour & shading models [2L]:** Light & colour model; interpolative shading model; Texture. **Introduction to Ray-tracing [3L]:** Human vision and colour, Lighting, Reflection and transmission models.	6

Text book and Reference books:

1. Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education

2. Z. Xiang, R. Plastock – "Schaum's outlines Computer Graphics (2nd Ed.)" – TMH

3. D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH

Course Outcomes:	
On completion of the course students will be able to	
PEC-CS 501C.1	Outline computer graphics system, display devices and various application areas of graphics.
PEC-CS 501C.2	Develop scan conversion algorithms for line, circle and ellipse with examples.
PEC-CS 501C.3	Demonstrate and illustrate 2D and 3D transformation operations such as translation, rotation, scaling, etc.
PEC-CS 501C.4	Analyse and model any kind of 3D objects using viewing, clipping and projection techniques.

PEC-CS 501C.5	Apply various curve and surface representation methods such as B-Spline, Bezier, etc.
PEC-CS 501C.6	Demonstrate and discuss various hidden surface removal algorithms, and lighting and shading models.

Constitution of India

Code: MC-CS501

Contacts: 2L

Theory: 1 hrs. / Week

Credit Points: 0

Objective:	
1.	The main objective of the course is to introduces students to the Constitution of India
2.	To make the students understand about the preamble and the basic structures of the Constitution, the fundamental rights, duties and the directive principles of state policies

Unit	Content	Hrs. / Unit
1.	**Introduction**: Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy	2
2.	**Union Government and its Administration** : Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha	3
3.	**State Government and its Administration Governor**: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions	3
4.	**Local Administration District's Administration head**: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different 4.departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	4

5.	**Election Commission Election Commission**: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Text book and Reference books:

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

Course Outcomes:	
On completion of the course students will be able to	
MC- CS501.1	Know the importance of Indian Constitution and fundamental rights and duties of citizens of India
MC- CS501.2	Know about the administration and modus operandi of Central Government
MC- CS501.3	Know about the administration and modus operandi of State Governments
MC- CS501.4	Know about the administration and modus operandi of local district administrators.
MC- CS501.5	Know about the administration and modus operandi of Election Commission of India
MC- CS501.6	Know about the various Socio-Political Activities and various functionaries involved in the system.

Essence of Indian Knowledge Tradition

Code: MC-CS501

Contacts: 2L

Theory: 1 hrs. / Week

Credit Points: 0

Objective:	
1.	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

2.	To make the students understand the traditional knowledge and analyse it and apply it to their day to day life.

Unit	Content	Hrs. / Unit
1.	Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge.	3
2.	Protection of traditional knowledge:The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.	2
3.	Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.	4
4.	Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.	4
5.	Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.	4

Text book and Reference books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

2. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.

3. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

Course Outcomes:	
On completion of the course students will be able to	
MC- CS501.1	Know the importance of essence of Indian knowledge tradition of citizens of India.
MC- CS501.2	Identify the concept of Traditional knowledge and its importance.
MC- CS501.3	Explain the need and importance of protecting traditional knowledge.

MC- CS501.4	Illustrate the various enactments related to the protection of traditional knowledge.
MC- CS501.5	Interpret the concepts of Intellectual property to protect the traditional knowledge.
MC- CS501.6	Explain the importance of Traditional knowledge in Agriculture and Medicine.

Database Management System Lab

Code: PCC-CS 591

Contacts: 4P

Practical: 4 hrs. / Week

Credit Points: 2

Laboratory Experiments:		
Structured Query Language		**No. of sessions**
1.	**Creating Database** Creating a Database Creating a Table Specifying Relational Data Types Creating Constraints	1
2.	**Table and Record Handling** INSERT, DELETE, UPDATE, TRUNCATE commands DROP, ALTER commands COMMIT, ROLLBACK commands	1
3.	**Retrieving Data from a Database** The SELECT statement Using the WHERE clause ORDER BY, GROUP BY and HAVING Clause Using Logical Operators, Using IN, BETWEEN, LIKE, IS operators Using ANY, ALL, EXISTS operator Using Aggregate Functions Combining Tables Using JOINS Subqueries(independent and correlated)	4

4.	**Database Management** Creating Views Creating Column Aliases Creating Database Users Using GRANT and REVOKE	2
5.	**Introduction to PL/SQL** Basic programming constructs (decision making, iteration) Practical implementation of Stored Procedure and function Cursor Trigger	4

Any experiment specially designed by the college

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Outcomes:	
On completion of the course students will be able to	
1.	Create a database schema, relation and implement referential integrity constraint.
2.	Manipulate the database and control the database.
3.	Construct the SQL queries for a given specification in Open source and Commercial DBMS – ORACLE platform.
4.	Develop updatable and non updatable view for implementing logical level independence
5.	Exercise administrative activities like creating users and granting or revoking privileges on database objects.
6.	Create database objects by using Procedural extension of SQL to develop a better control on database.

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Operating System Lab

Code: PCC-CS592

Contacts: 4P

Practical: 4 hrs. / Week

Credit Points: 2

1.	**Managing Unix/Linux Operating System:** Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, and commands)., user-management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user.
2.	**Process & Memory:** Starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process, implementation of process scheduling algorithms (FCFS, SJF, RR) and page replacement algorithms (FIFO, LRU and Optimal).
3.	**Signal:** Signal handling, sending signals, signal interface, signal sets.
4.	**Semaphore**: programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).
5.	**POSIX Threads :**programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
6.	**Inter-process communication:** Pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO), message passing & shared memory using message queue and sockets.

Any experiment specially designed by the college

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Outcomes:	
On completion of the course students will be able to	
PCC- CS592.1	Acquire knowledge of Linux commands to perform the basic operations related to process and system.
PCC- CS592.2	Comprehend shell programs and other programs related to pipes, message queue, socket etc.
PCC- CS592.3	Apply programs skill to create new process, orphan process and zombie process based on child-parent relationship.
PCC- CS592.4	Analyze process synchronization, applying the knowledge of semaphore and thread;
PCC- CS592.5	Demonstrate the concept of signals and their uses in process executions.

PCC- CS592.6	Synthesize the different algorithms of process scheduling and page replacement. Process synchronization and process-deadlock, in various fields of research and higher studies.

Machine Learning Lab
Code: PCC- CS 593
Contacts: 4P
Practical: 4 hrs. / Week
Credit points: 2

Pre-Requisite:	
1.	Statistics, Probability, Linear algebra, calculus and
2.	Programming language (Python)

Laboratory Experiments:	
1.	Write a program in python to implement linear and logistic regression in real life dataset
2.	Write a program in python to implement k-nearest neighbour algorithm to classify a real life dataset.
3.	Write a program in python to implement Naive based algorithm in real life dataset classification.
4.	Write a program in python to demonstrate the working of decision-tree algorithm. Use an appropriate dataset for building the decision trees and apply this knowledge to classify a new sample.
5.	Write a program to demonstrate the working of SVM algorithm. Use an appropriate dataset and apply this knowledge to classify the new sample.
6.	Write a program to implement random-forest algorithm to classify real life dataset.
7.	Write a program to implement k-means algorithm to classify real life dataset.
8.	Write a program to implement principal component analysis (PCA) in real life dataset.
9.	Write a program to implement random-forest algorithm to classify real life dataset.
10.	Write a program to implement ANN algorithm to classify real life dataset.
11.	Write a program to implement CNN algorithm to classify real life dataset
12.	Write a program to implement RNN algorithm to classify real life dataset.

Text book and Reference books:

1. Manaranjan Pradhan and U Dinesh Kumar, machine Learning using Python , First edition, Wiley India Pvt. Ltd, 2019.
2. Andreas C.Mueller, Sarah Guido,Introduction toMachine Learning with Python guide for data scientists, O'REILLY Media, 2016.
3. Abhishek Vijayvargia, Machine Learning with Python, BPB Publications, 2018

Course Outcomes:	
On completion of the course students will be able to	
PCC-CS 593.1	Remember the concept of machine learning fundamentals.
PCC-CS 593.2	Understand different machine learning techniques.
PCC-CS 593.3	Apply the knowledge of machine learning in various practical fields.
PCC-CS 593.4	Analyze the performances of different machine learning algorithms.
PCC-CS 593.5	Evaluate machine learning algorithms towards fine tuning of the models.
PCC-CS 593.6	Develop machine learning models to solve real life problems.

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Syllabus for B. Tech in Computer Science & Engineering

CSE

Third Year - Sixth Semester

(Semester VI)

Software Engineering

Code: PCC-CS 601

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	This course introduces the concepts and methods required for the construction of large software intensive systems.
2.	It seeks to complement this with a detailed knowledge of techniques for the analysis and design of complex software intensive systems.
3	It provides a scope to develop project management skills.
4	It provides a broad understanding to solve small and real life problems.

Pre-Requisite:	
1.	Programming knowledge

Unit	Content	Hrs. / Unit
1.	The role of software, Overview of System Analysis & Design, SDLC, Waterfall Model , Iterative Model, Incremental Model, Evolutionary Model, Spiral Model, Agile Methodology, Feasibility Analysis, Requirement Specification.	10
2.	System Design – Context diagram and DFD, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.	6

3.	Coding & Documentation – Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation. Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification Metrics, Monitoring & Control.	9
4.	Software Project Management – Project Scheduling, Staffing, Cost-Benefit Analysis, COCOMO model, Software Configuration Management, Quality Assurance, Project Monitoring.	7
5.	Static and dynamic models, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram and implementation diagram.	8

Text book and Reference books:

1. Pressman, Software Engineering: A practitioner's approach– (TMH)

2. Pankaj Jalote, Software Engineering- (Wiley-India)

3. N.S. Gill, Software Engineering – (Khanna Publishing House)

4. Rajib Mall, Software Engineering- (PHI)

5. Agarwal and Agarwal, Software Engineering – (PHI)

6. Sommerville, Software Engineering – Pearson

7. Martin L. Shooman, Software Engineering – TMH

Course Outcomes:	
On completion of the course students will be able to	
PCC- CS601.1	Explain the principles of software engineering in the context of social, ethical, legal, economic and environmental concerns by building applicable solutions.
PCC- CS601.2	Identify and classify the customer requirements to the solution of complex engineering problems by proper analysis and interpretation of data and processes.
PCC- CS601.3	Estimate software matrices like size, effort and cost, software reliability and quality, etc and apply project management techniques to maximize the productivity.
PCC- CS601.4	Design various components of software using DFD, ERD, Modularization, Use-case diagram, Class diagram, Sequence diagram, etc. following the professional software design guidelines.
PCC- CS601.5	Develop and Test software products following standard coding and testing guidelines.

PCC- CS601.6	Construct various components of software development process and to combine them to produce different types of software to adapt in the software industries in future.

Computer Networks

Code: PCC-CS602

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To develop an understanding of modern network architectures from a design and performance perspective.
2.	To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3.	To provide an opportunity to do network programming.
4.	To provide a WLAN measurement ideas.

