Semester V

Sr. No.	Course Codes	Nomenclature of the Courses	Hours per week			Credits	Internal	External
			L	T	P			
1.	PCC-CSEAI301-T	Machine Learning	3	0	0	3	30	70
2.	PCC-CSEAI302-T	Evolutionary and Swarm Intelligence for Optimization	3	0	0	3	30	70
3.	PCC-CSEAI303-T/ PCC-CSE306-T/ PCC-IT303-T	Formal Language and Automata Theory	3	0	0	3	30	70
4.	PCC-CSEAI304-T/ PCC-CSE206-T/ PCC-IT301-T	Computer Networks	3	0	0	3	30	70
5.	OEC-T	Open Elective Course be opted by students	3	0	0	3	30	70
6.	HSMC301-T	Economics for Engineers	2	0	0	2	30	70
7.	MC104-T	*Essence of Indian Traditional Knowledge	3	0	0	0	30	70
8.	PCC-CSEAI301-P	Machine Learning Lab.	0	0	4	2	50	50
9.	PCC-CSEAI302-P	Evolutionary and Swarm Intelligence for Optimization Lab.	0	0	4	2	50	50
10	INT-CSEAI301	Industrial Training I	0	0	0	2	100	-
Total			20	0	8	23	410	590

*** It is a non-credit qualifying course only.**

SEMESTER VI

Sr. No.	Course Codes	Nomenclature of the Courses	Hours per week			Credits	Internal	External
			L	T	P			
1.	PCC-CSEAI305-T	Neural Networks	3	0	0	3	30	70
2.	PCC-CSEAI306-T	Cloud Computing	3	0	0	3	30	70
3.	PCC-CSEAI307-T/ PCC-CSE208-T/ PCC-IT208-T	Analysis and Design of Algorithms	3	0	0	3	30	70
4.	PEC-CSEAI301-T to PEC-CSEAI305-T	Professional Elective Course to be opted by students **(Electives I)**	3	0	0	3	30	70
5.	HSMC302-T	Fundamentals of Management for Engineers	2	0	0	2	30	70
6.	OEC-T	Open Elective Course be opted by students	3	0	0	3	30	70
7.	PCC-CSEAI305-P	Neural Networks Lab.	0	0	3	1.5	50	50
8.	PCC-CSEAI306-P	Cloud Computing Lab.	0	0	3	1.5	50	50
9.	PROJ-CSEAI301	Minor Project I	0	0	4	2	50	50
Total			17		10	22	330	570
*4-6 weeks Industrial Training after completion of VI semester								

*** A 4-6 weeks industrial training/internship is mandatory after the completion of the VIth semester. The training / internship will be evaluated in the VIIth semester.**

List of Electives I

1. PEC-CSEAI301-T/ PCC-CSE301-T/ PEC-IT402-T: Computer Graphics
2. PEC-CSEAI302-T/ PEC-CSE409-T/PEC-IT409-T: Internet of Things
3. PEC-CSEAI303-T/ PEC-CSE304-T/ PEC-IT304-T: Bio-informatics
4. PEC-CSEAI304-T: Information Retrieval Systems
5. PEC-CSEAI305-T: Microprocessor and Embedded Systems
6. Any one of the MOOC not studied earlier and of equal credits (3)

*A student can do only one course from MOOC in lieu of elective courses in a semester with the approval of the Chairperson of the Department.

Machine Learning

General Course Information

Course Code: PCC-CSEAI301-T Course Credits:3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basics of Linear Algebra and Statistics, Basics of Probability Theory, Data Structures and Computer Algorithms.

About the Course:

Machine learning is the study of computer algorithms that improve their performance through experience. Machine learning draws its conceptual foundation from the fields like artificial intelligence, probability and statistics, computational complexity, cognitive science, biology and information theory etc. The course introduces some of the key machine learning algorithms and the theory that form the backbone of these algorithms. The examples of such algorithms are classification algorithms for learning patterns from data, clustering algorithms for grouping objects based on similarity, neural network algorithms for pattern recognition, genetic algorithms for searching large and complex search spaces etc.

Course Outcomes: By the end of the course students will be able to:

CO1. **outline** the concepts and working of different machine learning algorithms. (LOTS: Level 1: Remember)
CO2. **interpret** the results of machine learning algorithms. (LOTS: Level 2: Understand)
CO3. **apply** machine learning concepts and algorithms to given problems. (LOTS: Level 3: Apply)
CO4. **analyse** the performance of machine learning algorithms. ((HOTS: Level 4: Analyse)
CO5. **compare** different machine learning algorithms. (HOTS: Level 5: Evaluate)
CO6. **design** machine learning algorithms for optimization, pattern recognition and search problems. (HOTS: Level 6: Create)

Course content

Unit I

Introduction: Well-Posed Learning Problems, Designing a Learning System, Perspectives and Issues in Machine Learning, Examples of Machine Learning Applications

Concept Learning and General-to-Specific Ordering: the concept learning task, Concept learning as search, Finding a maximally specific hypothesis, Version spaces and candidate elimination algorithm, Remarks on version spaces and candidate-eliminations, Inductive bias.

Unit II

Bayesian Learning: Bayes Theorem, Bayes Theorem and Concept learning, Maximum likelihood and least-squared error hypotheses, Maximum likelihood and least square hypothesis, Maximum likelihood hypothesis for Predicting Probabilities, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Bayesian Belief Network.

Unit III

Artificial Neural Network: Introduction, Neural Network Representation, Perceptron: Representational Power of Perceptrons, Perceptron Training Rule, Gradient Descent Algorithm.

Kernel Machines: Introduction, Optimal Separating Hyperplane, Support Vector Machine (SVM), The Non-separable Case: Soft Margin Hyperplane, Kernel Trick, Vectorial Kernels, Defining Kernels, Multiclass Kernel Machines. Kernel Machines for Regression,

Unit IV

Dimensional Reduction: Introduction, Subset selection, Principal Component analysis, Feature Embedding, Factor analysis, Probabilistic PCA, Singular Value Decomposition and Matrix Factorization, Linear Discriminant analysis.

Reinforcement Learning: Introduction, Elements of Reinforcement Learning, the Learning Task, Q Learning, Deterministic Rewards and Actions, Non-Deterministic Rewards and Actions, Temporal Difference Learning

T**ext and Reference Books:**

1. Tom M. *Mitchell, Machine Learning*, McGraw-Hill, 1997.
2. Ethem Apaydin, *Introduction to Machine Learning*, 3rd Edition, MIT Press, 2014.
3. Bishop Christopher, *Pattern Recognition and Machine Learning*, Springer Verlag, 2006.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference and Prediction*, Springer, 2nd edition, 2009.
5. J. Han and M. Kamber, *Data Mining Concepts and Techniques*, 3rd Edition, Elsevier, 2012

CO-PO Articulation Matrix: Machine Learning (PCC-CSEAI301-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Outline** the concepts and working of different machine learning algorithms. (LOTS: Level 1: Remember)	1	_	_	_	_	_	_	_	_	_	_	_	_	1
CO2. **Interpret** the results of machine learning algorithms. (LOTS: Level 2: Understand)	1	1	_	_	_	_	_	_	_	_	_	_	_	2
CO3. **Apply** machine learning concepts and algorithms to given problems. (LOTS: Level 3: Apply)	2	2	_	_	1	_	_	_	_	_	_	_	_	2
CO4. **Analyse** the performance of machine learning algorithms. ((HOTS: Level 4: Analyse)	2	3	_	1	2	_	_	_	_	_	_	_	_	3
CO5. **Compare** different machine learning algorithms. (HOTS: Level 5: Evaluate)	3	3	_	2	2	_	_	_	_	_	_	_	_	3
CO6. **Design** machine learning algorithms for optimization, pattern recognition and search problems. (HOTS: Level 6: Create)	3	3	_	3	3	_	_	_	_	_	_	_	_	3
Level of Attainments PCC-CSEAI301-T														

Evolutionary and Swarm Intelligence for Optimization

General Course Information

Course Code: PCC-CSEAI302-T Course Credits: 3 Type: Professional Core Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basic understanding of computer algorithms, familiarity with basic optimization methods

About the Course:

This course provides the introduction to the concepts, principles and applications of evolutionary and swarm optimization techniques. It covers evolutionary computing, particle swarm optimization, ant colony optimization algorithms. It offers an opportunity to understand and apply these nature inspired algorithms to solve complex optimization problems which otherwise cannot be solved within reasonable time due to their high complexity.

Course Outcomes: By the end of the course students will be able to:

CO1. **outline** the terminology and concepts in evolutionary and swarm optimization (LOTS: Level 1: Remember)
CO2. **explain** the working of evolutionary and swarm optimization algorithms. (LOTS: Level 2: Understand)
CO3. **solve** optimization problems by using evolutionary and optimization algorithms. (LOTS: Level 3: Apply)
CO4. **compare** evolutionary and swarm intelligence algorithms. (HOTS: Level 4: Analyse)
CO5. **judge** the performance of evolutionary and swarm intelligence algorithms on diverse optimization problems (HOTS: Level 5: Evaluate)
CO6. **design** novel evolutionary and swarm intelligence algorithm for optimization problems. (HOTS: Level 6: Create)

Course content

Unit I

History and need for nature inspired algorithm.
Basics of Genetic Algorithm (GA) and its working: Encoding, Fitness evaluation, Selection, Crossover and Mutation operators. Parameters of GA.
Different Encoding Schemes, Selection and Sampling mechanisms and GA Operators, Designing GAs for solving problems regarding function optimization.

Unit II

Local and Global Convergence, Linear Scaling, Multi-objective optimization, Multi-Objective GAs, Working of NSGA-II. Solving function optimization, knapsack, numeric optimization, routing and scheduling problems using GA, parallel genetic algorithms.

Unit III

Swarm Intelligence, Basic of Particle Swarm Optimization (PSO): Definitions and Concepts of PSO, Working of PSO, swarm size, information links, initialization, Equations of motion, interval confinement, proximity distributions, distribution bias, explosion and maximum velocity, parameters of PSO, Local best and global best PSO, Solving function optimization, knapsack, numeric optimization, routing and scheduling problems using PSO.

Unit IV

Ants' foraging behaviour and optimization, Artificial Ants, Artificial Ants and minimum cost paths, combinatorial optimization, Ant Colony Optimization (ACO) Metaheuristic, Applying ACO, Theoretical considerations on ACO, Convergence Proof, ACO and Model based search, solving travelling sales person and other similar problems using ACO, Ant Systems and its successors, ACO plus local search.

Text and Reference Books:

1. Zbigniew Michalewicz, *Genetic algorithms +Data Structures = Evolution Programs*, Springers-Verlag, 1999.
2. David.E. Goldberg, *Genetic Algorithms in Search, Optimization and machine learning*, Addison Wesley, 1999.
3. Marco Dorigo, Thomas, Stutzle, *Ant Colony Optimization*, MIT Press, 2004.
4. Helio J.C. Barbosa, "*Ant Colony Optimization - Techniques and Applications*", Intech 2013
5. Maurice Clerc, *Particle Swarm Optimization*, ISTE, Ltd., London, UK, 2006.