Pre-Requisite:	
1.	Basic mathematics principal
2.	Basic understanding of computer fundamentals

Unit	Content	Hrs. / Unit
1.	**Introduction:** history and development of computer networks, networks topologies. Layering and protocols.	5
2.	**Physical Layer:** Different types of transmission media, errors in transmission: attenuation, noise. Repeaters. Encoding (NRZ, NRZI, Manchester, 4B/5B, etc.).	5
3.	**Data Link Layer:** Error detection (Parity, CRC), Sliding Window, Stop and Wait protocols. LAN: Design, specifications of popular technologies, switching. Design of LAN of a campus or a building	5
4.	**Medium Access Control Sub Layer**: MAC Layer: Aloha, CSMA, CSMA/CD, CSMA/CA protocols. Examples: Ethernet, including Gigabit Ethernet and WiFi (802.11), Token Ring, Bluetooth and WiMax	5

5.	**Network Layer:** Internet Protocol, IPv6, ARP, DHCP, ICMP, Routing algorithms: Distance vector, Link state, Metrics, Inter-domain routing. Subnetting, Classless addressing, Network Address Translation (NAT).	5
6.	**Transport Layer:** UDP, TCP. Connection establishment and termination, sliding window revisited, flow and congestion control, timers, retransmission, TCP extensions, etc.	5
7.	**Session, Presentation, and Application Layers**. Examples: DNS, SMTP, IMAP, HTTP, etc.	5
8.	**Design issues in protocols at different layers**. Network Programming: Socket Programming	5

Text book and Reference books:

1. Tanenbaum, A.S, "Computer Networks", 4th Ed., PearsonEducation.

2. Forouzan, B.A., "Data Communication and Networking", 4th Ed.,Tata McGraw-Hill.

3. Stallings W., "Data and Computer Communication", 8th Ed., Prentice-Hall.

4. Kurose, J.F. and Ross, K.W., "Computer Networking: A Top-DownApproach Featuring the Internet", 3rd Ed., Addison Wesley.

5. Comer, D.E. and Droms, R.E., "Computer Networks and Internets",4th Ed., Prentice-Hall.

Course Outcomes:	
On completion of the course students will be able to	
PCC- CS602.1	Understand data communication system, components and the purpose of layered architecture.
PCC- CS602.2	Relate the functionalities of each layer of OSI and TCP/IP reference model including their associated protocols.
PCC- CS602.3	Apply the thoughts toward building the networks, secure devices in virtue of analyzing data.
PCC- CS602.4	Analyze the growing demand of skilled people in the field of network and system administration.
PCC- CS602.5	Evaluate today's market of digital economy which is very much dependent on computer network skill to provide services in the field of finance, education, transportation, manufacturing, healthcare, retail and so on.
PCC- CS602.6	Create the requirements of enterprises or global corporations to be placed there.

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Introduction to Cyber Security & Blockchain Technology

Code: PCC CS 603

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	The student will be able to understand the basics of Cyber Security.
2.	The student will be able to understand the basics of Cryptography.
3.	The student will be able to assess Blockchain applications and concepts in a structured manner.
4.	The student will be able to incorporate ideas from Blockchain and Cryptocurrency technology into their own projects.

Pre-Requisite:	
1.	Data structures, Distributed systems, Computer Networks. Engineering Mathematics

Unit	Content	Hrs. / Unit
1	**Introduction to Cyber Security**: Introduction, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy and law. Security attacks (active and passive): With respect to information security attacks, computer security attacks, network security attacks that means cyber security attacks	10
2	**Cryptography:** Introduction to Cryptography and related mathematics Modern Cryptography: Symmetric key (DES, Blowfish, AES etc) & Asymmetric key Cryptography (RSA, ElGamal, etc) Key management and authentication: Hash function (MD5, SHA1), Digital signature, Signcryption -, Kerbaros	10

3.	**Blockchain:** Application of cryptography: Introduction, centralize and Decentralize system**,** Distributed Database, Comparison of Database Systems, Advantage over conventional distributed database, Distributed consensus algorithms, Blockchain Technology Mechanisms & Networks, Objective of Blockchain, Blockchain Challenges, Transactions, Merkle Tree, private vs. public Blockchain, Mining Mechanism, applications of Blockchain	8
4.	**Cryptocurrency:** an application of Blockchain: Introduction, What is Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.	8

Text book and Reference books:

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security, Dorothy F. Denning, Addison Wesley.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities, Henry A. Oliver, Create Space Independent Publishing Platform.
4. Data Privacy Principles and Practice, Natraj Venkataramanan and Ashwin Shriram, CRC Press.
5. Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Application by Lorne Lantz, O'Reilly Media; 1st edition.
6. Blockchain Technology: Concepts and Applications, Kumar Saurabh , Ashutosh Saxena, Wiley.

Course Outcomes:	
On completion of the course students will be able to	
PEC- CS603.1	Explain design principles of Cyber security, Cryptography and Blockchain technology.
PEC- CS603.2	Understand and explore threats, risk management, attacks in various security domains.
PEC- CS603.3	Apply the concepts of Cybersecurity and Crypto algorithms on Blockchain technology and cryptocurrency.
PEC- CS603.4	Analyze and relate to a Blockchain system by sending and reading transactions.
PEC- CS603.5	Evaluate the workings of Bitcoin and Cryptocurrency.
PEC- CS603.6	Develop a strong, secure system that can withstand various types of security issues, such as attacks and threats.

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Advanced Algorithms

Code: PEC-CS601 A

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Introduce students to the advanced methods of designing and analysing algorithms.
2.	The student should be able to choose appropriate algorithms and use it for a specific problem.
3.	To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
4.	Students should be able to understand different classes of problems concerning their computation difficulties.
5.	To introduce the students to recent developments in the area of algorithmic design.

Pre-Requisite:	
1.	Algorithm Design and Analysis

Unit	Content	Hrs. / Unit
1.	**Sorting**: Review of various sorting algorithms, topological sorting. **Graph**: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.	4
2.	**Matroids**: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. **Graph Matching**: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.	7
3.	**Flow-Networks**: Maxflow-mincut theorem, Ford Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. **Matrix Computations**: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	7

4.	**Shortest Path in Graphs**: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. **Modulo Representation of integers/polynomials**: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. **Discrete Fourier Transform (DFT)**: In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm	8
5.	**Linear Programming**: Geometry of the feasibility region and Simplex algorithm. **NP-completeness**: Examples, proof of NP-hardness and NP-completeness. **One or more of the following topics based on time and interest** Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm	8
6.	Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	5

Text book and Reference books:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.

2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.

3. "Algorithm Design" by Kleinberg and Tardos.

4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

Course Outcomes:	
On completion of the course students will be able to	
PEC- CS601A.1	Analyze the asymptotic performance of algorithms.
PEC- CS601A.2	Write rigorous correctness proofs for algorithms.
PEC- CS601A.3	Demonstrate a familiarity with major algorithms and data structures.
PEC- CS601A.4	Apply important algorithmic design paradigms and methods of analysis.
PEC- CS601A.5	Synthesize efficient algorithms in common engineering design situations.
PEC- CS601A.6	Understand on a wide range of advanced algorithmic problems, their relations and variants, and application to real-world problems.

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Distributed Systems

Code: PEC-CS601B

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

Pre-Requisite:	
1.	Database Management Systems

Unit	Content	Hrs. / Unit
1.	**INTRODUCTION:** Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts. **DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE** Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues.	10
2.	**DISTRIBUTED DATABASE DESIGN** Alternative design strategies; Distributed design issues; Fragmentation; Data allocation. **SEMANTICS DATA CONTROL** View management; Data security; Semantic Integrity Control. **QUERY PROCESSING ISSUES** Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data	07
3.	**DISTRIBUTED QUERY OPTIMIZATION** Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms. **TRANSACTION MANAGEMENT** The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models. **CONCURRENCY CONTROL** Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management	10

4.	**Reliability issues in DDBSs**; Types of failures; Reliability techniques; Commit protocols; Recovery protocols Algorithm	03
5.	**PARALLEL DATABASE SYSTEMS** Parallel architectures; parallel query processing.	04
6.	**ADVANCED TOPICS** Mobile Databases, Distributed Object Management, Multi-databases.	04

Text book and Reference books:

1. Principles of Distributed Database Systems, M.T. Ozsu and PValduriez, Prentice-Hall, 1991.

2. Distributed Database Systems, D. Bell and J. Grimson, AddisonWesley, 1992.

Course Outcomes:	
On completion of the course students will be able to	
PEC- CS601B.1	Learn the principles, architectures, algorithms and programming models used in distributed systems.
PEC- CS601B.2	Apply knowledge of distributed systems techniques and methodologies.
PEC- CS601B.3	Explain the design and development of distributed systems and distributed systems applications.
PEC- CS601B.4	Use the application of fundamental Computer Science methods and algorithms in the development of distributed systems and distributed systems applications.
PEC- CS601B.5	Discuss the design and testing of a large software system, and to be able to communicate that design to others.
PEC- CS601B.6	Design and implement sample distributed systems.

Signals & Systems

Code: PEC-CS601C

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Pre-Requisite:	
1.	Understanding of mathematics: Sequence and series, algebra of complex numbers, basic trigonometry.
2.	Understanding of Differential and Integral calculus (single variable)
3.	Knowledge of Analysis of continuous and discrete signals and systems in the natural/time domain, convolution, Continuous time Fourier analysis - the continuous Fourier Series and Fourier transform.
4.	Basic circuit analysis - ohm's law, KVL, KCL

Unit	Content	Hrs. / Unit
1.	Introduction to Signals and Systems: Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.	3
2.	Behaviour of continuous and discrete-time LTI systems (8 hours) Impulse response and step response, convolution, input-output behaviour with periodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multioutput representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.	8
3.	Fourier, Laplace and z- Transforms Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.	10

4.	The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.	9

Text book and Reference books:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signal sand systems", Prentice Hall India, 1997.

2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.

3. H. P. Hsu, "Signals and systems", Schaum'sseries, McGraw Hill Education, 2010.

4. S. Haykinand B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.

5. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.

6. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.

7. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

8. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.

9. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.

10. B. P. Lathi, "Linear Systems and Signals", Oxford University Press,2009.

11. R. Anand, "Signals and Systems, Khanna Publishing House, 2018.

Course Outcomes:	
On completion of the course students will be able to	
PEC- CS601C.1	Apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.
PEC- CS601C.2	Analyze the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
PEC- CS601C.3	Classify systems based on their properties and determine the response of LSI system using convolution.
PEC- CS601C.4	Analyze system properties based on impulse response and Fourier analysis.
PEC- CS601C.5	Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.
PEC- CS601C.6	Understand the process of sampling and the effects of under sampling.

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Image Processing

Code: PEC-CS601D

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To introduce the concepts of image processing and basic analytical methods to be used in image processing.
2.	To familiarize students with image enhancement and restoration techniques.
3.	To explain different image compression techniques.
4.	To introduce segmentation and morphological processing techniques.

Pre-Requisite:	
1.	Concepts of Digital Signal Processing

Unit	Content	Hrs. / Unit
1.	**Introduction:** Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.	7
2.	**Digital Image Formation:** A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.	4
3.	**Mathematical Preliminaries:** Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.	8

4.	**Image Enhancement:** Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High pass Filtering, High- boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.	8
5.	**Image Restoration:** Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.	6
6.	**Image Segmentation:** Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & 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 & Merging.	6

Text book and Reference books:

1. Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education

2. Z. Xiang, R. Plastock – "Schaum's outlines Computer Graphics (2nd Ed.)" – TMH

3. D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH

4. J.C. Russ," The Image Processing Handbook", (5/e), CRC, 2006.

5. R.C.Gonzalez & R.E. Woods; "Digital Image Processing with MATLAB", Prentice Hall, 2003.

Course Outcomes:	
On completion of the course students will be able to	
PEC- CS601D.1	Review the fundamental concepts of a digital image processing system.
PEC- CS601D.2	Understand the need for image transforms different types of image transforms and their properties.
PEC- CS601D.3	Analyze images in the frequency domain using various transforms.
PEC- CS601D.4	Evaluate the techniques for image enhancement and image restoration.
PEC- CS601D.5	Interpret image segmentation and representation techniques.
PEC- CS601D.6	Develop any image processing application.

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Parallel and Distributed Algorithms

Code: PEC-CS602A

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To learn parallel and distributed algorithms development techniques for shared memory and message passing models.
2.	To study the main classes of parallel algorithms
3.	To to study the complexity and correctness models for parallel algorithms.

Pre-Requisite:	
1.	Basic understandings of distributed systems
2.	Knowledge of sequential algorithms and their analysis.
3.	Basic knowledge of formal models of computation

Unit	Content	Hrs. / Unit
1.	**UNIT-I**: Basic Techniques, Parallel Computers for increase Computation speed and Parallel & Cluster Computing.	6
2.	**UNIT-II**: Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples.	6
3.	**UNIT-III**: Pipelining- Techniques computing platform, pipeline programs examples.	8
4.	**UNIT-IV**: Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelist sharing data parallel programming languages and constructs, open MP.	10
5.	**UNIT-V**: Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms – sorting and numerical algorithms.	8

Text book and Reference books:

1. Parallel Programming, Barry Wilkinson, Michael Allen, Pearson Education, 2nd Edition.

2. Introduction to Parallel algorithms by Jaja from Pearson, 1992.

Course Outcomes:	
On completion of the course students will be able to	
PEC- CS602A.1	Develop and apply knowledge of parallel and distributed computing techniques and methodologies.
PEC- CS602A.2	Apply design, development, and performance analysis of parallel and distributed applications.
PEC- CS602A.3	Use the application of fundamental Computer Science methods and algorithms in the development of parallel applications.
PEC- CS602A.4	Explain the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.
PEC- CS602A.5	Analyze modeling and performance of parallel programs.
PEC- CS602A.6	Analyze complex problems with shared memory programming with OpenMP.

Data Mining

Code: PEC-CS602B

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To introduce the basic concepts and techniques of data mining.
2.	To be aware of advanced concepts of data mining techniques and its applications in the knowledge discovery process.
3.	To study techniques for developing effective, efficient, and scalable data mining tools and develop skills of using recent data mining software for solving problems.

Pre-Requisite:	
1.	Basic database concepts such as schema, ER model, Structured Query language(Basic understanding of DBMS)
2.	Engineering Mathematics
3.	Data Structure and Algorithm

Unit	Content	Hrs. / Unit
1.	**Unit 1**: Introduction to Data Warehousing; KDD Process, Data Pre-processing- Data Cleaning methods, Data Mining: Mining frequent patterns, Association Rules- Mining various kinds of association rules, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;	8
2.	**Unit 2**: Classification and prediction; Decision Tree, Bayesian Classification, Rule Based Classification, KNN Classification, Regression-Accuracy and Error Measures.	8
3.	Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical-Agglomerative and Divisive Methods; K-Means, K-Medoids, Density Based method-DBSCAN, Graph Based Clustering;	
4.	**Unit 3**: Mining Time series Data, Trend analysis, and Similarity search in Time-series analysis.	5
5.	**Unit 4**: Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams; modulation for communication, filtering, feedback control systems.	8
6.	**Unit 5**: Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining, Text Mining	5
7.	**Unit 6**: Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis, Data Mining software and Applications.	4

Text book and Reference books:

1. Data Mining Techniques – Arun K Pujari – Universities Press.

2. Data Warehousing, Data Mining, & OLAP – Second Edition by Alex Berson and Stephen J. Smith, Tata McGraw Hill Education.

3. Data Mining – Vikram Pudi, P. Radha Krishna – Oxford University Press. 4. Data Mining & Ware housing by Ikvinderpal Singh, Khanna Publishing House.

5. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication, 2011.

6. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley,2006.

7. G Dong and J Pei, Sequence Data Mining, Springer, 2007.

8. Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India.

9. Data warehouse Toolkit by Ralph Kimball, Wiley India.

Course Outcomes:	
On completion of the course students will be able to	
PEC- CS602 B.1	Define the concept of data warehouse and data mart, building blocks, and recall in independent and life-long learning of data warehouse and Data Mining.
PEC- CS602 B.2	Summarize Data warehouse Architecture in the areas of Data acquisition, Data storage and Information delivery and illustrate the engineering principles and major issues in Data Mining.
PEC- CS602 B.3	Relate the architecture of Data warehouse with Database models and apply machine learning, pattern recognition, statistics, algorithm, visualization and high performance computing in data mining applications
PEC- CS602 B.4	Illustrate Metadata types by functional areas and assume effective reports on Business metadata by understanding of the engineering principles of metadata. Categorize the different technologies used for different applications.
PEC- CS602 B.5	Evaluate effective reports on data preprocessing, mining frequent pattern, association, classification, clustering and outlier detection.
PEC- CS602 B.6	Discover interesting pattern from large amounts of data to analyze for predictions and classifications and discuss Knowledge Discovery Process for developing applications in societal, health, safety, legal and cultural issues.

Human Computer Interaction

Code: PEC-CS602C

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3.

Objective:	
1.	Learn the foundations of Human Computer Interaction.
2.	Be familiar with the design technologies for individuals and persons with disabilities.
3.	Be aware of mobile Human Computer interaction.
4.	Learn the guidelines for user interface.

Pre-Requisite:	
1.	Computer Organization & Architecture

Unit	Content	Hrs. / Unit
1.	Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.	7
2.	Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.	9
3.	Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.	7
4.	Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.	7
5.	Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.	6
6.	Recent Trends: Speech Recognition and Translation, Multimodal System.	3

Text book and Reference books:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett

2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

Course Outcomes:	
On completion of the course students will be able to	
PEC- CS602 C.1	Provide an overview of the concepts relating to the design of human-computer interfaces in ways making computer-based systems comprehensive, friendly and usable.
PEC- CS602 C.2	Understand the theoretical dimensions of human factors involved in the acceptance of computer interfaces.

PEC- CS602 C.3	Understand the important aspects of implementation of human-computer interfaces.
PEC- CS602 C.4	Identify the various tools and techniques for interface analysis, design, and evaluation.
PEC- CS602 C.5	Identify the impact of usable interfaces in the acceptance and performance utilization of information systems.
PEC- CS602 C.6	Identify the importance of working in teams and the role of each member within an interface development phase.

Pattern Recognition

Code: PEC-CS602D

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Study the fundamental algorithms for pattern recognition
2.	To instigate the various classification techniques
3.	To originate the various structural pattern recognition and feature extraction techniques.

Pre-Requisite:	
1.	Statistics and Probability Theory
2.	Differential Equations, ordinary and partial
3.	Analytical Geometry and Linear Algebra
4.	Differential and Integral Calculus

Unit	Content	Hrs. / Unit
1.	Basics of pattern recognition.	2
2.	**Bayesian decision theory 8L** Classifiers, Discriminant functions, Decision surfaces Normal density and discriminant functions Discrete features.	8

3.	**Parameter estimation methods 6L** Maximum-Likelihood estimation Gaussian mixture models Expectation-maximization method Bayesian estimation.	6
4.	**Hidden Markov models for sequential pattern classification 8L** Discrete hidden Markov models Continuous density hidden Markov models.	8
5.	**Dimension reduction methods 3L** 5.1. Fisher discriminant analysis 5.2Principal component analysis. Parzen-window method K-Nearest Neighbour method	3
6.	Non-parametric techniques for density estimation.	2
7.	**Linear discriminant function based classifier 5L** Perceptron Support vector machines.	5
8.	**Non-metric methods for pattern classification 4L** Non-numeric data or nominal data Decision trees	4
9.	**Unsupervised learning and clustering 2L** Criterion functions for clustering Algorithms for clustering: K-means, Hierarchical and other methods.	2

Text book and Reference books:

1. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification, John Wiley, 2001.

2. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.

3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

Course Outcomes:	
On completion of the course students will be able to	
PEC- CS602 D.1	Explain and define concepts of pattern recognition.
PEC- CS602 D.2	Explain and distinguishprocedures, methods and algorithms related to pattern recognition.
PEC- CS602 D.3	Apply methods from the pattern recognition for new complex applications.
PEC- CS602 D.4	Analyze and breakdown problem related to the complex pattern recognition system.
PEC- CS602 D.5	Design and develop a pattern recognition system for the specific application.
PEC- CS602 D.6	Evaluate quality of solution of the pattern recognition system.

Numerical Methods

Code: OEC-CS601A

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Pre-Requisite:	
1.	Basic knowledge of ordinary differential equations

Unit	Content	Hrs. / Unit
1.	Approximation in numerical computation: Truncation and rounding errors, Fixed and floating point arithmetic, Propagation of errors.	2
2.	Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation.	8
3.	Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.	3
4.	Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.	8
5.	Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method.	3
6.	Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor Corrector methods and Finite Difference method.	2

Text book and Reference books:

1. R.S. Salaria: Computer Oriented Numerical Methods, Khanna Publishing House

2. C.Xavier: C Language and Numerical Methods.

3. Dutta & Jana: Introductory Numerical Analysis.

4. J.B.Scarborough: Numerical Mathematical Analysis.

5. Jain, Iyengar& Jain: Numerical Methods (Problems and Solution).

6. Balagurusamy: Numerical Methods, Scitech.

7. Baburam: Numerical Methods, Pearson Education.

8. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.

Course Outcomes:	
On completion of the course students will be able to	
OEC- CS601A.1	Recalling the basic mathematical tools such as, derivative, real integration, solution of equations, existence of solution of system of linear equations and differential equation.
OEC- CS601A.2	Describe the concept of error, operators and interpolation. Numerical approach of solving missing term, finding of polynomials, integrated value, solution of algebraic equations, system of linear equations and differential equation.
OEC- CS601A.3	Use interpolation, integration for data analysis and finding of volume of rough surface. Apply different numerical techniques to solve algebraic equations, system of linear equations in iterative way. Solve boundary value wave and heat equations using differential equations.
OEC- CS601A.4	Analyze different real time problems and categorize them during the process of solving, by numerical technique mentioned.
OEC- CS601A.5	Justify and make gradation of above mentioned numerical tools and determine the right approach to find the optimal solution for multidisciplinary engineering problems.
OEC- CS601A.6	Design a working model and build a path by which a new approach can be generated to create a new problem appreciated by academics, research & emerging direction in industry.

Human Resource Development and Organizational Behaviour

Code: OEC-CS601B

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Unit	Content	Hrs. / Unit
1.	Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. [2] Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction.	4

2.	Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making. [2] 4. Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory.	8
3.	Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision Making. [2] Communication: Communication Process, Direction of Communication, Barriers to Effective Communication. [2] Leadership: Definition, Importance, Theories of Leadership Styles.	4
4.	Organizational Politics: Definition, Factors contributing to Political Behaviour. [2] Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process. [2] Organizational Design: Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture.	8

Text book and Reference books:

1. Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15th Edn.