CO-PO Articulation Matrix: Evolutionary and Swarm Intelligence for Optimization (PCC-CSEAI302-T)

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO13**	**PSO14**
CO1. **Outline** the terminology and concepts in evolutionary and swarm optimization (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-		1
CO2. **Explain** the working of evolutionary and swarm optimization algorithms. (LOTS: Level 2: Understand)	1	1	-	1	-	-	-	-	-	-	-	-		2
CO3. **Solve** optimization problems by using evolutionary and optimization algorithms. (LOTS: Level 3: Apply)	2	2	-	2	2	-	-	-	-	-	-	-		3
CO4. **Compare** evolutionary and swarm intelligence algorithms. (HOTS: Level 4: Analyse)	2	2	-	2	1	-	-		-	-	-	-		3
CO5. **Judge** the performance of evolutionary and swarm intelligence algorithms on diverse optimization problems. (HOTS: Level 5: Evaluate)	3	3	-	3	2	-	-	-	-	-	-	-		3
CO6. **Design** novel evolutionary and swarm intelligence algorithm for optimization problems. (HOTS: Level 6: Create)	3	3		3	3									3
Level of Attainments PCC-CSEAI302-T														

Formal Language and Automata Theory

General Course Information

Course Code: PCC-CSEAI303-T/ PCC-CSE306-T/ PCC-IT303-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: The students are expected to have a strong background in the fundamentals of discrete mathematics like in the areas of symbolic logic, set, induction, number theory, summation, series, combinatorics, graph, recursion, basic proof techniques.

About the Course:

Formal Languages and Automata theory presents the theoretical aspects of computer science, which lay the foundation for students of Computer Science. The course introduces some fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton, and Turing machine.

Course Outcomes: By the end of the course students will be able to:

CO1. **define** terminology related to theory of computation. (LOTS: Level1: Remember)
CO2. **explain** the basic concepts and applications of Theory of Computation. (LOTS: Level 2: Understand)
CO3. **apply** the principles of Theory of Computation to solve computational problems. (LOTS: Level3: Apply)
CO4. **contrast** the hierarchy of grammars (HOTS: Level 5: Evaluate).
CO5. **design** various types of automata for given problems. (HOTS: Level6: Create)

Course content

Unit I

Finite Automata and Regular Expressions: Finite State Systems, Basic Definitions Non-Deterministic finite automata (NDFA), Deterministic finite automata (DFA), Equivalence of DFA and NDFA Finite automata with E-moves, Regular Expressions, Equivalence of finite automata and Regular Expressions, Regular expression conversion and

vice versa, Conversion of NFA to DFA by Arden's Method.

Unit II

Introduction to Machines: Concept of basic Machine, Properties and limitations of FSM. Moore and mealy Machines, Equivalence of Moore and Mealy machines.

Properties of Regular Sets: The Pumping Lemma for Regular Sets, Applications of the pumping lemma, Closure properties of regular sets, Myhill-Nerode Theorem and minimization of finite Automata, Minimization Algorithm.

Unit III

Grammars: Definition, Context free and Context sensitive grammar, Ambiguity regular grammar, Reduced forms, Removal of useless Symbols and unit production, Chomsky Normal Form (CNF), Griebach Normal Form (GNF).

Pushdown Automata: Introduction to Pushdown Machines, Application of Pushdown Machines

Unit IV

Turing Machines: Deterministic and Non-Deterministic Turing Machines, Design of T.M, Halting problem of T.M., PCP Problem.

Chomsky Hierarchies: Chomsky hierarchies of grammars, Unrestricted grammars, Context sensitive languages, Relation between languages of classes.

Computability: Basic concepts, Primitive Recursive Functions.

Text and Reference Books:

1. Hopcroaft & O. D. Ullman, R Mothwani, *Introduction to automata theory, language &computations*, AW, 2001.
2. K. L. P. Mishra & N. Chandrasekaran, *Theory of Computer Sc. (Automata, Languages and computation)*, PHI, 2000.
3. PeterLinz, *Introduction to formal Languages & Automata*, Narosa, Publication,2001.
4. Ramond Greenlaw and H. James Hoover, *Fundamentals of the Theory of Computation-Principles and Practice*, Harcourt India Pvt. Ltd.,1998.
5. H.R. Lewis & C.H. Papaditriou, *Elements of theory of Computation*, PHC, 1998.
6. John C. Martin, *Introduction to Languages and the Theory of Computation*, T.M.H.,2003.

CO-PO Articulation Matrix: Formal Language and Automata Theory (PCC-CSEAI303-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Define** terminology related to theory of computation. (LOTS: Level1: Remember)	1	–	–	–	–	–	–	–	–	–	–	–	3	–
CO2. **Explain** the basic concepts and applications of Theory of Computation. (LOTS: Level 2: Understand)	1	–	–	–	–	–	–	–	–	–	–	–	3	–
CO3. A**pply** the principles of Theory of Computation to solve computational problems. (LOTS: Level3: Apply)	2	1	2	–	2	–	–	–	–	–	–	–	3	–
CO4. **Contrast** the hierarchy of grammars (HOTS: Level 5: Evaluate).	3	2	2	2	2	–	–	–	–	–	–	–	3	–
CO5. **Design** various types of automata for given problems. (HOTS: Level6: Create)	3	3	2	2	2	–	–	–	–	–	–	–	3	–
Level of Attainments PCC-CSEAI303-T														

Computer Networks

General Course Information

Course Code: PCC-CSEAI304-T/ PCC-CSE206-T/ PCC-IT301-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basic knowledge of Digital and Analog Communication.

About the Course:

This course has been designed with an aim to provide students with an overview of the concepts and fundamentals of data communication and computer networks. The learner is given an opportunity to grasp various algorithms for routing of data, forwarding data and switching the data from hop to hop. Layered Architecture adds value to the subject contents.

Course Outcomes: By the end of the course students will be able to:

CO1. **outline** various models, topologies and devices of Computer Networks. (LOTS: Level 1: Remember)
CO2. **explain** the functions of various layers in Network Reference Model. (LOTS: Level 2: Understand)
CO3. **apply** different network concepts in various network communication protocols. (LOTS: Level 3: Apply)
CO4. **analyse** performance of various protocols in different scenarios. (HOTS: Level 4: Analyse)
CO5. **design** network for an organisation. (HOTS: Level 6: Create)

Course content

Unit I

Data communication: Components, Data representation and Data flow; Network: Uses, Topologies, Network Services, OSI and TCP/IP Reference Models; Network categories: LAN, MAN, WAN; Guided Transmission Media, Wireless Transmission Media, Switching Techniques: Circuit Switching, Packet Switching, Message Switching, Networking Devices**:** Hubs, Repeaters, Bridges, Modems, Switches, Routers, and Gateways.

Unit II

Data Link Layer-design issues, Framing & Error Handling: Framing Protocols, Error detection and correction mechanisms; Flow Control Protocols: Stop-and-wait, Sliding Window protocols: Go-back-N and Selective Repeat;

Medium Access sub layer: Channel allocation methods, Multiple Access Communication: Random Access-ALOHA, Slotted-ALOHA, CSMA, CSMA-CD, LAN Standards: Ethernet, Fast Ethernet & Gigabit Ethernet.

Unit III

Network Layer-Design issues, store and forward packet switching connection less and connection-oriented networks, Routing algorithms: optimality principle, shortest path, flooding, Distance Vector Routing, Count to Infinity Problem, Link State Routing, Hierarchical Routing, Congestion control algorithms, admission control.

Internetworking: IPV4 and IPV6, IP Addressing (Classful Addressing, Private IP Addresses, Classless Addressing, Sub-netting), ARP, RARP, ICMP, Internet Routing Protocol.

Unit IV

Transport Layer: Transport layer Services: Addressing, Multiplexing, Flow control, Buffering and Error control. Internet Transport Protocols: UDP, TCP, TCP Segment, TCP Connection.

Application Layer: Introduction to DNS, FTP, TELNET, HTTP, SMTP, Electronic Mail, WWW and Multimedia.

Text and Reference Books:

1. Andrew S Tanenbaum, *Computer Networks*, 5th Edition, Pearson publications, 2010.
2. Forouzan, *Data Communication and networking* ,5th Edition, Tata McGraw Hill, 2012.
3. William Stalling, *Data & Computer Communication* 6th edition, LPE Pearson Education, 2013.
4. Todd Lammle, *CCNA Study Guide*,6th Edition, 2013.
5. RFCs and Internet Drafts available from Internet Engineering Task Force.

CO-PO Articulation Matrix: Computer Networks (PCC-CSEAI304-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Outline** various models, topologies and devices of Computer Networks. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2. **Explain** the functions of various layers in Network Reference Model. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3. **Apply** different network concepts in various network communication protocols. (LOTS: Level 3: Apply)	2	1	-	-	2	-	-	-	-	-	-	-	3	-
CO4. **Analyse** performance of various protocols in different scenarios. (HOTS: Level 4: Analyse)	2	2	2	1	2	-	-	-	-	-	-	-	3	-
CO5. **Design** network for an organisation. (HOTS: Level 6: Create)	3	2	2	-	2	-	-	-	-	-	-	-	3	-
Level of Attainments PCC-CSEAI304-T														

Economics for Engineers

General Course Information

Course Code: HSMC301-T Course Credits: 2 Type: Humanities and Social Sciences including Management courses Contact Hours: 2 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: None

About the Course:

This course is designed to provide the elementary and essential knowledge of economics relevant to their profession as engineers. The graduating engineers will learn about the basic principles of economics and cost benefit analysis for various economic alternatives. The course also gives an initial exposure to issues and challenges for sustainable development.

Course Outcomes: By the end of the course students will be able to:

CO1. **outline** the principles of economics in general and economics in Indian context. (LOTS: Level 1: Remember)
CO2. **discuss** concepts related to economics in general and particularly relevant to Indian scenario. (LOTS: Level 2: Understand)
CO3. **apply** the principles of economics for solving problems related to Engineering sector. (LOTS: Level 3: Apply)
CO4. **carry** out cost/benefit/, life cycle and breakeven analyses on one or more economic alternatives. (HOTS: Level 4: Analyse)
CO5. **judge** the issues and challenges of sustainable development. (HOTS: Level 5: Evaluate)

Course content

Unit I

Definition of Economics- various definitions, Nature of economic problem, Production possibility curve, Economics laws and their nature. Relation between Science, Engineering, Technology and Economics. Concepts

and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility - its practical applications and importance.

Unit II

Meaning of Demand, Individual and Market demand schedules, Law of demand, shape of demand curve, Elasticity of Demand, measurement of elasticity of demand, factors affecting elasticity of demand, practical importance and applications of the concept of elasticity of demand.