2. Luthans, Fred: Organizational Behavior, McGraw Hill, 12th Edn.

3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI

4. Fincham, R. & Rhodes, P.: Principles of Organizational Behaviour, OUP, 4th Edn.

5. Hersey, P., Blanchard, K.H., Johnson, D.E.- Management of Organizational Behavior Leading Human Resources, PHI, 10th Edn.

Course Outcomes:	
On completion of the course students will be able to	
OEC- CS601B.1	Interpret given organization structure, culture, climate
OEC- CS601B.2	Interpret how to behave in a group through proper communication
OEC- CS601B.3	Interpret how to participate in a group decision making process
OEC- CS601B.4	Know about various leadership qualities required keeping in mind Various Organizational Structures and their Effects on Human Behaviour
OEC- CS601B.5	Learn the art of motivating employees by studying various theories and by their application for smooth functioning of the organisation.

OEC- CS601B.6	Learn about different types of Conflicts which are common in an organisation and how to handle those conflicting situations and will also Learn the art of negotiation and bargaining.

Software Engineering Lab

Code: PCC-CS 691

Contact: 4P

Practical: 4 hrs. / Week

Credit Points: 2

Laboratory Experiments:	
1.	Problem Analysis and Project Planning -Thorough study of the problem – Identify Project scope, Objectives and Infrastructure.
2.	Software Requirement Analysis – Describe the individual Phases/modules of the project and Identify deliverables. Identify functional and non-functional requirements.
3.	Data Modeling – Use work products, DFD models (level-0 and level-1),
4.	Software Designing - Develop use case diagrams and activity diagrams, build class diagrams, sequence diagrams and add interface to class diagrams.
5.	Software Testing – Develop test cases and test suits for various testing techniques.
6.	Prototype model – Develop the prototype of the small and real life problems.

Course Outcomes:	
On completion of the course students will be able to	
PCC- CS691.1	Identify and classify the customer requirements for the solution of complex engineering problems by proper analysis and interpretation of data and processes supported by standard documentation.
PCC- CS691.2	Analyze the software processes by mapping requirements in to Use case diagrams/ Data Flow Diagrams and Entity Relationship Diagrams for given case studies.
PCC- CS691.3	Experiment with modern tools like Rational Rose, Smartdraw, Erdraw, etc. to design dynamic behaviour of software with modular programming, class diagrams, sequence diagrams, etc. following standard guidelines.
PCC- CS691.4	Estimate software matrices like size, effort and cost , software reliability and quality, etc and plan development schedule using PERT and GNATT charts.
PCC- CS691.5	Design the Test cases and the Test suits for the given case studies using Black box and White box techniques.

PCC- CS691.6	Determine and evaluate the various components of software development process practically and to combine them to produce different types of software to adapt in the software industries in future.

Computer Networks Lab

Code: PCC-CS692

Contacts: 4P

Practical: 4 hrs. / Week

Credit Points: 2

Laboratory Experiments:	
1.	NIC Installation & Configuration (Windows/Linux)
2.	Understanding IP address, subnet etc. Familiarization with Networking cables (CAT5, UTP) Connectors (RJ45, T-connector) Hubs, Switches
3.	DHCP configuration Message queue TCP/UDP Socket Programming Simple, TCP based, UDP based Multicast & Broadcast Sockets
4.	Implementation of Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window) Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
5.	Server Setup/Configuration FTP, Telnet, NFS, DNS, Firewall;

Any experiment specially designed by the college.

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Outcomes:	
On completion of the course students will be able to	
PCC- CS692.1	Define the hardware, related to computer network.
PCC- CS692.2	Understand the performance of network protocols such as message queue, stop-and-wait, CRC etc.

PCC- CS692.3	Apply UNIX socket programs efficiently, based on the knowledge of client server paradigm.
PCC- CS692.4	Analyse the network traffic in terms of congestion control mechanism.
PCC- CS692.5	Evaluate the datagram forwarding and routing mechanisms compatible with UNIX platform.
PCC- CS692.6	Create networks in small scale by configuring devices with the help of knowledge in network addressing.

CSE

Fourth Year - Seventh Semester

(Semester VII)

Quantum Computing

Code: PEC-CS701A

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	The course will provide an insight of basic of quantum physics from a computer scientist's perspective, and how it describes reality and understand the philosophical implications of quantum computing.

Pre-Requisite:	
1.	Linear Algebra, Theory of Computation

Unit	Content	Hrs. / Unit
1.	Qubit & Quantum States: The Qubit, Vector Spaces. Linear Combination Of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt orthogonalization, bra-ket formalism, the Cauchyschwarez and triangle Inequalities.	3
2.	Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators.	10
3.	Commutator Algebra, Heisenberg uncertainty principle, polar	5

	decomposition &singular values, Postulates of Quantum Mechanics.	
4.	Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices. Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.	5
5.	Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, and Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures.	8
6.	Recent trends in Quantum Computing Research, Quantum Computing Applications of Genetic Programming.	6

Text book and Reference books:

1. Quantum Computing without Magic by Zdzislaw Meglicki

2. Quantum Computing Explained By DAVID Mc MAHON

3. Quantum Computer Science by Marco Lanzagorta, Jeffrey Uhlmann

4. An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca.

Course Outcome:	
On completion of the course students will be able to	
PEC- CS701A.1	Understand the foundations of post-quantum and implications of quantum computing.
PEC- CS701A.2	Understand the quantum computing paradigm. Understand Matrices & Operators in Quantum computing.
PEC- CS701A.3	Understand the power and limitation of quantum computers and the underlying power of quantum mechanics for computation.
PEC- CS701A.4	Design and analyse quantum algorithms. Grasp the notions of Tensor Products and Density Operator.
PEC- CS701A.5	Evaluate the principles of Quantum Measurement Theory. Distinguishing Quantum states & Measures.
PEC- CS701A.6	Understand recent trends in Quantum Computing and to know Quantum Computing Applications of Genetic Programming.

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Cloud Computing

Code: PEC-CS701B

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To understand the concepts of Cloud Computing.
2.	To learn Taxonomy of Virtualization Techniques.
3.	To learn Cloud Computing Architecture.
4.	To acquire knowledge on Aneka Cloud Application Platform.
5.	To learn Industry Cloud Platforms.

Pre-Requisite:	
1.	Prerequisites: Discrete Mathematics, Computer Networks

Unit	Content	Hrs. / Unit
1.	Distributed Computing and Enabling Technologies,Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Applications, deployment models, and service models. Virtualization: Issues with virtualization, virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors,virtualization of data centers, and Issues with Multi-tenancy.	9
2.	Implementation: Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, Build Private/Hybrid Cloud using open source tools, Deployment of Web Services from Inside and Outside a Cloud Architecture. MapReduce and its extensions to Cloud Computing, HDFS, and GFS. Interoperability and Service Monitoring: Issues with interoperability, Vendor lock-in, Interoperability approaches. SLA Management, Metering Issues, and Report generation.	12
3.	Resource Management and Load Balancing: Distributed Management of Virtual Infrastructures, Server consolidation, Dynamic provisioning and resource management, Resource Optimization, Resource dynamic reconfiguration, Scheduling Techniques for Advance Reservation, Capacity Management to meet SLA Requirements, and Load Balancing, various load balancing techniques.	9
4.	Migration and Fault Tolerance: Broad Aspects of Migration into Cloud,	3

	Migration of virtual Machines and techniques. Fault Tolerance Mechanisms.	

Text book and Reference books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013

2. Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, McGraw Hill Education (India) Private Limited, 2013

3. Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill

4. Cloud Computing, Miller, Pearson

5. Building applications in cloud:Concept, Patterns and Projects, Moyer, Pearson

6. Cloud Computing – Second Edition by Dr. Kumar Saurabh, Wiley India

Course Outcome:	
On completion of the course students will be able to	
PEC- CS701B.1	Create the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing,
PEC- CS701B.2	Illustrate various problems and evaluate related cloud computing solutions
PEC- CS701B.3	Analyze the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud and hybrid cloud to different problems
PEC- CS701B.4	Apply the acquired knowledge to cloud provider for a defined environment and to a specific platform in a cost effective way.
PEC- CS701B.5	Understand the case studies to derive the best practice model to apply when developing and deploying cloud based applications
PEC- CS701B.6	Remember recent trends and applications in the Cloud computing.

Neural Networks and Deep Learning

Code: PEC-CS 701C

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Understanding Human learning aspects.
2.	Acquaintance with primitives in the learning process by computer.
3.	Understanding the nature of problems solved with Deep Learning.

Pre-Requisite:	
1.	Statistics, Linear Algebra, Probability.

Unit	Content	Hrs. / Unit
1.	**Introduction**: Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.	3
2.	**Feed forward neural network**: Artificial Neural Network, activation function, multi-layer neural network, cardinality, operations, and properties of fuzzy relations.	6
3.	**Training Neural Network**: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.	6
4.	**Conditional Random Fields**: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.	9
5.	**Deep Learning**: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.	6
6.	**Deep Learning research**: Object recognition, sparse coding, computer vision, natural language.	6

Text book and Reference books:

1. Goodfellow I, BengioY., and Courville, A., Deep Learning, MIT Press, 2016.

2. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.

3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.

4. Golub, G., H., and Van Loan, C., F., Matrix Computations, JHU Press, 2013.

5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

6. Dr. Rajiv Chopra, Deep Learning, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

Course Outcome:	
On completion of the course students will be able to	
PEC- CS701C.1	Provide an introduction to the field of artificial neural networks and deep learning.
PEC- CS701C.2	Understand motivation and functioning of the most common types of deep neural networks.
PEC- CS701C.3	analyze and evaluate model performance and interpret results
PEC- CS701C.4	Analyze how to solve practical problems via artificial neural networks and deep learning techniques.
PEC- CS701C.5	Apply Artificial Neural Networks and Deep Neural Networks in solving complex real world problems
PEC- CS701C.6	Promote further independent learning on the topics of artificial neural networks and machine learning.

Soft Computing

Code: PEC-CS701D

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Familiarize with soft computing concepts.
2.	Introduce and use the idea of Neural networks, fuzzy logic and use of heuristics based on human experience.
3.	Introduce and use the concepts of Genetic algorithm and its applications to soft computing using some applications.

Unit	Content	Hrs. / Unit
1.	**Introduction**: Introduction to soft computing; introduction to fuzzy sets and fuzzy logic systems; introduction to biological and artificial neural network; introduction to Genetic Algorithm	8
2.	**Fuzzy sets and Fuzzy logic systems**: Classical Sets and Fuzzy Sets and Fuzzy relations: Operations on Classical sets, properties of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality, operations, and properties of fuzzy relations. **Membership functions**: Features of membership functions, standard	10

	forms and boundaries, different fuzzification methods. Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods. **Classical Logic and Fuzzy Logic**: Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication Fuzzy Rule based Systems: Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules, Fuzzy Inference System- Mamdani Fuzzy Models – Sugeno Fuzzy Models. **Applications of Fuzzy Logic**: How Fuzzy Logic is applied in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting.	
3.	**Introduction to Neural Networks**: Advent of Modern Neuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron. **Learning Methods**: Hebbian, competitive, Boltzman etc., **Neural Network models**: Perceptron, Adaline and Madaline networks; single layer network; Backpropagation and multi-layer networks. **Competitive learning networks**: Kohonen self-organizing networks, Hebbian learning; Hopfield Networks. Neuo-Fuzzy modelling: Applications of Neural Networks: Pattern Recognition and classification	8
4.	**Genetic Algorithms**: Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA). **Applications of Genetic Algorithm**: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and pattern Recognition	8
5.	**PSO**: Other Soft Computing techniques: Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).	4

Text book and Reference books:

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 Outcome:	
On completion of the course students will be able to	
PEC- CS701D.1	Identify the difference between Conventional Artificial Intelligence to Computational Intelligence.
PEC- CS701D.2	Understand fuzzy logic and reasoning to handle and solve engineering problems
PEC- CS701D.3	Apply the Classification and clustering techniques on various applications.
PEC- CS701D.4	Understand the advanced neural networks and its applications
PEC- CS701D.5	Perform various operations of genetic algorithms, Rough Sets.
PEC- CS701D.6	Comprehend various techniques to build model for various applications

Ad-hoc and Sensor Network

Code: PEC-CS 701E

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Provide an overview about sensor networks and emerging technologies
2.	To study about the node and network architecture of sensor nodes and its execution environment.
3.	To understand the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN
4.	To learn about topology control and clustering in networks with timing synchronization for localization services with sensor tasking and control
5.	To study about sensor node hardware and software platforms and understand the simulation and programming techniques.

Pre-Requisite:	
1.	Computer networking concepts.

Unit	Content	Hrs. / Unit
1.	**Introduction and Overview:** Overview of wireless networks, types, infrastructure-based and infrastructure-less, introduction to MANETs (Mobile Ad-hoc Networks), characteristics, reactive and proactive routing protocols with examples, introduction to sensor networks, commonalities and differences with MANETs, constraints and challenges, advantages, applications, enabling technologies for WSNs.	4
2.	**Architectures Single-node architecture -** hardware components, design constraints, energy consumption of sensor nodes , operating systems and execution environments, examples of sensor nodes, sensor network scenarios, types of sources and sinks – single hop vs. multi hop networks, multiple sources and sinks – mobility, optimization goals and figures of merit, gateway concepts, design principle.	9
3.	**Communication Protocols :**Physical layer and transceiver design considerations, MAC protocols for wireless sensor networks, low duty cycle protocols and wakeup concepts - S-MAC , the mediation device protocol, wakeup radio concepts, address and name management, assignment of MAC addresses, routing protocols classification, gossiping, flooding, energy efficient routing, unicast protocols, multipath routing, data-centric routing, data aggregation, SPIN, LEACH, Directed Diffusion, geographic routing.	9
4.	**Infrastructure Establishment**: Topology control, flat network topologies, hierarchical networks by clustering, time synchronization, properties, protocols based on sender-receiver and receiver-receiver synchronization, LTS, TPSN, RBS, HRTS, localization and positioning, properties and approaches, single-hop localization, positioning in multi-hop environment, range based localization algorithms – location services, sensor tasking and control	8
5.	**Sensor Network Platforms and Tools :**Sensor node hardware, Berkeley motes, programming challenges, node level software platforms, node-level simulators, state-centric programming, Tiny OS, nesC components, NS2 simulator, TOSSIM.	9

Text book and Reference books:

1. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

3. KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks- Technology, Protocols, and Applications", John Wiley, 2007.
4. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
5. Thomas Haenselmann, "Sensor Networks", available online for free, 2008.

Course Outcome:	
On completion of the course students will be able to	
PEC- CS701E.1	Provide an overview about sensor networks and emerging technologies
PEC- CS701E.2	Study about the node and network architecture of sensor nodes and its execution environment.
PEC- CS701E.3	Understand the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN
PEC- CS701E.4	Learn about topology control and clustering in networks with timing synchronization for localization services with sensor tasking and control
PEC- CS701E.5	Study about sensor node hardware and software platforms and understand the simulation and programming techniques.
PEC- CS701E.6	Promote further independent learning on the topics of ad hoc and wireless sensor networks.

Information Theory and Coding

Code: PEC-CS701F

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To develop an understanding of modern network architectures from a design and performance perspective.
2.	To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3.	To provide an opportunity to do network programming
4.	To provide a WLAN measurement ideas.

Pre-Requisite:	
1.	Probability Theory.

2.	Analog and Digital Communication Engineering.

Unit	Content	Hrs. / Unit
1.	**Source Coding:** Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes.	7
2.	**Channel Capacity And Coding:** Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.	7
3.	**Linear And Block Codes For Error Correction:** Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, and Hamming codes.	8
4.	**Cyclic Codes:** Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes.	7
5.	**BCH Codes:** Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.	8
6.	**Convolutional Codes:** Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding	8

Text book and Reference books:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.

2. Information and Coding - N Abramson; McGraw Hill.

3. Introduction to Information Theory - M Mansurpur; McGraw Hill.

4. Information Theory - R B Ash; Prentice Hall.

5. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

Course Outcome:	
On completion of the course students will be able to	
PEC- CS701F.1	Define and apply the basic concepts of information theory (entropy, channel capacity etc.)
PEC- CS701F.2	Learn the principles and applications of information theory in communication systems.
PEC- CS701F.3	Study various data compression methods and describe the most common such methods.
PEC- CS701F.4	Understand the theoretical framework upon which error-control codes are built.
PEC- CS701F.5	Apply convolution codes for performance analysis & cyclic codes for error detection and correction.
PEC- CS701F.6	Design BCH codes for Channel performance improvement

Operation Research

Code: OEC-CS 701A

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To comprehend and use operations research methods to analyse and solve your operational challenges in real life.
2.	To formulate and apply the techniques of Linear Programming and the extended topics to solve certain optimization problems

Pre-Requisite:	
1.	Knowledge of probability distributions and statistics, and preferably basic calculus, for learning Simulation.

Unit	Content	Hrs. / Unit
1.	**Basic LPP and Applications; Various Components of LP Problem Formulation:** Solution of Linear Programming Problems: Solution of LPP: Using Simultaneous Equations and Graphical Method; Definitions: Feasible Solution, Basic and non-basic Variables, Basic Feasible Solution, Degenerate and Non-degenerate Solution, Convex	17

	set and explanation with examples Solution of LPP by Simplex Method; Charnes' Big-M Method; Duality Theory. Transportation Problems and Assignment Problems.	
2.	**Network Analysis**: Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERTCPM (Cost Analysis, Crashing, Resource Allocation excluded). **Inventory Control**: Introduction to EOQ Models of Deterministic and Probabilistic; Safety Stock; Buffer Stock.	9
3.	**Game Theory**: Introduction; 2-Person Zero-sum Game; Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance.	5
4.	**Queuing Theory**: Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: (M/M/1): (∞ / FIFO) and (M/M/1: N / FIFO) and problems.	5

Text book and Reference books:

1. H. A. Taha, "Operations Research", Pearson

2. P. M. Karak – "Linear Programming and Theory of Games", ABS Publishing House

3. Ghosh and Chakraborty, "Linear Programming and Theory of Games", Central Book Agency

4. Ravindran, Philips and Solberg - "Operations Research", WILEY INDIA

Course Outcome:	
On completion of the course students will be able to	
OEC-CS 701A.1	Understand the linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.
OEC-CS 701A.2	Relate the determination of optimal strategy for Minimization of Cost of shipping of products from source to Destination/ Maximization of profits of shipping products using various methods, Finding initial basic feasible and optimal solution of the Transportation problems.
OEC-CS 701A.3	Apply the Optimization technique for the allocation of resources to Demand points in the best possible way using various techniques and minimize the cost or time of completion of number of jobs by number of persons.
OEC-CS 701A.4	Analyse pure and mixed strategy in games problem, and Model competitive real-world phenomena using concepts from game theory.
OEC-CS 701A.5	Evaluate the importance of Operations research in the various field like, the field of finance, education, transportation, manufacturing, healthcare, retail

	and so on
OEC-CS 701A.6	Create Network models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Network problems.

Multimedia Systems

Code: OEC-CS701B

Contacts: 3L

Theory: 3 hrs. / Week

Objective:	
1.	To understand various components of the multimedia systems
2.	To introduce how multimedia can be used in various application areas.
3.	To provide a solid foundation to the students so that they can identify the proper applications of multimedia, evaluate the appropriate multimedia systems and develop effective multimedia applications.

Pre-Requisite:	
1.	Knowledge in Data Structure, Computer Network and Operating System.

Unit	Content	Hrs. / Unit
1.	**Introduction**: Multimedia today, Impact of Multimedia, Multimedia Systems, Components and Its Applications.	2
2.	**Text and Audio, Image and Video:** Text: Types of Text, Ways to Present Text, Aspects of Text Design, Character, Character Set, Codes, Unicode, Encryption; Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI Image: Formats, Image Color Scheme, Image Enhancement; Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture, and Computer based Animation.	10
3.	**Synchronization, Storage models and Access Techniques**: Temporal relationships, synchronization accuracy specification factors, quality of service, Magnetic media, optical media, file systems (traditional, multimedia) Multimedia devices – Output devices, CD-ROM, DVD, Scanner, and CCD.	8
4.	**Image and Video Database, Document Architecture and Content**	15

	Management: Image representation, segmentation, similarity based retrieval, image retrieval by color, shape and texture; indexing- kd trees, R-trees, quad trees; Case studies- QBIC, Virage. Video Content, querying, video segmentation, indexing, Content Design and Development, General Design Principles Hypertext: Concept, Open Document Architecture (ODA), Multimedia and Hypermedia Coding Expert Group (MHEG), Standard Generalized Markup Language (SGML), Document Type Definition (DTD), Hypertext Markup Language (HTML) in Web Publishing. Case study of Applications.	
5.	**Multimedia Applications**: Interactive television, Video-on-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, media editors.	4

Text book and Reference books:

1. Ralf Steinmetz and Klara Nahrstedt, Multimedia: Computing, Communications & Applications, Pearson Ed.

2. Nalin K. Sharda, Multimedia Information System, PHI.

3. Fred Halsall, Multimedia Communications, Pearson Ed.

4. Koegel Buford, Multimedia Systems, Pearson Ed.

5. Fred Hoffstetter, Multimedia Literacy, McGraw Hill.

6. Ralf Steinmetz and Klara Nahrstedt, Multimedia Fundamentals: Vol. 1- Media Coding and Content Processing, PHI.

7. J. Jeffcoate, Multimedia in Practice: Technology and Application, PHI.

8. V.K. Jain, Multimedia and Animation, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

Course Outcome:	
On completion of the course students will be able to	
OEC-CS 701B.1	Identify a range of concepts, techniques and tools for creating and editing the interactive multimedia applications
OEC-CS 701 B.2	Understand the hardware and software needed to create projects using creativity and organization to create them.
OEC-CS 701 B.3	Understand the concepts of Synchronization, Storage models and Access Techniques.
OEC-CS 701 B.4	Incorporate approaches for Image and Video Database, Document Architecture and Content Management.
OEC-CS 701 B.5	Understand recent trends and applications of Multimedia Systems.
OEC-CS 701 B.6	Develop multimedia skills understanding the principal players of individual

	players in multimedia teams in developing projects.