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

Unit III

Various concepts of cost- Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost etc. in short run and long run both.

Meaning of Market, Types of Market - Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)

Issues, Strategies and challenges for sustainable development for developing economies

Unit IV

Elements of Business/Managerial Economics and forms of organizations, Cost &Cost Control Techniques, Types of Costs, Lifecycle Costs, Budgets, Break Even Analysis, Capital Budgeting, Application of linear Programming. Investment Analysis- NPV, ROI, IRR, Payback Period, Depreciation, Time Value of Money (present and future worth of cash flows).

Business Forecasting- Elementary techniques. Statements- Cash Flows, Financial. Case Study Method. Nature and Characteristics of Indian Economy (brief and elementary introduction). Privatization - meaning, merits, and demerits. Globalisation of Indian economy- merits and demerits.

WTO and TRIPs agreements.

T**ext and Reference Books:**

1. Alfred William Stonier, D. C. Hague, *A textbook of Economic Theory*, 5th edition, Longman Higher Education, 1980.
2. K. K. Dewett, M. H. Navalur, *Modem Econornic Theory*, S. Chand, 2006.
3. H. L. Ahuja, *Modern Microeconomic: Theory and Applications*, S. Chand, 2017.
4. N. Gregory Mankiw, *Principles of Economics*, 7th edition, South-Western College Publishing, 2013.
5. Ruddar Dutt & K.P.M. Sundhram, *Indian Economy*, S. Chand, 2004.
6. V. Mote, S. Paul, G. Gupta, *Managerial, Economics*, McGraw Hill Education, 2017.
7. Saroj Pareek, *Textbook of Business Economics*, Neha Publishers and Distributors, 2013.
8. William McDonough and Michael Braungart, *Cradle to Cradle Remaking the Way We Make Things*, North Point Press, New York, 2002.
9. Sustainable Development Challenges, *World Economic and Social Survey*, United Nations Publication, 2013.

CO-PO Articulation Matrix: Economics for Engineers (HSMC301-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Outline** the principles of economics in general and economics in Indian context particularly for public sector agencies and private sector businesses. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2. **Discuss** concepts related to economics in general and particularly relevant to Indian scenario. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3. **Apply** the principles of economics for solving problems related to Engineering sector. (LOTS: Level 3: Apply)	2	2	2	2	2	-	-	-	-	-	-	-	-	-
CO4. **Carry** out benefit/cost, life cycle and breakeven analyses on one or more economic alternatives. (HOTS: Level 4: Analyse)	3	2	2	3	3	-	-	-	2	-	-	3	-	-
CO5. **Judge** the issues and challenges of sustainable development. (HOTS: Level 4: Evaluate)	3	_	3	3	_	_	3	-		3	3	3	-	-
Level of Attainments HSMC301-T														

Essence of Indian Traditional Knowledge

General Course Information

Course Code: MC104-T Course Credits: 0 Type: Mandatory course Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Internal Examination (30 marks):** • Three minor tests each of 20 marks including third minor in open book mode will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks) • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Two questions are to be set from each unit. All questions will carry equal marks. • A candidate is required to attempt 05 questions in all, one compulsory and remaining four questions selecting one from each of the four units.

Pre-requisites: None

About the Course:

This course is designed to acquaint students with Indian knowledge traditions It introduces students to Vedic period, Post Vedic period, Sufi and Bhakti Movement in India, the ancient scientists of India and social reform movements of 19th century.

Course Outcomes: By the end of the course students will be able to:

CO1. **recognise** the forms and sources of Indian traditional knowledge. (LOTS: Level 1: Remember)
CO2. **identify** the contribution of the great ancient Indian scientists and spiritual leaders to the world of knowledge. (LOTS: Level 2: Understand)
CO3. **apply** the reasoning based on objectivity and contextual knowledge to address the social and cultural issues prevalent in Indian society. (LOTS: Level 3: Apply)
CO4. **differentiate** the myths, superstitions from reality in context of traditional knowledge to protect the physical and social environment. (LOTS: Level 4: Evaluate)
CO5. **suggest** means of creating a just and fair social environment that is free from any prejudices and intolerance for different opinions and cultures. (LOTS: Level 6: Create)

Unit I

Introduction to Indian Tradition Knowledge: Defining traditional knowledge, forms, sources and dissemination of traditional knowledge.

Vedic Period: Vedas and Upanishads, Yogsutras of Patanjali

Post Vedic Period: Budhism, Janism and Indian Materialism: Charvak School of Thought

Unit II

Sufi and Bhakti Movement (14th to 17th century): सगुण-निर्गुणभक्ति, Sufism and Sufi saints, Kabir, Nanak and Guru Jambheshwar ji Maharaj etc., Composite Culture of Indian sub-continent.

Unit III

Jyotirao Phuleand Savitri Bai Phule and other 19th Century Social Reform Movements;

India's cultural heritage.

Unit IV

India's Contribution to the world of knowledge: प्राचीन भारत के महान वैज्ञानिक: बौधायन, चरक, कौमारभृत्यजीवन, सुश्रुत, आर्यभट, बराहमिहिर, ब्रह्मगुप्त, नागार्जुन, वाग्भट; Astrology and Astronomy, Myths and Reality

T**ext and Reference Books:**

1. A. L. Bhansam, The *Wonder That was India, A Survey of the Culture of the, Indian Sub-Continent before, the Coming of the Muslims*, Vol 1, Groove Press, New York, 1959.
2. S. A. A. Rizvi, *Wonder That was India, A Survey of the History and Culture of the Indian Sub-Continent from the Coming of the Muslims to the British Conquest 1*200-1700, Vol 2, Rupa and Co. 2001.
3. *प्रतियोगितादर्पणअतिरिक्तांकसीरीज–5*भारतीयकलाएवंसंस्कृति,
4. गुणाकरमूले,*प्राचीनभारतकेमहानवैज्ञानिक,*ज्ञानविज्ञानप्रकाशन,नईदिल्ली,1990.
5. B. V. Subbarayappa, *A Historical Perspective of Science in India*, Rupa Publications, New Delhi, 2013.
6. Thich Nhat Hanh, Nguyen Thi Hop, Mobi Ho , *Old Path White Clouds: Walking in the Footsteps of the Buddha*, Parallax Press, 1991.
7. Hermann Hesse, *Siddhartha*, Simon & Brown, 2017.
8. सावित्रीचंद्रशोभा, *हिन्दीभक्तिसाहित्यमेंसामाजिकमूल्यएवंसहिष्णुतावाद,* नेशनलबुकट्रस्ट, इंडिया, 2007.
9. Rosalind O' Hanlon, *Caste Conflict and Ideology, Mahatma Jyotirao Phule and low caste protest in nineteen century*, Western India, Camridge University Press, 2009.
10. Melanie P. Kumar, Savitribai Phule: *Forgotten liberator*, Infochange, 2009.
11. Leah Verghese, Ranjna, and Medha Sundar, *Savitribai, Journey of a Trailblazer*, Azim Prem Ji University, 2014.

CO-PO Articulation Matrix: Essence of Indian Traditional Knowledge (MC104-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Recognise** the forms and sources of Indian traditional knowledge. (LOTS: Level 1: Remember)	-	1		-	-		-	-	-	-	-	1	-	-
CO2. **Identify** the contribution of the great ancient Indian scientists and spiritual leaders to the world of knowledge. (LOTS: Level 2: Understand)	-	2	1	-	-	3	-	-	-	-	-	1	-	-
CO3. **Apply** the reasoning based on objectivity and contextual knowledge to address the social and cultural issues prevalent in Indian society. (LOTS: Level 3: Apply)	-	3	3	2	-	3	-	-	-	-	-	3	-	-
CO4. **Differentiate** the myths, superstitions from reality in context of traditional knowledge to protect the physical and social environment. (LOTS: Level 4: Evaluate)	-	2	3	3	-	3	1	-	-	-	-	3	-	-
CO5. **Suggest** means of creating a just and fair social environment that is free from any prejudices and intolerance for different opinions and cultures. (LOTS: Level 6: Create)	-	3	3	3	-	3	-	-	-	-		3	-	-
Level of Attainments MC104-T														

Machine Learning Lab.

General Course Information

Course Code: PCC-CSEAI301-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours / week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Programming in Java, Python, R and Octave/MATLAB.

About the Course:

In this lab course, students learn to solve optimization, supervised, unsupervised and reinforcement learning problems using machine learning tools. Students will use machine learning tools available in Java, R, Python and MATLAB etc. The lab experiments involve downloading datasets and applying machine learning techniques on these datasets. The course has a special focus on interpreting and visualizing results of machine learning algorithms.

Course Outcomes: By the end of the course students will be able to:

CO1. **implement** machine learning algorithms using modern machine learning tools. (LOTS: Level 3: Apply)
CO2. **analyse** the trends in datasets using descriptive statistics. (HOTS: Level 4: Analyse)
CO3. **apply** descriptive and predictive modelling. (LOTS: Level 3: Apply)
CO4. **compare** machine learning algorithms for a given problem. (HOTS: Level 5: Evaluate)
CO5. **create** lab records of assignment by incorporating problem definitions, design of solutions, results, and interpretations. (HOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments

List of Experiments:

1. Install R/Python/Matlab and learn to use these software packages.
2. Implement perceptron learning with step function. Also show the decision boundary for classification.
3. Two assignments related to clustering algorithms and interpreting the results of these algorithms.
4. Two assignments on ranking or selecting relevant features.
5. Implement feature scaling/normalization.
6. Implement gradient descent algorithm to optimize linear regression and logistic regression algorithm.
7. Apply various evaluation metrics on breast cancer data set after classification using:
    a. ANN (a multilayer perceptron)
    b. SVM
8. In exercise-7 plot decision boundary using *matplotlib*
9. Implement PCA on breast cancer dataset.
10. Draw two-dimensional scatter plot of the breast cancer dataset using the first two principal components as done in exercise 7.
11. Implement SVM with different kernels. The program must classify the “Orange and Apple” dataset with Accuracy as a performance measure.
12. Implement Bayesian theorem and classifier.
13. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
14. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm. Output a description of the set of all hypotheses consistent with the training examples.
15. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
16. Implementation of Q-learning (Reinforcement learning)

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix: Machine Learning Lab. (PCC-CSEAI301-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Implement** machine learning algorithms using modern machine learning tools. (LOTS: Level 3: Apply)	2	3	_	_	3	_	_	_	_	_	_	_	_	3
CO2. **Analyse** the trends in datasets using descriptive statistics. (HOTS: Level 4: Analyse)	2	-	_	2	3	_	_	_	_	_	_	_	_	3
CO3. **Apply** descriptive and predictive modelling. (LOTS: Level 3: Apply)	3	2	_	3	3	_	_	_	_	_	_	_	_	3
CO4. **Compare and contrast** machine learning algorithms for a given problem. (HOTS: Level 5: Evaluate)	3	3	_	3	3	_	_	_	_	_	_	_	_	3
CO5.**Create** lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations. (HOTS: Level 6: Create)	–	–	–	–	–	–	–	–	–	3	–	–	–	–
CO6. **Demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	–	–	–	–	–	–	–	3	3	_	_	3	_	_
Level of Attainments PCC-CSEAI301-P														

Evolutionary and Swarm Intelligence for Optimization Lab.