Introduction to Philosophical Thoughts

Code: OEC-CS701C

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Unit	Content	Hrs. / Unit
1.	**Nature of Indian Philosophy**: Plurality as well as common concerns. 2. Basic concepts of the Vedic and Upanisadic views: Atman, Jagrata, Svapna, Susupti, Turiya, Brahman, Karma, Rta, Rna.	17
2.	**Carvaka school**: its epistemology, metaphysics and ethics. Mukti	9
3.	**Jainism**: Concepts of sat, dravya, guna, paryaya, jiva, ajiva, anekantavada, syadvada, and nayavada; pramanas, ahimsa, bondage and liberation.	
4.	Buddhism: theory of pramanas, theory of dependent origination, the four noble truths; doctrine of momentaryness; theory of no soul. The interpretation of these theories in schools of Buddhism: Vaibhasika, Sautrantrika, Yogacara, Madhyamika.	5
5.	Nyaya: theory of Pramanas; the individual self and its liberation; the idea of God and proofs for His existence.	5

Text book and Reference books:

1. M. Hiriyanna: Outlines of Indian Philosophy.
2. C. D. Sharma: A Critical Survey of Indian Philosophy.
3. S. N. Das Gupta: A History of Indian Philosophy Vol – I to V.
4. S. Radhakrishnan: Indian Philosophy Vol – I & II.
5. T. R. V. Murti: Central Philosophy of Buddhism.
6. J. N. Mahanty: Reason and Tradition of Indian Thought.
7. R. D. Ranade: A Constructive Survey of Upanisadic Philosophy.
8. P. T. Raju: Structural Depths of Indian Thought.
9. K. C. Bhattacharya: Studies in Philosophy Vol – 1.
10. Datta and Chatterjee: Introduction of Indian Philosophy

Course Outcome:	
On completion of the course students will be able to	
OEC-CS701C.1	Understand clearly various aspects of Vedas and Upanishadic views: Atman, Jagrata etc.
OEC-CS701C.2	Interpret the thoughts related to Carvaka schooland its epistemology, metaphysics and ethics. Mukti etc.
OEC-CS701C.3	Learn the philosophical thoughts associated with Jainism.
OEC-CS701C.4	Learn the philosophical thoughts associated with Buddhism and will be able to interpret various theories in School of Buddhism.
OEC-CS701C.5	Understand the width and depth of Indian Philosophical Concepts which will help them to chose the right path in the journey of life.
OEC-CS701C.6	Gain the power of self-realisation. Also will Gain the power of understanding the Existence of Super Power i.e God Almighty.

Project Management and Entrepreneurship

Code: HSMC 701

Contact: 2L+1T

Theory: 3 hrs. / Week

Credit Points: 3

Unit	**Content**	**Hrs. / Unit**
1.	Introduction: Meaning and Concept of Entrepreneurship, Innovation and entrepreneurship, Contributions of entrepreneurs to the society, risk-opportunities perspective and mitigation of risks.	2
2.	Entrepreneurship – An Innovation: Challenges of Innovation, Steps of Innovation Management, Idea Management System, Divergent v/s Convergent Thinking, Qualities of a prospective Entrepreneur.	2
3.	Idea Incubation: Factors determining competitive advantage, Market segment, blue ocean strategy, Industry and Competitor Analysis (market structure, market size, growth potential), Demand-supply analysis.	4
4.	Entrepreneurial Motivation: Design Thinking - Driven Innovation, TRIZ (Theory of Inventive Problem Solving), Achievement motivation	2

	theory of entrepreneurship – Theory of McClelland, Harvesting Strategies.	
5.	Information: Government incentives for entrepreneurship, Incubation, acceleration. Funding new ventures – bootstrapping, crowd sourcing, angel investors, Government of India's efforts at promoting entrepreneurship and innovation – SISI, KVIC, DGFT, SIDBI, Defense and Railways.	4
6.	Closing the Window: Sustaining Competitiveness, Maintaining Competitive Advantage, the Changing Role of the Entrepreneur.	2
7.	Applications and Project Reports Preparation	4
8.	Project Management: Definitions of Project and Project Management, Issues and Problems in Project Management, Project Life Cycle - Initiation / Conceptualization Phase, Planning Phase, Implementation / Execution Phase, Closure / Termination Phase.	4
9.	Project Feasibility Studies – Pre-Feasibility and Feasibility Studies, Preparation of Detailed Project Report, Technical Appraisal, Economic/Commercial/Financial Appraisal including Capital Budgeting Process, Social Cost Benefit Analysis.	2
10.	Project Planning – Importance of Project Planning, Steps of Project Planning, Project Scope, Work Breakdown Structure (WBS) and Organization Breakdown Structure (OBS), Phased Project Planning.	2
11.	Project Scheduling and Costing – Gantt chart, CPM and PERT Analysis, Identification of the Critical Path and its Significance, Calculation of Floats and Slacks, Crashing, Time Cost Trade-off Analysis, Project Cost Reduction Methods.	6
12.	Project Monitoring and Control – Role of Project Manager, MIS in Project Monitoring, Project Audit.	2
13.	Case Studies with Hands-on Training on MS-Project	4

Text Books and References

1. Innovation and Entrepreneurship by Drucker, P.F.; Harper and Row

2. Business, Entrepreneurship and Management: Rao, V. S. P Vikas

3. Entrepreneurship: Roy Rajeev; OUP.

4. Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.; McMillan

5. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.; PHI

6. Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G.V.; MGH

Course Outcome:	
On completion of the course students will be able to	
HSMC 701.1	Learn about what entrepreneurship is and how to be motivated for emerging as a budding entrepreneur
HSMC 701.2	Learn the idea of incubation and its application and various Government Schemes available for the budding entrepreneurs.
HSMC 701.3	Learn about various National and International level Venture Capitalists and their project funding procedures
HSMC 701.4	Learn about Project Feasibility Studies, Preparation of Detailed Project Report, Technical Appraisal, Economic/Commercial/Financial Appraisal including Capital Budgeting Process, Social Cost Benefit Analysis etc.
HSMC 701.5	Learn how to plan a project considering Work Breakdown Structure (WBS) and Organization Breakdown Structure (OBS). Will also learn about Phased Project Planning, Project Scheduling and Costing through different cost analysis techniques
HSMC 701.6	Learn how to monitor a project continuously and ensure proper control on the progress of the project for its timely completion, cost effectiveness etc.

Industry Internship

Code: TR CS 771

Contact:

Credit Points: 3

Industry Internship

OBJECTIVES

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training:

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical /

managerial skills required at the job.

- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Learn to apply the Technical knowledge in real industrial situations.
- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
- Promote academic, professional and/or personal development.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

INTERNSHIP GUIDELINES:

The T&P cell will arrange internship for students in industries/organization after second, fourth and six/seventh semester(s) or as per AICTE/ affiliating University guidelines. The general procedure for arranging internship is given below:

- **Step 1:** Request Letter/ Email from the office of Training & Placement cell of the college should go to industry to allot various slots of 4-6 weeks during summer vacation as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training. (Sample attached)

- **Step 2:** Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students in the office of Training & Placement through concerned department. Based on the number of slots agreed to by the Industry, TPO will allocate the students to the Industry. In addition, the internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by the TPO or other members of the T&P cell / Faculty members who are particularly looking after the Final/Summer Internship of the students.

- **Step 3:** Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

- **Step 4:** Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department office/TPO with the consent of Industry persons/ Trainers. (Sample Attached)

- **Step 5:** Students will submit training report after completion of internship.

- **Step 6:** Training Certificate to be obtained from industry.

- **Step 7:** List of students who have completed their internship successfully will be issued by Training and Placement Cell.

Course Outcomes:	
On completion of the course students will be able to	
TR-CS 771.1	Student is able to construct the company profile by compiling the brief history, management structure, products / services offered, key achievements and market performance for his / her organization of internship.
TR-CS 771.2	For his / her organization of internship, the student is able to assess its Strengths, Weaknesses, Opportunities and Threats (SWOT).
TR-CS 771.3	Student is able to determine the challenges and future potential for his / her internship organization in particular and the sector in general.
TR-CS 771.4	Student is able to test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period.
TR-CS 771.5	Student is able to apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship organization.
TR-CS 771.6	Student is able to analyze the functioning of internship organization and recommend changes for improvement in processes.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Project-I

Code: PROJ-CS781

Contact: 12P

Credit Points: 6

Project Work I
The object of Project Work I is to enable the student to take up investigative study in the broad field of Computer Science & Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

Course Outcome:	
On completion of the course students will be able to	
PROJ- CS781.1	To survey the literature; Identify and classify the requirements for the solution of complex engineering problems.
PROJ- CS781.2	To define the requirements of the project by proper analysis and interpretation of data and processes supported by standard documentation.
PROJ- CS781.3	To analyze the processes by mapping requirements in to Use case diagram(s)/ Data Flow Diagram(s)/ Algorithm(s)/ User-Interface design/ Entity Relationship Diagram(s) etc.
PROJ- CS781.4	To design behaviour of the application with modular programming and program flowchart/ class diagrams and sequence diagrams, etc., following standard guidelines.
PROJ- CS781.5	To estimate project metrics like size, effort and cost , reliability and quality, etc and plan project development schedule using PART and GNATT charts.
PROJ- CS781.6	To justify the project work with technical documentation, presentation, and discussions as a group to share knowledge.

Department of Computer Science and Engineering
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Syllabus for B. Tech in Computer Science & Engineering

CSE

Fourth Year - Eighth Semester

(Semester VIII)

Signal and Networks

Code: PEC-CS801A

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To understand the fundamental characteristics of signals and systems.
2.	To understand signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.

Pre-Requisite:	
1.	Knowledge Computer Networks

Unit	Content	Hrs. / Unit
1.	Objective and overview, signal and system types and classifications, step response, impulse response and convolution integral.	3
2.	Periodic signal analysis: Fourier series and properties; Aperiodic signal analysis: Fourier Transform - its properties and sinusoidal steady state analysis of systems.	7
3.	Elements of electrical network : dependent and independent sources, active and passive components; classical differential equations for description of transient conditions of Network; Solutions of linear time invariant networks with initial conditions; Unilateral and Bilateral Laplace Transforms and properties; Transient solutions of networks using Laplace Transform; Network functions: poles, zeros, transfer	12

	function, Bode plot.	
4.	One and two port network parameters and functions: Z, Y and ABCD parameters, driving point and transfer impedances and admittances; Network Theorems and Formulation of Network equations: generalized formulation of KCL, KVL, State Variable descriptions; Thevenin, Norton, Maximum Power Transfer, Tellegen and Reciprocity Theorems.	10
5.	Graph theory: Tree, Co-tree, fundamental cut-set, fundamental loop analysis of network; Analog filter design: Butterworth, Sallen Key, frequency transformation and scaling	6

Text book and Reference books:

1. Signals and Systems by P. Ramesh Babu& R. Ananda Natarajan, Scitech Publications (India).

2. Signals & Systems by A. V. Oppenheim, A. S. Willsky and S. H. Nawab, Prentice-Hall India.

3. Networks & Systems by D Roy Choudhury.

4. Networks & Systems by Asfhaq Husain.

Course Outcome:	
On completion of the course students will be able to	
PEC-CS801A.1	Understand the objective and overview of signal and system networks.
PEC-CS801A.2	Understanding the fundamental characteristics of signals and systems.
PEC-CS801A.3	Apply the concepts of Periodic signal analysis with Fourier series and properties.
PEC-CS801A.4	Understanding signals and systems in terms of elements of electrical network.
PEC-CS801A.5	Analyze One and two port network parameters and functions.
PEC-CS801A.6	Development of the mathematical skills to solve problems.

Cryptography and Network Security

Code: PEC-CS801B

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To understand basics of Cryptography and Network Security.
2.	To be able to secure a message over insecure channel by various means.
3.	To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4.	To understand various protocols for network security to protect against the threats in the networks.

Pre-Requisite:	
1.	Computer Network and Telecommunication.

Unit	Content	Hrs. / Unit
1.	Attacks on Computers & Computer Security - Introduction, Need for Security, Security approaches, Principles of Security, Types of attack.	5
2.	Cryptography: Concepts & Techniques Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric & Asymmetric key Cryptography, Key Range & Key Size	7
3.	Symmetric Key Algorithm - Introduction, Algorithm types & Modes, Overview of Symmetric Key Cryptography, DES(Data Encryption Standard) algorithm, IDEA(International Data Encryption Algorithm) algorithm, RC5 (Rivest Cipher 5) algorithm.	8
4.	Asymmetric Key Algorithm, Digital Signature and RSA - Introduction, Overview of Asymmetric key Cryptography, RSA algorithm, Symmetric & Asymmetric key Cryptography together, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required).	5
5.	Internet Security Protocols, User Authentication - Basic Concepts, SSL protocol, Authentication Basics, Password, Authentication Token, and Certificate based Authentication, Biometric Authentication.	6
6.	Electronic Mail Security - Basics of mail security, Pretty Good Privacy, S/MIME.	4
7.	Firewall - Introduction, Types of firewall, Firewall Configurations, DMZ Network	3

Text book and Reference books:

1. “Cryptography and Network Security”, William Stallings, 2nd Edition, Pearson Education Asia

2. “Cryptography and Network Security” by V.K. Jain, Khanna Publishing House,

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, 2nd Edition, Oreilly.

8. "Practical Unix & Internet Security", Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly.

Course Outcome:	
On completion of the course students will be able to	
PEC-CS801B.1	Elaborate the importance of communications in terms of confidentiality and integrity to serve the society in a better way.
PEC-CS801B.2	Define complex problems describing the basic Mathematics on Number theory, probability theory and their application in Security
PEC-CS801B.3	Analyze the problems and solutions of Cryptographic algorithms and its applicability in network security and describe the concepts of principles of security, types of attacks, symmetric key cryptography and asymmetric key cryptography and their differences.
PEC-CS801B.4	Use modern tools to implement the techniques like, DES, IDEA, RC4, RC5, DSA, Elgamal and SSL protocol etc
PEC-CS801B.5	Justify the applications of the aforesaid techniques in network security.
PEC-CS801B.6	Develop the systems this can withstand against the different types of attacks.

Speech and Natural Language Processing

Code: PEC-CS 801C

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Provide the student with knowledge of various levels of analysis involved in Speech and Natural Language Processing.
2.	Understand the applications of Speech and Natural Language Processing
3.	Gain knowledge in automated Natural Language Generation and Machine Translation

Pre-Requisite:	
1.	Concepts of Automata Theory.

Unit	Content	Hrs. / Unit
1.	Regular Expressions and Automata Recap - Introduction to NLP, Regular Expression, Finite State Automata Tokenization - Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance Morphology - Morphology – Inflectional and Derivational Morphology, Finite State Morphological Parsing, The Lexicon and Morphotactic, Morphological Parsing with Finite State Transducers, Orthographic Rules and Finite State Transducers, Porter Stemmer .	11
2.	Language Modeling Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Back off, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models. Hidden Markov Models and POS Tagging Markov Chain, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Part of Speech Tagging – Rule based and Machine Learning based approaches, Evaluation.	8
3.	Text Classification Text Classification, Naïve Bayes' Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. Context Free Grammar Context Free Grammar and Constituency, Some common CFG phenomena for English, Top-Down and Bottom-up parsing, Probabilistic Context Free Grammar, Dependency Parsing.	9
4.	Computational Lexical Semantics Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity Information Retrieval Boolean Retrieval, Term document incidence, The Inverted Index, Query Optimization, Phrase Queries, Ranked Retrieval – Term Frequency – Inverse Document Frequency based ranking, Zone Indexing, Query term proximity, Cosine ranking, Combining different features for ranking, Search Engine Evaluation, Relevance Feedback.	9

Text book and Reference books:

1. Speech and Language Processing, Jurafsky and Martin, Pearson Education

2. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press

3. Multilingual Natural Language Processing Applications from Theory to Practice: Bikel, Pearson.

Course Outcome:	
On completion of the course students will be able to	
PEC-CS801C.1	Understand the fundamental concepts and techniques of natural language processing (NLP).
PEC-CS801C.2	Analyze the diffract approaches to discourse, generation, dialogue and summarization within NLP
PEC-CS801C.3	Understand current methods for statistical approaches to machine translation.
PEC-CS801C.4	Understand of the computational properties of natural languages and the commonly used algorithms for processing linguistic information
PEC-CS801C.5	Analyze NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
PEC-CS801C.6	Understand Computational Lexical Semantics Introduction to Lexical Semantics.

Web and Internet Technology

Code: PEC-CS801D

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To provide the conceptual and technological developments in the field of Internet and web designing with the emphasis on comprehensive knowledge of Internet and its corresponding web applications.

Prerequisite:	
1.	Before starting with the syllabi basics of Java programming, HTML, Scripting knowledge is necessary.

Unit	**Content**	**Hrs. / Unit**
1.	Introduction (1L): Overview, Network of Networks, Intranet, Extranet and Internet.	6

	World Wide Web (1L): Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP, DOM. Review of TCP/IP (1L): Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing: Classful and Classless Addressing, Subnetting. NAT, IP masquerading, IP tables. Internet Routing Protocol: Routing -Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast. Electronic Mail: POP3, SMTP.	
2.	HTML: Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps: map, area, attributes of image area. Extensible Markup Language (XML): Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts: Introduction, Environment Variable, GET and POST Methods.	9
3.	PERL: Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling. JavaScript: Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation, Angular JS. Cookies: Definition of cookies, Create and Store a cookie with example, Session tracking. Java Applets: Container Class, Components, Applet Life Cycle, Update method; Parameter passing applet, Applications.	10
4.	Client-Server programming In Java: Java Socket, Java RMI. Threats: Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks. Network security techniques: Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall: Introduction, Packet filtering, Stateful, Application layer, Proxy.	4
5.	Internet Telephony: Introduction, VoIP. Multimedia	5

	Applications: Multimedia over IP: RSVP, RTP, RTCP and RTSP. Streaming media, Codec and Plugins, IPTV. Search Engine and Web Crawler: Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.	

Text book and Reference books:

1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Chapters 1-5,7,8,9).

2. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011.

Course Outcome:	
On completion of the course students will be able to	
PEC-CS801D.1	Explain the principal of Internetworking, TCP/IP protocols, World Wide Web, client-server architecture, IP addressing, routing etc.
PEC-CS801D.2	Examine and evaluate the need for secured web application development with client-side, server-side scripting languages.
PEC-CS801D.3	Construct web programs using the web languages--HTML, XML, JavaScript, Applet, Perl, etc.
PEC-CS801D.4	Design and develop small interactive websites using modern tools following the professional web based engineering solutions, ethics and management techniques.
PEC-CS801D.5	Determine and combine the advanced technologies like network security, multimedia applications, search engine, web crawler, etc with the websites.
PEC-CS801D.6	Assess the need and utility for different web components and their role-play to produce huge distributed data driven web applications to contribute to lifelong learning.

Internet of Things

Code: PEC-CS801E

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Able to understand the application areas of IOT.
2.	Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.

3.	Able to understand building blocks of Internet of Things and characteristics.

Pre-Requisite:	
1.	Wireless Networks.

Unit	Content	Hrs. / Unit
1.	Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT	4
2.	Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications. Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc.	8
3.	Important Characteristics of Sensors: Determination of the Characteristics. Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality. Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors	9
4.	Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel	8
5.	Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor And Future scope of research in smart sensor.	6
6.	Recent trends in smart sensor for day to day life, evolving sensors and their architecture.	4

References:

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing

2. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing

3. Jeeva Jose, Internet of Things, Khanna Publishing House.

4. Internet of Things, ArsheepBahga and Vijay Madisetti

Course Outcomes:	
After completion of course, students will be able to	
PEC-CS801E.1	Understand the application areas of IOT.
PEC-CS801E.2	Realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
PEC-CS801E.3	Understand building blocks of Internet of Things and characteristics.
PEC-CS801E.4	Analyze various M2M and IoT architecture.
PEC-CS801E.5	Valuate design issues in IoT applications.
PEC-CS80.E.6	Understand Recent trends in smart sensor for day to day life.

Big Data Analysis

Code: OEC-CS 801A

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	Understand big data for business intelligence. Learn business case studies for big data analytics. Understand no sql big data management. Perform map-reduce analytics using Hadoop and related tools

Pre-Requisite:	
1.	Programming language to solve real world learning problems and extract knowledge from real datasets.

Unit	Content	Hrs. / Unit
1.	What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.	6

2.	Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.	6
3.	Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures	8
4.	MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats	8
5.	Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.	6
6.	Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.	5

References:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging

2. V.K. Jain, Big Data and Hadoop, Khanna Publishing House, New Delhi (2017).

3. V.K. Jain, Data Analysis, Khanna Publishing House, New Delhi (2019).

4. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.

5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.

6. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.

7. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.

8. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.

9. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.

10. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.

11. Alan Gates, "Programming Pig", O'Reilley, 2011.

Course Outcomes:
After completion of course, students will be able to

OEC- CS801A.1	Understand the Big Data Platform and its Use cases.
OEC- CS801A.2	Provide an overview of Apache Hadoop .
OEC- CS801A.3	analyze HDFS Concepts and Interfacing with HDFS
OEC- CS801A.4	Evaluate and learn business case studies for big data analytics.
OEC- CS801A.5	Understand big data management
OEC- CS801A.6	Perform map -reduce analytics using Hadoop and related tools

Cyber Law and Ethics

Code: OEC-CS801B

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To introduce the cyber world and cyber law in general.
2.	To explain about the various facets of cyber crimes.
3.	To enhance the understanding of problems arising out of online transactions and provoke them to find solutions.
4.	To clarify the Intellectual Property issues in the cyber space and the growth and development of the law in this regard.

Unit	Content	Hrs. / Unit
1.	**Introduction of Cybercrime:** What is cybercrime? Forgery, Hacking, Software Piracy, Computer Network intrusion . **Category Cybercrime:** of how criminals plan attacks, passive attack, Active attacks, cyberstalking.	8
2.	**Cybercrime Mobile & Wireless devices**: Security challenges posted by mobile devices, cryptographic security for mobile devices, Attacks on mobile/cellphones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop	8
3.	**Tools and Methods used in Cybercrime**: Proxy servers, pan word checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow.	8

4.	**Phishing & Identity Theft**: Phishing methods, ID Theft; Online identity method. **Cybercrime & Cybersecurity**: Legal aspects, Indian laws, IT act, Public key certificate.	8

Text book and Reference books:

1. Cyber security by Nina Gobole&SunitBelapune; Pub: Wiley India.

2. Information Security & Cyber laws, Gupta & Gupta, Khanna Publishing House

Course Outcomes:	
After completion of course, students would be:	
OEC- CS801B.1	To understands the conceptual and technical foundation cyber security.
OEC- CS801B.2	To exhibit knowledge to secure corrupted systems, protect personal data, and secure computer networks in an Organization
OEC- CS801B.3	To identify and analyze statutory, regulatory, constitutional, and organizational laws that affects the information technology professional.
OEC- CS801B.4	To apply case law and common law to current legal dilemmas in the technology field.
OEC- CS801B.5	To apply diverse viewpoints to ethical dilemmas in the information technology field and recommend appropriate actions,
OEC- CS801B.6	To understand principles of web security and to guarantee a secure network by monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools.