General Course Information

Course Code: PCC-CSEAI302-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Knowledge of evolutionary and swarm intelligence techniques, Proficiency in R, Python, MATLAB and other AI tools

About the Course:

The objective of this lab is to enable students to use diverse tools for applying Nature Inspired Algorithms.

Course Outcomes: By the end of the course students will be able to:

CO1. **solve** optimization and related problems using evolutionary and swarm intelligence algorithms. (LOTS: Level 3: Apply)
CO2. **usages** of R/Python, MATLAB, and other tools for addressing optimization problems. (LOTS: Level 3: Apply)
CO3. **judge** the performance of Nature Inspired Algorithms. (LOTS: Level 5: Evaluate)
CO4. **design** experiments for implementing Nature Inspired Algorithms for solving complex optimization problems. (LOTS: Level 6: Create)
CO5. **create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create)
CO6. **demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments

List of experiments: (Using MATLAB and its toolboxes)

1. Solve function optimization problems using GA, PSO and ACO.
2. Implementing Genetic Algorithm to solve Traveling Salesperson problems.
3. Implementing Swarm Intelligence Algorithms to solve Traveling Salesperson problems.
4. Compare performance of various Nature Inspired Algorithms on diverse optimization problems.
5. Address feature selection problem using Nature Inspired Algorithms.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix: Evolutionary and Swarm Intelligence for Optimization Lab. (PCC-CSEAI302-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Solve** optimization and related problems using evolutionary and swarm intelligence algorithms. (LOTS: Level 3: Apply)	2	3	_	2	3	_	_	_	_	_	_	_	_	3
CO2. **Usages** of R/Python, MATLAB and other tools for addressing optimization problems. (LOTS: Level 3: Apply)	1	-	_	2	3	_	_	_	_	_	_	_	_	3
CO3. **Judge** the performance of Nature Inspired Algorithms. (LOTS: Level 5: Evaluate)	3	2	_	2	3	_	_	_	_	_	_	_	_	3
CO4. **Design** experiments for implementing Nature Inspired Algorithms for solving complex optimization problems. (LOTS: Level 6: Create)	3	3	_	3	3	_	_	_	_	_	_	_	_	3
CO5.**Create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create).	–	–	–	–	–	–	–	–	–	3	–	–	–	–
CO6.**Demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	–	–	–	–	–	–	–	3	3	–	–	3	–	–
Level of Attainments PCC-CSEAI302-P														

Industrial Training I

General Course Information

Course Code: INT-CSEAI301 Course Credits: 2 Mode: Industrial Training	**Course Assessment Methods (100 Marks)** An internal evaluation is done by internal examiner/(s) appointed by the Chairperson. Significance and originality of the problem addressed, and the solution provided: 20 Knowledge of the problem domain and tool used (VIVA-VOCE):25 Report Writing: 20 Judgement of the skill learnt, and system developed: 20 Level of ethics followed: 15

About the Industrial training:

Students will do an Industrial Training of 4 to 6 weeks after fourth semester. They are expected to learn novel skills and develop some software application during the training period. The training will be evaluated in the fifth semester.

After doing training students will be able to:

CO1. **review** the existing systems for their strengths and weaknesses. (HOTS: Level 4: Analyse)
CO2. **address** novel problems in an original and innovative manner (HOTS: Level 6: Create)
CO3. **select and apply** modern engineering tools. (LOTS: Level 3: Apply)
CO4. **evaluate** the system developed critically with respect to the requirement analysis and other similar systems. (HOTS: Level 5: Evaluate)
CO5. **prepare** training report by organising ideas in an effective manner.
CO6. **follow** ethical practices while doing the training and writing report. (LOTS: Level 3: Apply)

CO-PO Articulation Matrix: Industrial Training I (INT-CSEAI301)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Address** novel problems in an original manner using latest skills (HOTS: Level 6: Create)	3	3	3	2		1	_	_	2	_	1	_	_	_
CO2. **Select and apply** modern engineering tools. (LOTS: Level 3: Apply)	2	_	_	_	3	_	_	_	3	_	_	_	_	_
CO3. **Prepare** training report by organising ideas in an effective manner.	_	_	_	_	_	_	_	_	_	_	_	_	_	_
CO4. **Engage** in lifelong learning. (HOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	_	_	3	_	_
CO5. **Apply** ethical practices while doing the training and writing report. (LOTS: Level 3: Apply	_	_	_	_	_	_	_	3	_	3	_	_	_	_
Level of Attainments INT-CSEAI301														

Neural Networks

General Course Information

Course Code: PCC-CSEAI305-T Course Credits: 3 Type: Professional Core Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basic understanding of Mathematics and Machine Learning.

About the Course:

Neural Networks are important component of Machine Learning. These have ability to discover patterns from input data with or without a teacher. Neural Networks have a very wide spectrum of applications starting from simple pattern recognition to advanced image processing tasks. This course provides a comprehensive foundation of Neural Networks.

Course Outcomes: By the end of the course students will be able to:

CO1. **recognize** the basic vocabulary and functioning of Neural Networks. (LOTS: Level 1: Remember)
CO2. **describe** various kinds of Neural Networks and their learning mechanisms. (LOTS: Level 2: Understand)
CO3. **use** Neural Networks to solve pattern recognition problems. (LOTS: Level 3: Apply)
CO4. **compare** different Neural Networks and their suitability for diverse machine learning tasks. (HOTS: Level 4: Analyse)
CO5. **justify** the use of different Neural Networks in particular situations. (HOTS: Level 5: Evaluate)
CO6. **design** Neural Networks for machine learning problems. (HOTS: Level 6: Create)

Course content

Unit I

Introduction to neural networks: what is a neural network, human brain, feedback, neural network as directed graph, feedback, network architectures, knowledge representations, artificial intelligence and neural networks.

Learning Process: Error Correction learning, memory-based learning, Hebbian learning, competitive learning, Boltzmann learning, credit assignment problem, learning with a teacher, learning without a teacher, learning tasks, memory, adaptation, statistical nature of learning process, statistical learning theory, probability approximately correct model of learning

Unit II

Single Layer Perceptron: Adaptive filtering process, Unconstrained optimization techniques, linear least square filters, least mean square algorithm, learning curves, learning rate annealing technique, perceptron, perceptron convergence theorem.

Multilayer Perceptron: Back Propagation algorithm, XOR Problem, Output representation and decision rule, feature detection, Hessian matrix, generalization, approximation of function, cross validation, network pruning techniques, virtues and limitations of back propagation learning, convolutional networks

Unit III

Radial basis function networks: Cover's theorem on separability of patterns, interpolation problem, regularization theory and networks, generalized Radial basis function networks, approximation properties of RBF networks, comparison of RBF networks and multilayer perceptron.

Self-Organizing Maps: two basic feature mapping models, Self-Organizing Map, SOM algorithm, Properties of feature map, learning vector quantization, hierarchical vector quantization, contextual maps.

Unit IV

Associative Memories: Linear Associator, Basic Concepts of Recurrent Auto associative Memory Retrieval Algorithm, Storage Algorithm, Energy Function Reduction, Capacity of Auto Associative Recurrent Memory, Memory Convergence versus Corruption, Fixed Point Concept, Modified Memory Convergent Toward Fixed Points, Bidirectional Associative Memory, Memory Architecture, Association Encoding and Decoding, Stability Considerations, Multidirectional Associative Memory.

Applications of Neural Networks: Character Recognition Networks, Connectionist Expert Systems for Medical Diagnosis

T**ext and Reference Books:**

1. Simon S Haykin, *Neural Networks, A Comprehensive Foundations*, PHI, Second Edition, 2009.
2. Jacek M. Zurada, *Introduction to Artificial Neural Systems*, JAICO Publishing House Ed. 2006.
3. Bose N.K., Liang, P., *Neural Network Fundamentals*, T.M.H 2002.
4. Kosko, *Neural Network & Fuzzy System*, Prentice Hall, 1992.

CO-PO Articulation Matrix: Neural Networks (PCC-CSEAI305-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Recognize** the basic vocabulary and functioning of Neural Networks. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-		1
CO2. **Describe** various kinds of Neural Networks and their learning mechanisms. (LOTS: Level 2: Understand)	2	-	-	-	1	-	-	-	-	-	-	-		2
CO3. **Use** Neural Networks to solve pattern recognition problems. (LOTS: Level 3: Apply)	2	1	-	1	2	-	-	-	-	-	-	-		3
CO4. **Compare** different Neural Networks and their suitability for diverse machine learning tasks. (HOTS: Level 4: Analyse)	2	2	-	2	2	-	-		-	-	-	-		3
CO5. **Justify** the use of different Neural Networks in particular situations. (HOTS: Level 5: Evaluate)	3	3	-	3	2	-	-	-	-	-	-	-		3
CO6. **Design** Neural Networks for machine learning problems. (HOTS: Level 6: Create)	3	3	-		2									3
Level of Attainments PCC-CSEAI305-T														

Cloud Computing

General Course Information

Course Code: PCC-CSEAI306-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basics of Computer Network, Distributed System, Operating System

About the Course:

The objective of the course is to give students a comprehensive view of storage and networking infrastructures for highly virtualized cloud ready deployments. The course discusses the concepts and features related to Virtualized data-centre and cloud, information storage and design of applications.

Course Outcomes: By the end of the course students will be able to:

CO1. **define** concepts related to cloud computing. (LOTS: Level 1: Remember)
CO2. **express** deployment models for clouds. (LOTS: Level 2: Understand)
CO3. **apply** cloud computing techniques for various applications. (LOTS: Level 3: Apply)
CO4. **analyse** cloud computing services used at various levels. (HOTS: Level 4: Analyse)
CO5. **compare** different cloud management platform. (HOTS: Level 5: Evaluate)
CO6. **assess** real time cloud services. (HOTS: Level 5: Evaluate)

Course content

Unit I

Overview of Cloud Computing- Cloud at a Glance: The Vision of Cloud Computing, Defining a Cloud, Cloud Computing Reference Model, Characteristics and Benefits, Historical Developments: Distributed Systems, Cluster Computing, Grid Computing, Virtualization, Web 2.0, Service-Oriented Computing, Building Cloud Computing

Environment: Application Development, Infrastructure and System Development, Computing Platforms and Technologies: Amazon Web Services, Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com

Unit II

Virtualization & Cloud Computing Architecture – Introduction, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques: Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing: Pros and Cons of Virtualization, Technology Examples: Xen: Paravirtualization, VMware: Full Virtualization, Microsoft Hyper – V, Cloud Architecture: Introduction, Cloud Reference Model Architecture, Infrastructure as a Service, Platform as a Service, Software as a Service, Types of Clouds: Public, Private, Hybrid, Community,

Cloud management Platform: CloudStack, Eucalyptus, vCloud Director and OpenStack

Unit III

Cloud in Industry and Its Applications – Amazon Web Services: Compute Services, Storage Services, Communication Services, Additional Services, Google AppEngine: Architecture and Core Concepts, Application Life-Cycle, Microsoft Azure: Core Concepts, SQL Azure, Windows Azure Platform Appliance, Cloud Applications: Scientific Applications: Healthcare: ECG, Biology: Protein Structure Prediction, Gene Expression Data Analysis for Cancer Diagnosis, Geo-Science Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Media Applications, Multiplayer Online Gaming.

Unit IV

Security in Cloud – Cloud Information Security Fundamentals, Cloud Security Services, Design Principles, Secure Cloud Software Requirements, Policy Implementation, Cloud Computing Security Challenges, Virtualization Security Management, Cloud Computing Security Architecture.

Text and Reference Books and Links:

1. Rajkumar Buyya, Christian Vecchiola and S. Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill Publication (India) Private Limited, 2013.
2. Krutz, Vines, *Cloud Security*, Wiley Publication, 2010.
3. Bloor R., Kanfman M., Halper F. Judith Hurwitz, *Cloud Computing for Dummies*, (Wiley India Edition), 2010.
4. John Rittinghouse & James Ransome, *Cloud Computing Implementation Management and Strategy*, CRC Press, 2010.
5. Antohy T Velte , *Cloud Computing : A Practical Approach*, McGraw Hill, 2009.
6. Rajkumar Buyya, James Broberg and Andrez Gosscinski, *Cloud Computing: Principles and Paradigm*, John Wiley and Sons, Inc. 2011.
7. Kai Hwang, Geofferyu C. Fox and Jack J.Dongarra, *Distributed and Cloud Computing*, Elsevier, 2012.

CO-PO Articulation Matrix: Cloud Computing (PCC-CSEAI306-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Define** concepts related to cloud computing. (LOTS: Level 1: Remember)	1	_	_	_	_	_	_	_	_	_	_	_	1	_
CO2. **Express** deployment models for clouds. (LOTS: Level 2: Understand)	1	1	1	1	1	_	_	_	_	_	_	_	2	_
CO3. **Apply** cloud computing techniques for various applications. (LOTS: Level 3: Apply)	2	2	2	2	2	_	_	_	_	_	_	_	3	_
CO4. **Analyse** cloud computing services used at various levels. (HOTS: Level 4: Analyse)	3	3	2	3	2	_	_	_	_	_	_	_	3	_
CO5. **Compare** different cloud management platform and cloud platforms. (HOTS: Level 5: Evaluate)														
CO6. **Assess** real time cloud services. (HOTS: Level 5: Evaluate)	3	3	3	3	3	2	_	_	_	_	_	2	3	_
Level of Attainments PCC-CSEAI306-T														

Analysis and Design of Algorithms

General Course Information

Course Code: PCC-CSEAI307-T/ PCC-CSE208-T/ PCC-IT208-T Course Credits:3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Knowledge of Data Structure and a Programming Language

About the Course:

This Course focus on effective and efficient design of algorithms. In this course various algorithm design techniques and their analysis is to be studied. After studying this course, a student is expected to apply better techniques for solving computational problems efficiently and prove it analytically.

Course Outcomes: By the end of the course students will be able to:

CO1. **state** terminology and concepts algorithmic techniques. (LOTS: Level 1: Remember)
CO2. **discuss** various algorithmic techniques. (LOTS: Level 2: Understand)
CO3. **apply** appropriate algorithmic techniques to solve computational problems. (LOTS: Level 3: Apply)
CO4. **analyse** algorithms for their efficiency by determining their complexity. (HOTS: Level 4: Analyse)
CO5. **compare** the pros and cons of applying the different algorithmic techniques to solve problems. (HOTS: Level 5: Evaluate)
CO6. **formulate** efficient and effective algorithmic solutions for different real- world problems. (HOTS: Level: 6 Create)

Course content

Unit I

Algorithms, Algorithms as a technology, Insertion sort, analyzing algorithms, asymptotic notations, Divide and Conquer: General method, binary search, merge sort, quick sort, Strassen¨s matrix multiplication algorithms and analysis of algorithms for these problems.

Unit II

Sorting and Data Structures: Heapsort, Hash Tables, Red and Black Trees, Greedy Method: General method, knapsack problem, minimum spanning trees, single source paths and analysis of these problems.

Unit III

Dynamic Programming: General method, matrix chain multiplication, longest common subsequence, optimal binary search trees,

Back Tracking: General method, 8 queen's problem, graph colouring, Hamiltonian cycles, Analysis of these problems.

Unit IV

Branch and Bound: Method, O/I knapsack and traveling salesperson problem,NP Completeness: Polynomial time, NP-completeness and reducibility, NP-complete problems.

Text and Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronalde L. Rivest, Clifford Stein, *Introduction to Algorithms*, MIT press, 3rd Edition, 2009.
2. Ellis Horowitz, Satraj Sahni, Sanguthevar Rajasekaran, *Fundamental of Computer Algorithms*, Galgotia Publication Pvt. Ltd., 1999.
3. S. Dasgupta, C. Papadimitriou, and U. Vazirani, *Algorithms*, McGraw-Hill Higher Education, 2006.

CO-PO Articulation Matrix: Analysis and Design of Algorithms (PCC-CSEAI307-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **State** terminology and concepts algorithmic techniques. (LOTS: Level 1: Remember)	1	--	--	--	--	--	--	--	--	--	--	--	2	--
CO2. **Discuss** various algorithmic techniques. (LOTS: Level 2: Understand)	1	--	--	--	--	--	--	--	--	--	--	--	3	--
CO3. **Apply** appropriate algorithmic techniques to solve computational problems. (LOTS: Level 3: Apply)	2	1	1	--	1	--	--	--	--	--	--	--	3	1
CO4. **Analyse** algorithms for their efficiency by determining their complexity. (HOTS: Level 4: Analyse)	3	2	1	--	2	--	--	--	--	--	--	--	3	2
CO5. **Compare** the pros and cons of applying the different algorithmic techniques to solve problems. (HOTS: Level 5: Evaluate)	3	2	1	--	--	--	--	--	--	--	--	--	3	2
CO6. **Formulate** efficient and effective algorithmic solutions for different real- world problems. (HOTS: Level: 6 Create)	3	3	2	2	--	--	--	--	--	--	--	--	3	2
Level of Attainments PCC-CSEAI307-T														

Fundamentals of Management for Engineers

General Course Information

Course Code: HSMC302-T Course Credits: 2 Type: Humanities and Social Sciences including Management Contact Hours: 2 hours/week Mode: Lecture (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: None

About the Course:

Fundamentals of Management for Engineers is a necessary course for B. Tech. (CSE) graduates wishing to work with organizations in their near future. It helps them acquiring managerial, planning and decision-making skills. This course makes students ready to work in teams as well as play leadership roles.

Course Outcomes: By the end of the course students will be able to:

CO1. **define** fundamental concepts of management (LOTS: Level 1: Remember)
CO2. **explain** the basic principles of management related to planning and decision making, HRM and motivation, and leadership. (LOTS: Level 2: Understand)
CO3. **apply** the managerial skills to solve real world management problems. (LOTS: Level 3: Apply)
CO4. **identify** leadership roles in various scenarios. (HOTS: Level 4: Analyse)
CO5. **evaluate** a business model based on principles of management. (HOTS: Level 5: Evaluate)
CO6. **prepare** a plan for a start up in IT sector. (HOTS: Level 6: Create)

Course Content

Unit I

Management Definition: Scope and process of management, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management, Evolution of Management, Scientific and Administrative Management, The Behavioural approach, The Quantitative approach, The Systems Approach, Contingency Approach, IT Approach.

Unit II

Planning and Decision Making: General Framework for Planning, Planning Process, Types of plans, Management by objectives, Development of business strategy.

Decision making and Problem Solving: Programmed and Non-Programmed Decisions, Steps in Problem Solving and Decision Making, Bounded Rationality and Influences on Decision Making, Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

Unit III

Organization HRM and Controls: Organizational Design & Organizational Structures, Delegation, Empowerment, Centralization, Decentralization, Organizational culture, Organizational climate and Organizational change, Talent management, Talent management Models and strategic human Resource planning; Recruitment and selection; Training and development, Performance Appraisal. Types of controls and controlling Techniques.

Unit IV

Leading and Motivation: Leadership, Power and authority, Leadership styles; Behavioural leadership, Situational leadership, Leadership skills, Leader as mentor and coach, Leadership during adversity and crisis; Handling employee and customer complaints, Team leadership. Motivation: Types of motivation, Relationship between motivation, performance and engagement, Content motivational theories.

T**ext and Reference Books:**

1. Robert N Lussier, *Management Fundamentals*, 5th edition, Cengage Learning, 2013.
2. Stephen P. Robbins, *Fundamentals of Management*, Pearson Education, 2009.
3. Weihrich Koontz, *Essentials of Management*, fifth edition, Tata Mc Graw Hill, 1990.
4. Dubrin Andrew, *Management Essentials*, 9th edition, Cengage Learning, 2012.

CO-PO Articulation Matrix: Fundamentals of Management for Engineers (HSMC302-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Define** fundamental concepts of management (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2. **Explain** the basic principles of management related to planning and decision making, HRM and motivation, and leadership. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3. **Apply** the managerial skills to solve real world management problems. (LOTS: Level 3: Apply)	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO4. **Identify** leadership roles in various scenarios. (HOTS: Level 4: Analyse).	-	-	-	-	-	-	-	3	3	-	-	-	-	-
CO5. **Evaluate** business model based on principles of management. (HOTS: Level 5: Evaluate)	2	3	2	-	-	-	-	-	-	-	-	2	-	-
CO6. **Prepare** a plan for start-up in IT sector. (HOTS: Level 5: Create)	3	3	3	2	-	3	-	-	-	3	3	-	-	-
Level of Attainments HSMC302-T														

Neural Networks Lab.

General Course Information

Course Code: PCC-CSEAI305-P Course Credits: 1.5 Type: Professional Core Lab. Course Contact Hours: 3 hours / week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: MATLAB / Python

About the Course:

This course will serve as a comprehensive introduction to various tools used in neural network. This course would help the students to understand the different issues involved in designing and implementing of a Neural Networks.

Course Outcomes: By the end of the course students will be able to:

CO1. **apply** perceptron-based algorithms to solve simple learning problems. (LOTS: Level 3: Apply)
CO2. **solve** binary as well as multi-class classification problems using back propagation neural networks. (LOTS: Level 3: Apply)
CO3. **compare** various neural network solutions for given problems. (LOTS: Level 4: Analyse)
CO4. **judge** the performance of neural network models. (LOTS: Level 5: Evaluate)
CO5. **create** lab record for assignments that includes problem definitions, design of solutions and conclusions. (LOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply).