Mobile Computing

Code: OEC-CS801C

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To describe and analyse the network infrastructure requirements to support mobile devices and users.
2.	To illustrate the concepts, techniques, protocols and architecture employed in wireless local area networks, cellular networks, and perform basic requirements analysis

3.	To apply techniques and current network technologies to the consideration of next generation technologies

Pre-Requisite:	
1.	Understanding of computer networks.

Unit	Content	Hrs. / Unit
1.	Introduction to Personal Communications Services (PCS): PCS Architecture, Mobility management, Networks signaling. Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signaling.	5
2.	General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.	5
3.	Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless markup Languages (WML). Wireless Local Loop (WLL): Introduction to WLL Architecture, wireless Local Loop Technologies.	7
4.	Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G	7
5.	Global Mobile Satellite Systems; case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols.	7
6.	Server-side programming in Java, Pervasive web application architecture, Device independent example application	8

Text book and Reference books:

1. "Pervasive Computing", Burkhardt, Pearson

2. "Mobile Communication", J. Schiller, Pearson

3. "Wireless and Mobile Networks Architectures", Yi-Bing Lin &ImrichChlamtac, John Wiley & Sons, 2001

4. "Mobile and Personal Communication systems and services", Raj Pandya, Prentice Hall of India, 2001.

5. "Guide to Designing and Implementing wireless LANs", Mark Ciampa, Thomson learning, Vikas Publishing House, 2001.

6. "Wireless Web Development", Ray Rischpater, Springer Publishing,

7. "The Wireless Application Protocol", Sandeep Singhal, Pearson.

8. "Third Generation Mobile Telecommunication systems", by P.Stavronlakis, Springer Publishers,

9. Brijesh Gupta "Mobile Computing", Khanna Publishing House, New Delhi

Course Outcomes:	
After completion of course, students will be able to	
OEC- CS801C.1	Understand the concept of mobile communication.
OEC- CS801C.2	Analyze the basics of mobile Computing.
OEC- CS801C.3	Describe the functionality of Mobile IP and Transport Layer.
OEC- CS801C.4	Classify different types of mobile telecommunication systems.
OEC- CS801C.5	Demonstrate the Adhoc networks concepts and its routing protocols.
OEC- CS801C.6	Make use of mobile operating systems in developing mobile applications.

Robotics

Code: OEC-CS801D

Contacts: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To introduce the concepts of Robotic system, its components and instrumentation and control related to robotics.

Pre-requisite:	
1.	Multivariable calculus, linear algebra, and introduction to computing.

Unit	Content	Hrs. / Unit
1.	**Introduction**: Introduction -- brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.	1
2.	**Elements of robots– links, joints, actuators, and sensors** Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC	5

	servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.	
3.	**Kinematics of serial robots** Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator.	4
4.	**Kinematics of parallel robots** Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.	5
5.	**Velocity and static analysis of robot manipulators** Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.	5
6.	**Dynamics of serial and parallel manipulators** Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics, Commercially available multi-body simulation software (ADAMS) and Computer algebra software Maple.	4
7.	Motion planning and control Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in nonlinear control of manipulators.	6
8.	Modeling and control of flexible robots Models of flexible links and joints, Kinematic modeling of multilink flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations results, Experiments with a planar two-link flexible manipulator.	4

9.	Modeling and analysis of wheeled mobile robots 3Introduction and some well-known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three wheeled WMR's on uneven terrain, Simulations using Mat lab and ADAMS.	3
10.	Selected advanced topics in robotics Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE's).	3

Text book and Reference books:

1. Robotics Process Automation, Khanna Publishing House

2. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014

3. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.

Course Outcomes:	
After completion of course, students will be able to	
OEC- CS801D.1	Understand the knowledge in robotics, robot structures and their workspace.
OEC- CS801D.2	Develop skills in performing spatial transformations associated with rigid body motions.
OEC- CS801D.3	Develop skills in perform kinematics analysis of robot systems.
OEC- CS801D.4	Analyze knowledge of the singularity issues associated with the operation of robotic systems.
OEC- CS801D.5	Apply knowledge and analysis skills associated with trajectory planning.
OEC- CS801D.6	Provide knowledge and skills associated with robot control.

Soft Skill & Interpersonal Communication

Code: OEC-CS 801E

Contact: 3L

Theory: 3 hrs. / Week

Credit Points: 3

Objective:	
1.	To improve the communication skills to enrich personality development, Computing skills of the students.
2.	To enhance the employability of the students. The courses will help to bridge the gap between the skill requirements of the employer or industry and the competency of the students.

Unit	Content	Hrs. / Unit
1.	Introduction: A New Approach To Learning, Planning And Goal-Setting, Human Perceptions: Understanding People, Types Of Soft Skills: Self-Management Skills, Aiming For Excellence: Developing Potential And Self-actualization, Need Achievement And Spiritual Intelligence.	5
2.	Conflict Resolution Skills: Seeking Win-Win Solution, Inter-Personal Conflicts: Two Examples, Inter-Personal Conflicts: Two Solutions, Types Of Conflicts: Becoming A Conflict Resolution Expert Types Of Stress: Self-Awareness About Stress, Regulating Stress: Making The Best Out Of Stress.	5
3.	Habits: Guiding Principles, Habits: Identifying Good And Bad Habits, Habits: Habit Cycle, Breaking Bad Habits, Using The Zeigarnik Effect For Productivity And Personal Growth, Forming Habits Of Success.	5
4.	Communication: Significance Of Listening, Communication: Active Listening, Communication: Barriers To Active Listening, Telephone Communication: Basic Telephone Skills , Telephone Communication: Advanced Telephone Skills, Telephone Communication: Essential Telephone Skills	5
5.	Technology And Communication: Technological Personality, Technology And Communication: Mobile Personality?, Topic: Technology And Communication: E-Mail Principles, Technology And Communication: How Not To Send E-Mails!, Technology And Communication: Netiquette, Technology And Communication: E-Mail Etiquette	5
6.	Communication Skills: Effective Communication, Barriers To Communication: Arising Out Of Sender/Receiver's Personality, Barriers To Communication: Interpersonal Transactions, Barriers To Communication: Miscommunication, Non-Verbal Communication: Pre-Thinking Assessment-1, Non-Verbal Communication: Pre-Thinking Assessment-2	5
7.	Nonverbal Communication: Introduction And Importance, Non-Verbal	5

	Communication: Issues And Types, Non-Verbal Communication: Basics And Universals, Nonverbal Communication: Interpreting Nonverbal Cues, Body Language: For Interviews, Body Language: For Group Discussions	
8.	Presentation Skills: Overcoming Fear, Presentation Skills: Becoming A Professional, Presentation Skills: The Role Of Body Language, Presentation Skills: Using Visuals, : Reading Skills: Effective Reading, Human Relations: Developing Trust And Integrity	5

TEXT BOOKS AND REFERENCE:

1. S Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman& Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
4. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.
5. Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.

Course Outcomes:	
After completion of course, students would be:	
OEC-CS 801E.1	Effectively communicate through verbal/oral communication and improve the listening skills.
OEC-CS 801E.2	Write precise briefs or reports and technical documents.
OEC-CS 801E.3	Actively participate in group discussion / meetings / interviews and prepare & deliver presentations.
OEC-CS 801E.4	Become more effective individual through goal/target setting, self motivation and practicing creative thinking.
OEC-CS 801E.5	Function effectively in multi-disciplinary and heterogeneous fields of education.
OEC-CS 801E.6	Function effectively in teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality.

Department of Computer Science and Engineering
Haldia Institute of Technology
An Autonomous Institution (An Institution of ICARE)

Industry Internship

Code: TR CS 871

Contact:

Credit Points: 3

Industry Internship
OBJECTIVES Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training: • Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry. • Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job. • Exposure to the current technological developments relevant to the subject area of training. • Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions. • Create conditions conducive to quest for knowledge and its applicability on the job. • Learn to apply the Technical knowledge in real industrial situations. • Gain experience in writing Technical reports/projects. • Expose students to the engineer's responsibilities and ethics. • Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control. • Promote academic, professional and/or personal development. • Expose the students to future employers. • Understand the social, economic and administrative considerations that influence the working environment of industrial organizations • Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

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INTERNSHIP GUIDELINES:

The T&P cell will arrange internship for students in industries/organization after second, fourth and six/seventh semester(s) or as per AICTE/ affiliating University guidelines. The general procedure for arranging internship is given below:

- **Step 1:** Request Letter/ Email from the office of Training & Placement cell of the college should go to industry to allot various slots of 4-6 weeks during summer vacation as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training. (Sample attached)

- **Step 2:** Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students in the office of Training & Placement through concerned department. Based on the number of slots agreed to by the Industry, TPO will allocate the students to the Industry. In addition, the internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by the TPO or other members of the T&P cell / Faculty members who are particularly looking after the Final/Summer Internship of the students.

- **Step 3:** Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

- **Step 4:** Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department office/TPO with the consent of Industry persons/ Trainers. (Sample Attached)

- **Step 5:** Students will submit training report after completion of internship.

- **Step 6:** Training Certificate to be obtained from industry.

- **Step 7:** List of students who have completed their internship successfully will be issued by Training and Placement Cell.

Course Outcomes:	
On completion of the course students will be able to	
TR-CS 871.1	Student is able to construct the company profile by compiling the brief history, management structure, products / services offered, key achievements and market performance for his / her organization of internship.
TR-CS 871.2	For his / her organization of internship, the student is able to assess its Strengths, Weaknesses, Opportunities and Threats (SWOT).
TR-CS 871.3	Student is able to determine the challenges and future potential for his / her internship organization in particular and the sector in general.
TR-CS 871.4	Student is able to test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period.
TR-CS 871.5	Student is able to apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship organization.
TR-CS 871.6	Student is able to analyze the functioning of internship organization and recommend changes for improvement in processes.

Project-II

Code: PROJ-CS 881

Contact: 12P

Credit Points: 6

Project Work II & Dissertation
The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under guidance, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include: 1. In depth study of the topic assigned in the light of the Report prepared under EC P1; 2. Review and finalization of the Approach to the Problem relating to the assigned topic; 3. Preparing an Action Plan for conducting the investigation, including team work; 4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed; 5. Final development of product/process, testing, results, conclusions and future directions;

6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.

Course Outcomes:	
After completion of course, students would be:	
PROJ- CS881.1	To determine the software and hardware requirements from implementation perspective of Project-II
PROJ- CS881.2	To interpret the system design of project-I in to executable code(s) using modern programming languages to Build the system.
PROJ- CS881.3	To test and validate the developed system following standards testing techniques.
PROJ- CS881.4	To adapt the management techniques to handle a project as a whole.
PROJ- CS881.5	To justify the project work with technical documentation, presentation, and discussions as a group to share knowledge.
PROJ- CS881.6	To determine all the system development phases towards the completion of the Project and analyze/compare the result(s); evaluate and maximize system performances which contribute to lifelong learning.