List of experiments/assignments

List of experiments:

1. Write a program to generate following logic functions using McCulloch-Pitts neuron and appropriate values for weights, bias and threshold.
    a. AND logic function
    b. OR logic function
    c. NOT logic function
    d. NOR logic function
    e. XOR logic function
2. Write a program to build a logistic regression classifier with a Neural Network.

    Consider the following guidelines.
    a. Consider any convenient dataset (Cats dataset etc.) and pre-process the dataset.
    b. Define the appropriate model structure.
    c. Analyse the obtained results.
    d. Evaluate the model's performance.
3. Design a neural network (NN) model with one hidden layer for classification problems. Use any suitable datasets.
    a. Implement a 2-class classification neural network with a single hidden layer.
    b. Use units with a non-linear activation function, such as tanh.
    c. Compute the cross-entropy loss.
    d. Implement forward and backward propagation.
    e. Evaluate the model's performance.
    f. Analyse the results.
4. Implement a multilayer perceptron (MLP) model for prediction such as house prices.
    a. Perform Exploratory Data Analysis
    b. Prepare datasets.
    c. Build MLP models.
    d. Evaluate Models' performance.
    e. Make predictions for test data.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix: Neural Networks Lab. (PCC-CSEAI305-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Apply** perceptron-based algorithms to solve simple learning problems. (LOTS: Level 3: Apply)	1	1	_	2	3	_	_	_	_	_	_	_	_	3
CO2. **Solve** binary as well as multi-class classification problems using back propagation neural networks. (LOTS: Level 3: Apply)	2	2	_	2	3	_	_	_	_	_	_	_	_	3
CO3. **Compare** various neural network solutions for given problems. (LOTS: Level 4: Analyse)	3	2	_	2	3	_	_	_	_	_	_	_	_	3
CO4. **Judge** the performance of neural network models. (LOTS: Level 5: Evaluate)	3	3	_	3	3	_	_	_	_	_	_	_	_	3
CO5. **Create** lab record for assignments that includes problem definitions, design of solutions and conclusions. (LOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	3	_	_	_	_
CO6. **Demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply).	_	_	_	_	_	_	_	3	3	_	_	3	_	_
Level of Attainments PCC-CSEAI305-P														

Cloud Computing Lab.

General Course Information

Course Code: PCC-CSEAI306-P Course Credits: 1.5 Type: Professional Core Lab. Course Contact Hours: 3 hours / week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic programming skills and knowledge of Operating System.

About the Course:

This lab course on Cloud Computing helps students to learn how to use cloud services, implement virtualization and task scheduling. The main objective of this course is to help the students to learn the design and development process involved in creating a cloud based application. In addition to this, students also learn how to use the

different services provided by cloud platform AWS.

Course Outcomes: By the end of the course students will be able to:

CO1. **outline** the cloud computing with its applications using different architectures. (LOTS: Level 1: Remember)
CO2. **identify** and propose applications which advance the cloud computing. (LOTS: Level 4: Analyse)
CO3. **implement** different workflows according to requirements, apply GAE and CloudSim programming model. (LOTS: Level 3: Apply)
CO4. **develop** applications which advance the cloud computing (AWS). (LOTS: Level 4: Develop)
CO5. **create** lab record for assignments that includes problem definitions, design of solutions and conclusions. (LOTS: Level 6: Create)
CO6. **demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments

List of Experiments:

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine (GAE). Create hello world app and other simple web applications using python.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm.
6. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
7. Create a free tier account in Amazon Web Services (AWS), and run / demonstrate the following services of AWS
    a. Compute
    b. Database
    c. Networking
    d. Machine Learning
    e. Security
    f. Storage
    g. Auto-Scaling
    h. Load Balancing

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix: Cloud Computing Lab. (PCC-CSEAI306-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Outline** the cloud computing with its applications using different architectures. (LOTS: Level 1: Remember)	1	1	_	2	3	_	_	_	_	_	_	_	_	3
CO2. **Identify** and propose applications which advance the cloud computing. (LOTS: Level 4: Analyse)	2	2	_	2	3	_	_	_	_	_	_	_	_	3
CO3. **Implement** different workflows according to requirements and apply GAE and CloudSim programming model. (LOTS: Level 3: Apply)	3	2	_	2	3	_	_	_	_	_	_	_	_	3
CO4. **Develop** applications which advance the cloud computing (AWS). (LOTS: Level 4: Develop)	3	3	_	3	3	_	_	_	_	_	_	_	_	3
CO5. **Create** lab record for assignments that includes problem definitions, design of solutions and conclusions. (LOTS: Level 6: Create)	–	–	–	–	–	–	–	–	–	3	–	–	–	–
CO6. **Demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	–	–	–	–	–	–	–	3	3	–	–	3	–	–
Level of Attainments PCC-CSEAI306-P														

Minor Project I

General Course Information

Course Code: PROJ-CSEAI301 Course Credits: 2 Mode: Design and development of minor project in lab. No. of hours per week: -04	**Course Assessment Methods (Internal evaluation: 50 marks; External Evaluation marks: 50)** Evaluation is done by the internal examiner, preferably project guide and external examiner appointed by the Chairperson and COE respectively. The criteria for evaluation are given below. 1. Review of literature related to problem domain: 10(In.) +10(Ex.) 2. Significance and originality of the solution presented: 15(In.) +15(Ex.) 3. Significance and Scope of results: 10(In.) +10(Ex.) 4. Organisation and presentation of minor project report: 10(In.) +10(Ex.) 5. Level of Ethics followed: 5(In.) +5(Ex.)

About the minor project:

Students do a minor project using artificial intelligence and machine learning techniques in sixth semester. They are expected to learn any open artificial intelligence and machine learning specific tool/software and develop project that can be completed within sixth semester.

After doing minor project students will be able to

CO1. **identify** a suitable problem from the environment around. (HOTS: Level 4: Analyse)
CO2. **survey** the design of similar problems (HOTS: Level 5: Evaluate)
CO3. **select** suitable engineering specialisation and artificial intelligence and machine learning specific tools. (LOTS: Level 3: Apply)
CO4. **address** the problem in an original and innovative manner. (HOTS: Level 6: Create)
CO5. **communicate** orally as well as in written (minor project report) about the application developed. (HOTS: Level 6: Create)
CO6. **engage** in ethical practices, individual and teamwork, and lifelong learning. (LOTS: Level 3: Apply)

CO-PO Articulation Matrix: Minor Project (PROJ-CSEAI301)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Identify** a suitable problem from the environment around. (HOTS: Level 4: Analyse)	2	3	_	2	_	3	2	_	_	_	_	_	_	_
CO2. **Survey** the design of similar problems (HOTS: Level 5: Evaluate)	_	3	2	3	_	_	_	_	_	_	_	_	_	_
CO3. **Select** suitable engineering specialisation and artificial intelligence and machine learning specific tools. (LOTS: Level 3: Apply)	_	_	_	_	3	_	_	_	_	_	_	_	_	_
CO4. **Address** the problem in an original and innovative manner. (HOTS: Level 6: Create)	3	3	3	3	_	2	_	_	_	_	_	_	_	_
CO5. **Communicate** orally as well as in written (minor project report) about the application developed. (HOTS: Level 6: Create)	_	_	_	_	_	_	_	_	_	3	_	_	_	_
CO6. **Engage** in ethical practices and lifelong learning. (LOTS: Level 3: Apply)	_	_	_	_	_	_	_	3	3	_	_	3	_	_
Level of Attainments PROJ-CSEAI301														

Computer Graphics

General Course Information

Course Code: PEC-CSEAI301-T/ PCC-CSE301-T/ PEC-IT402-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Vector Mathematics, Matrices, Linear Algebra, Programming skills in C/C++ and Data Structures.

About the Course:

This course involves studying graphic techniques, algorithms and imaging models. Moreover, students learn about the techniques for clipping, cropping, representing 2-D and 3-D objects.

Course Outcomes: By the end of the course students will be able to:

CO1. **state** basic concepts related to graphics. (LOTS: Level 1: Remember)
CO2. **describe** the principles of creating graphical objects and graphical user interface applications. (LOTS: Level 2: Understand)
CO3. **apply** 2-D and 3-D transformations (rotation, scaling, translation, shearing) on geometric objects. (LOTS: Level 3: Apply)
CO4. **use** different techniques for clipping and filling geometric objects. (LOTS: Level 3: Apply)
CO5. **compare** different graphics algorithms for different geometric objects. (HOTS: Level 4: Analyse)
CO6. **create** user-friendly interfaces for computer applications. (HOTS: Level 6: Create)

Course Content

Unit I

Introduction to Computer Graphics: What is Computer Graphics, Computer Graphics Applications, Computer Graphics Hardware and software, Two dimensional Graphics Primitives: Points and Lines, Line drawing

algorithms: DDA, Bresenham's; Circle drawing algorithms: Using polar coordinates, Bresenham's circle drawing, mid-point circle drawing algorithm; Filled area algorithms: Scan-line: Polygon filling algorithm, boundary filled algorithm.

Unit II

Two/Three Dimensional Viewing: The 2-D viewing pipeline, windows, viewports, window to view port mapping; Clipping: point, clipping line (algorithms): 4 bit code algorithm, Sutherland-cohen algorithm, parametric line clipping algorithm (Cyrus Beck). Polygon clipping algorithm: Sutherland-Hodgeman polygon clipping algorithm.

Two dimensional transformations: transformations, translation, scaling, rotation, reflection, composite transformation.

Three dimensional transformations: Three-dimensional graphics concept, Matrix representation of 3-D Transformations, Composition of 3-D transformation.

Unit III

Viewing in 3D: Projections, types of projections, the mathematics of planner geometric projections, coordinate systems.

Hidden surface removal: Introduction to hidden surface removal, Z- buffer algorithm, scanline algorithm, area sub-division algorithm.

Unit IV

Representing Curves and Surfaces: Parametric representation of curves: Bezier curves, B-Spline curves. Parametric representation of surfaces; Interpolation method.

Illumination, shading, image manipulation: Illumination models, shading models for polygons, shadows, transparency. What is an image? Filtering, image processing, geometric transformation of images.

Text and reference books:

1. James D. Foley, Andeies van Dam, Stevan K. Feiner and Johb F. Hughes, *Computer Graphics Principles and Practices*, second edition, Addision Wesley, 2000.
2. Pradeep K Bhatia, *Computer Graphics*, 3rd edition, I K International Pub, New Delhi, 2013.
3. Donald Hearn and M. Pauline Baker, *Computer Graphics* 2nd Edition, PHI, 1999.
4. David F. Rogers, *Procedural Elements for Computer Graphics* Second Edition, T.M.H, 2001.
5. Alan Watt, *Fundamentals of 3Dimensional Computer Graphics*, Addision Wesley, 1999.
6. Corrign John, *Computer Graphics: Secrets and Solutions*, BPB, 1994.
7. Pilania & Mahendra, *Graphics, GUI, Games & Multimedia Projects in C*, Standard Pub., 2002.
8. N. Krishanmurthy, *Introduction to Computer Graphics*, T.M.H, 2002.

CO-PO Articulation Matrix: Computer Graphics (PEC-CSEAI301-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **State** basic concepts related to graphics. (LOTS: Level 1: Remember)	1	_	_	_	_	_	_	_	_	_	_	_	2	_
CO2. **Describe** the principles of creating graphical objects and graphical user interface applications. (LOTS: Level 2: Understand)	1	_	_	_	_	_	_	_	_	_	_	_	3	_
CO3. **Apply** 2-D and 3-D transformations (rotation, scaling, translation, shearing) on geometric objects. (LOTS: Level 3: Apply)	2	1	_	_	2	_	_	_	_	_	_	_	3	_
CO4. **Use** different techniques for clipping and filling geometric objects. (LOTS: Level 3: Apply)	2	1	_	_	2	_	_	_	_	_	_	_	3	_
CO5. **Compare** different graphics algorithms for different geometric objects. (HOTS: Level 4: Analyse)	-	2	2	2	1	_	_	_	_	_	_	_	3	_
CO6. **Create** user-friendly interfaces for computer applications. (HOTS: Level 6: Create)	1	2	2	_	3	_	_	_	_	_	-	_	3	_
Level of Attainments PEC-CSEAI301-T			_	_	_	_	_	_	_	_	_	_	_	_

Internet of Things

General Course Information

Course Code: PEC-CSEAI302-T/ PEC-CSE409-T/ PEC-IT409-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Fundamentals of Computer Networks

About the Course:

The field of Internet of Things is growing very fast. The purpose of this course is to impart the knowledge on basic concepts of IoT, its Architecture, various protocols and applications in real world scenarios.

Course Outcomes: By the end of the course students will be able to:

CO1. **state** the basic concepts and key technologies of IoT. (LOTS: Level 1: Remember)
CO2. **discuss** the pros and cons of various protocols for IoT. (LOTS: Level 2: Understand)
CO3. **apply** the IOT models for business applications. (LOTS: Level 3: Apply)
CO4. **analyse** applications of IoT in real time scenario. (HOTS: Level 4: Analyse)
CO5. **design** business model scenarios (HOTS: Level 6: Create)

Course content

Unit I

What is the Internet of Things: History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks : IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities, Basics Of Microcontroller, Microprocessor Vs Microcontroller, Types of Sensor, Actuators and their Applications.

Unit II

Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies,

Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology-Introduction, Principle of RFID, Components of an RFID system, Issues, Satellite Technology.

Unit III

IoT Access Technologies: Physical and MAC layers, Topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

Unit IV

Business Models and Business Model Innovation, Value Creation in the Internet of Things, Business Model Scenarios for the Internet of Things. Internet of Things Applications: Smart Metering Advanced Metering Infrastructure, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Smart Transportation and Smart Shopping.

T**ext and Reference Books:**

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things*, Cisco Press, 1st Edition, 2017.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, *The Internet of Things – Key applications and Protocols*, Wiley, 2nd Edition, 2012.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), *Architecting the Internet of Things*, 1st Edition, Springer, 2011.
4. Michael Margolis, Arduino Cookbook, "*Recipes to Begin, Expand, and Enhance Your Projects*", 2nd Edition, O'Reilly Media, 2011.
5. Arshdeep Bahga, Vijay Madisetti, *Internet of Things – A hands-on approach*, 1st Edition, Universities Press, 2015.

CO-PO Articulation Matrix: Internet of Things (PEC-CSEAI302-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **State** the basic concepts and key technologies of IoT. (LOTS: Level 1: Remember)	1	_	_	2	_	_	_	_	_	_	_	_	_	2
CO2. **Discuss** the pros and cons of various protocols for IoT. (LOTS: Level 2: Understand)	1	_	_	3	_	_	_	_	_	_	_	_	_	3
CO3. **Apply** the IOT models for business applications. (LOTS: Level 3: Apply)	2	2	2	3	3	_	_	_	_	_	_	_	2	3
CO4. **Analyse** applications of IoT in real time scenario. (HOTS: Level 4: Analyse)	3	3	2	_	3	_	_	_	_	_	_	_	2	3
CO5. **Design** business model scenarios (HOTS: Level 6: Create)	3	3	2	_	3	_	_	_	_	_	_	_	_3	3
Level of Attainments PEC-CSEAI302-T														

Bio-informatics

General Course Information:

Course Code: PEC-CSEAI303-T/ PEC-CSE304-T/ PEC-IT304-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: None

About the Course:

The scope of Bio-informatics is growing rapidly. Analysing data related to bio-informatics is not possible without computational skills. This course is designed to impart fundamental knowledge of bio-informatic which would enable students to understand the intricacies of Bioinformatics. The students will learn about the characteristic of bio-informatic data and the tools for analysis of such data.

Course Outcomes: By the end of the course students will be able to:

CO1. **list** the applications of bioinformatics and biological databases. (LOTS: Level 1: Remember)
CO2. **explain** storage and retrieval of biological data from various biological databases. (LOTS: Level 2: Understand)
CO3. **apply** the knowledge of bioinformatics concepts. (LOTS: Level 3: Apply)
CO4. **identify** challenges in bioinformatics and computational biology. (HOTS: Level 4: Analyse)
CO5. **compare and contrast** various algorithms for sequence alignment and scoring algorithms. (HOTS: Level 5: Evaluate)
CO6. **devise** schemes for addressing bioinformatics problems. (LOTS: Level 6: Create)

Course content

Unit I

Bioinformatics: Introduction to Bioinformatics, Scope, Overview of molecular biology & genetics, Nucleic acid; structure & function, Protein structure & function; DNA Replication, Transcription, Translations, Genetic code, Codon Bias, Molecular Biology Techniques used in Bioinformatics.

Computer applications in molecular biology, Protein domains and human genome analysis program (BLAST, FASTA etc.). Search and retrieval of biological information and databases sequence, databank (NCBI)

Unit II

Sequence Alignment

Pairwise Sequence Alignment: Evolutionary Basis, Sequence Homology versus Sequence Similarity, Sequence Similarity versus Sequence Identity, Methods, Scoring Matrices, Statistical Significance of Sequence Alignment

Database Similarity Searching: Unique Requirements of Database Searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST, Database Searching with the Smith–Waterman Method.

Unit III

Multiple Sequence Alignment: Scoring Function, Exhaustive Algorithms, Heuristic Algorithms, Practical Issues.

Profiles and Hidden Markov Models: Position-Specific Scoring Matrices, Profiles, Markov Model and Hidden Markov Model.

Protein Motifs and Domain Prediction: Identification of Motifs and Domains in Multiple Sequence Alignment, Motif and Domain Databases Using Regular Expressions, Motif and Domain Databases Using Statistical Models, Protein Family Databases, Motif Discovery in Unaligned Sequences, Sequence Logos**.**

Unit IV

Molecular Phylogenetics

Phylogenetics Basics: Molecular Evolution and Molecular Phylogenetics, Terminology, Gene Phylogeny versus Species Phylogeny, Forms of Tree Representation, Procedure.

Phylogenetic Tree Construction Methods and Programs: Distance-Based Methods, Character-Based Methods, Phylogenetic Tree Evaluation, Phylogenetic Programs

Text and References Books:

1. T K Attwood and D J Parry Smith, *Introduction to Bioinformatics*, Pearson Education Asia, Singapore, 2001.
2. Sensen, C.W., *Essentials of Genomics and Bioinformatics*, John Wiley and Sons, 2002
3. Attwood, T. and Pary-Smith, D., *Introduction to Bioinformatics*, Prentice Hall, 1999
4. Baxevanis, A.D. and Ouellette, B.F.F., *Bioinformatics: A Practical Guide to the Analysis of genes and Protein*, Wiley- Interscience, 2001
5. Stuart M. Brown, *Bioinformatics: A Biologists Guide to Computing and the Internet*, NKU MedicalCentre, NY USA, 2000.

CO-PO Articulation Matrix: Bio-informatics (PEC-CSEAI303-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **List** the applications of bioinformatics and biological databases. (LOTS: Level 1: Remember)	1	–	–	–	–	–	–	–	–	–	–	–	–	2
CO2. **Explain** storage and retrieval of biological data from various biological databases. (LOTS: Level 2: Understand)	1	–	–	–	–	–	–	–	–	–	–	–	–	3
CO3. **Apply** the knowledge of bioinformatics concepts. (LOTS: Level 3: Apply)	2	–	–	–	–	–	–	–	–	–	–	–	–	3
CO4. **Identify** challenges in bioinformatics and computational biology. (HOTS: Level 4: Analyse)	–	2	–	–	–	–	–	–	–	–	–	–	–	3
CO5. **Compare and contrast** various algorithms for sequence alignment and scoring algorithms. (HOTS: Level 5: Evaluate)	2	3	2	–	2	–	–	–	–	–	–	–	–	3
CO6. **Devise** schemes for addressing bioinformatics problems. (LOTS: Level 6: Create)	3	3	2	3	2	–	–	–	–	–	–	–	–	3
Level of Attainments PEC-CSEAI303-T														

Information Retrieval Systems

General Course Information:

Course Code: PEC-CSEAI304-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Data Structures, Data Base Management Systems

About the Course:

This course would enable the students to understand the various aspects of an information retrieval system and its evaluation and to be able to design. The main aim of this course is to give students an understanding about data/file structures that are necessary to design, and implement information retrieval (IR) systems, IR principles to locate relevant information large collections of data, different document clustering algorithms, information retrieval systems for web search tasks etc.

Course Outcomes: By the end of the course students will be able to:

CO1. **define** the information retrieval system and its objectives along with various capabilities. (LOTS: Level 1: Remember)
CO2. **understand** to apply IR principles to locate relevant information from large collections of data using various indexing process and data structures. [Understand] (LOTS: Level 2: Understand)
CO3. **implement** to design different document clustering algorithms. (LOTS: Level 3: Apply)
CO4. **analyze** different retrieval systems for text search. (HOTS: Level 4: Analyse)
CO5. **compare** various algorithms and systems for information retrieval. (HOTS: Level 5: Evaluate)
CO6. **investigate** various information retrieval systems which falls under Multimedia retrieval systems. (LOTS: Level 6: Create)

Course content

Unit I

Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses. Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities.

Unit II

Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction. Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, PAT Data Structure, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models.

Unit III

Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages. Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters.

User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext.

Unit IV

Information Visualization: Introduction to Information Visualization, Cognition and Perception, Information Visualization Technologies.

Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems. Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval.

Text and References Books:

1. Kowalski & Maybury, *Information storage and retrieval systems: theory and implementation* (Vol. 8). Springer Science & Business Media, 2002.
2. Frakes & Baeza-Yates (Eds)., Information *retrieval: data structures and algorithms*. Prentice-Hall, Inc., 1992.
3. Korfhage, *Information Retrieval and Storage*, John Wiley & Sons, 1997
4. Baeza-Yates & Ribeiro-Neto (1999), *Modern information retrieval* (Vol. 463), New York: ACM press, 1999.

CO-PO Articulation Matrix: Information Retrieval Systems (PEC-CSEAI304-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Define** the Information retrieval system and its objectives along with various capabilities. (LOTS: Level 1: Remember)	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2. **Understand** to apply IR principles to locate relevant information from large collections of data using various indexing process and data structures. (LOTS: Level 2: Understand)	1	-	-	1	-	-	-	-	-	-	-	-	-	3
CO3. **Implement** to design different document clustering algorithms. (LOTS: Level 3: Apply)	2	-	1	2	-	-	-	-	-	-	-	-	-	3
CO4. **Analyze** different retrieval systems for text search. (HOTS: Level 4: Analyse)	3	1	2	2	-	-	-	-	-	-	-	-	-	3
CO5. **Compare** various algorithms and systems for information retrieval. (HOTS: Level 5: Evaluate)	3	2	2	3	-	-	-	-	-	-	-	-	-	3
CO6. **Investigate** various information retrieval systems which falls under Multimedia retrieval systems. (LOTS: Level 6: Create)	3	3	3	3	-	-	-	-	-	-	-	-	-	3
Level of Attainments PEC-CSEAI304-T														

Microprocessor and Embedded Systems

General Course Information:

Course Code: PEC-CSEAI305-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Computer Architecture and Organization

About the Course:

A microprocessor incorporates the functions of a central processing unit (CPU) on a single integrated circuit. The advent of microprocessors and their increased capacity made them to be used in everything be it a smallest embedded system or handheld device, or the largest mainframe and supercomputer. It is being used in variety of applications such as process control systems, security systems, household appliances, and mobile phone technologies. An embedded system is a self-contained unit that have a dedicated purpose within a device. This course aims to provide a strong foundation about the principles, programming and various applications of different microprocessors and microcontrollers. This course also helps the students to build new-age technological solutions with the embedded systems.

Course Outcomes: By the end of the course students will be able to:

CO1. **outline** the architecture of 8085 and 8086 Microprocessor. (LOTS: Level 1: Remember)
CO2. **discuss** the principles of embedded systems and their applications. (LOTS: Level 2: Understand)
CO3. **describe** the general procedure of IO and memory interfacing (LOTS: Level 2: Understand)
CO4. **apply** the principles of embedded design for problem solving. (LOTS: Level 3: Apply)
CO5. **compare** and contrast the working of 8085 and 8086 microprocessors. (HOTS: Level 5: Evaluate)
CO6. **develop** new-age technological solutions with the embedded systems. (HOTS: Level 6: Create)

Course content

Unit - I

Internal architecture of 8085 microprocessor –Instruction set - Addressing modes – Classification of instructions. Assembly language programming –standard programs in assembly language – code conversion, sorting – binary and BCD arithmetic

16-bit microprocessor- 8086 architecture, registers, memory segmentation and addressing, 32-bit/64-bit microprocessor families (Only architecture)

Unit - II

Stack and Subroutines – CALL and RETURN instructions – Delay subroutines. Timing and control – Machine cycles, instruction cycle and T states – fetch and execute cycles – Timing diagram for instructions.

IO and memory interfacing – Address decoding– interrupt structure of 8085. I/O ports- Programmable peripheral interface PPI 8255 - Modes of operation. Interfacing of LEDs, ADC and DAC with 8085.

Unit - III

Introduction to Embedded Systems-Application domain of embedded systems, features and characteristics, System model, Microprocessor Vs Microcontroller, current trends and challenges, hard and soft real time systems, Embedded product development, Life Cycle Management (water fall model), Tool Chain System,

Introduction to Real-time operating systems (RTOS) -RTOS and Scheduling, Operating basics, types, RTOS, tasks, process and threads, multiprocessing and multitasking, types of multitasking, non-preemptive, preemptive scheduling.

Unit - IV

8051- Microcontrollers Hardware: Microcontroller Architecture: IO Port structure, Register organization, general purpose RAM, Bit Addressable RAM, Special Function Registers (SFRs). Instruction Set, addressing modes Instruction Types.

Interfacing – LCD, ADC, Stepper motor, and DAC.

Text and References Books:

1. Gaonkar R., *Microprocessor, Architecture, Programming and Applications*, Penram International Publishing; Sixth edition, 2014.
2. Mathur A., *Introduction to Microprocessors*, Tata McGraw Hill, New Delhi, 1992.
3. Brey B. B., *The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions*, 8th Edition, Pearson Education, 2008
4. Hall D.V., *Microprocessors and Interfacing*, Tata McGraw Hill, Education, New Delhi, Third Edition.
5. Rafiquzzaman, *Microprocessor Theory and Application*, PHI Learning, First Edition.
6. Ajoy R. and Burchandi, *Advanced Microprocessor & Peripherals*, Tata McGraw Hill, Education, New Delhi, Second Edition.
7. Mazidi M. A. and Mazidi J. G., *The 8051 microcontroller and embedded systems using Assembly and C*,second edition, Pearson education /Prentice Hall of India, 2004
8. MacKenzie S., and Raphael C W Phan, The *8051 Microcontroller*, Fourth Edition, Pearson education
9. Daniele Lacamera, *Embedded Systems Architecture*, Packt Publishing, May 2018, ISBN: 9781788832502.
10. Raj Kamal, *Embedded Systems*, TMH, 2004.
11. Wayne Wolf, *Computers as components: Principles of Embedded Computing System Design,* Morgan Kaufman Publication, 2000.
12. Tim Wilmshurst, *The Design of Small-Scale embedded systems*, Palgrave, 2003.
13. Marwedel, Peter, *Embedded System Design*, Kluwer Publishers, 2004.

CO-PO Articulation Matrix: Microprocessor and Embedded Systems (PEC-CSEAI305-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Outline** the architecture of 8085 and 8086 Microprocessor. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2. **Discuss** the principles of embedded systems and their applications. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3. **Describe** the general procedure of IO and memory interfacing (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4. **Apply** the principles of embedded design for problem solving. (LOTS: Level 3: Apply)	2	1	1	1	-	-	-	-	-	-	-	-	3	-
CO5. **Compare** and contrast the working of 8085 and 8086 microprocessors. (HOTS: Level 5: Evaluate)	3	2	2	2	-	-	-	-	-	-	-	-	3	-
CO6. **Develop** the programs in assembly language and in C language for embedded applications. (HOTS: Level 6: Create)	3	3	3	2	-	-	-	-	-	-	-	-	3	-
Level of Attainments PEC-CSEAI305-T														

6.3. Evaluation of minor project

The proforma for evaluating the minor project is given on the next page.

Department of Computer Science and Engineering
Guru Jambheshwar University of Science and Technology, Hisar-125001

Name of the Programme:_____ Semester:_____ Session:_____	Credits: 2 Total Marks: 100

Evaluation of minor project report (PROJ-CSEAI301)

SR. No.	Roll. No.	Significance of the problem addressed CO1 (20)	Knowledge of the problem domain CO2 (15)	Knowledge of the techniques and tools used CO3 (15)	Quality of the solution provided CO4 (20)	Quality of the Report Writing CO5 (20)	Level of engagement with ethical practices and self-learning CO6 (10)	Total (100)
1								
2								
3								
.								
.								

Name of the examiner(s): Signature of the Examiner(s): Date: Signature of Chairperson	Total Candidates: No. of Candidates Present: No. of Candidates Absent:

6.4. Guidelines for Preparing Minor Project report (PROJ-CSEAI301)

All the students are required to follow these guidelines for preparing their minor project report.

6.4.1. Formatting Instructions

The formatting instructions are given in the table below.

Formatting Instructions		
Sr. No.	Item	Formatting
1.	Front Cover	Quality paper suitable for soft binding
2.	No. of pages	Minimum 20 and maximum 40 excluding the front material
3.	Paper size	A4
4.	Font Type	Times New Roman
5.	Chapter Heading Font	16
6.	Font of Sections and Subsections	14 and 12 in bold style
7.	Numbering style for sections and subsections; Do not use more than three levels.	2., 2.1 and 2.1.1
8.	Normal text size	12
9.	Figures and Tables must be numbered chapter-wise. Table headings on the top of the tables and Figure heading at the bottoms of the figures.	For example, for chapter 2, Figures should be numbered as Fig. 2.1, Fig. 2.2 etc. and Tables as Table 2.1 and Table 2,2 etc.
10.	Page numbering	Place: Centre Bottom Type: Front material in Roman numbers Body of the report: in Arabic numerals. Pagination must start with first page of the first chapter and continue throughout the end of the report.
11.	Margins	Left margin: 3.75 cms (1.5 inch) Right, bottom, top= 2.5 cms (1 inch)
12	References/Bibliography	IEEE format
13	Binding	Soft binding of good quality

6.4.2 Contents of the Minor Project Report

The contents of the report should be organised as described below.

1. The title page as per instructions.
2. Declaration that the student has carried out his work on his own. It is his/her original creation, not plagiarised from any other source and due credit has been given to the source material used in the report through references and citations.
3. Acknowledgement
4. List of figures
5. List of Tables
6. List of Abbreviations
7. Contents

8. Body of the Report

The report must be written in English. The ideas must be organized in a clear and concise fashion. Chapters must be tentatively organized as below.

Chapter 1. Introduction

This includes introduction to relevant area of minor project, problem formulation, objectives of the minor project, and structure of the project report.

Chapter 2. Requirement analysis, solution design framework of the minor project work and tools used

Chapter 3. Outputs of the minor project

References/Bibliography

6.4.3 Format of the Title page

The format for the title page of the minor project is given on next page.

TITLE OF THE MINOR PROJECT REPORT

(Write in Times New Roman, 16-point size, Bold and Centred and Uppercase font)

Minor Project report submitted to
Guru Jambheshwar University of Science and Technology, Hisar
for the partial award of the degree

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 2 lines gap with 12 font size from the title of the project)

of

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 1 lines gap with 12 fontsize from the text above in three lines)

Bachelor of Technology
in Computer Science and Engineering
(Artificial Intelligence and Machine Learning)

(Write in Times New Roman, 14-point size, Bold, Centred style after "***of***" after 1 line gap with 12 font size)

By

(Write in Times New Roman 12-point size, Bold, Italics, and Centred style after the name of the degree with 1 line gap with 12)

Your Name
(Enrolment Number)

(Write in Times New Roman, 14-point size font, Bold, Centred style after 1 line gap with 12 font from "***By***")

Department of Computer Science &Engineering
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR

Month, Year

(Write in Times New Roman, 14-point size font, Bold, Centred style, after 2 lines gap from logo)