Academic Program: PG

Academic Year 2021-22

Department of Computer Science & Engineering

Master of Technology in

Computer Science and Engineering

I & II Semester M.Tech

Syllabus

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution approved by AICTE & Affiliated to VTU, Belagavi)

Ph: 0836-2447465 Fax: 0836-2464638 Web: www.sdmcet.ac.in

SDM College of Engineering & Technology, Dharwad
Department of Computer Science & Engineering

College Vision and Mission

Vision:

To develop competent professionals with human values.

Mission:

1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise for connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

SDMCET- Quality Policy

- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

Department Vision and Mission

Vision:

To develop competent professionals in the field of Computer Science and Engineering with human values.

Mission:

1. To have contextually relevant curricula in line with industry trends and body of knowledge stated by IEEE /ACM.
2. To promote OBE based effective Teaching Learning Practices supported by modern educational tools and techniques.
3. To enhance research.
4. To involve the industrial expertise for connecting classroom contents to real-life situations.
5. To inculcate ethics and soft-skills leading to overall personality development.

SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for I & II semester M.Tech in Computer Science & Engineering is recommended by the Board of Studies of Computer Science & Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Chairman BoS & HoD **Principal**

Program Educational Objectives (PEOs):

I. Contribute to the profession as an excellent employee or as an entrepreneur

II. Enhance their knowledge informally or by pursuing research work leading to new innovations and products

III. Work effectively in heterogeneous environment and be responsible member and leader of their communities

IV. Contribute positively to the needs of individuals and society at large by understanding the human, social and environmental context of their profession

Program Outcomes (POs):

PO1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report / document.

PO3: Student should be able to demonstrate a degree of mastery over the current knowledge and technological trends in the field of Computer Science & Engineering.

PO4: Demonstrate the knowledge and understanding of the Computer Science & Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage a project in a multidisciplinary environment in terms of identifying requirements, conceptualizing the new and innovate system, modelling and designing the system / process, transforming the system model to working system and verify and validate the correctness of the system

PO5: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

PO6: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.

Scheme of Teaching and Examination
I Semester M. Tech

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
20PRMIC100	Research Methodology and IPR	2-0-0	2	50	50	2		
20PMCSC100	Mathematical foundations of Computer Science	4-0-0	4	50	100	3		
20PCSEC101	Advanced algorithms	4-0-0	4	50	100	3		
20PCSEC102	Artificial Intelligence and Machine Learning	4-0-0	4	50	100	3		
20PCSEE1XX	Elective 1	3-0-2/ 4-0-0	4	50	100	3		
20PCSEL102	Artificial Intelligence & Machine Learning Lab	0-0-3	2	50			50	3
20PCSEL103	Seminar	0-0-2	1	50				
Total		**17/18-0-7/5**	**21**	**350**	**450**		**50**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

***** SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

Seminar is to be conducted every week and 2-3 students/week will present a topic from emerging areas in respective PG program preferably the contents not studied in their regular courses. The seminar shall be evaluated by 3 faculty members having specialization in respective program and allied areas.

List of Electives

Course Code	Course Title	L-T-P
20PCSEE125	Image Processing and Computer Vision	3-0-2
20PCSEE126	Block Chain Technology	4-0-0

Scheme of Teaching and Examination
II Semester M. Tech

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
20PCSEC200	Advanced Computer Networks	4-0-0	4	50	100	3		
20PCSEC201	Distributed systems	4-0-0	4	50	100	3		
20PCSEE2XX	Elective 2	3-0-2	4	50	100	3		
20PCSEE2XX	Elective 3	3-0-2	4	50	100	3		
20PCSEE2XX	Elective 4	3-0-2	4	50	100	3		
20PCSEL202	Advanced Computer Networks Lab	0-0-3	2	50			50	3
20PCSEL203	Seminar	0-0-2	1	50				
Total		**17-0-11**	**23**	**350**	**500**		**50**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

***** SEE for theory courses is conducted for **100 marks** and reduced to **50 marks**.

Seminar is to be conducted every week and 2-3 students/week will present a topic from emerging areas in respective PG program preferably the contents not studied in their regular courses. The seminar shall be evaluated by 3 faculty members having specialization in respective program and allied areas.

List of Electives:

Sl. No	Course code	Course Title
1.	20PCSEE225	Internet of Things
2.	20PCSEE226	Deep Learning
3.	20PCSEE227	Data Science
4.	20PCSEE228	Wireless Networks & Mobile Computing
5.	20PCSEE229	Soft Computing
6.	20PCSEE230	Natural Language Processing and Text Mining

Scheme of Teaching and Examination

III Semester M. Tech

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
20PCSEC300	High Performance Computing	4-0-0	4	50	100	3		
20PCSEE3XX	Elective 5	3-0-0	3	50	100	3		
20PCSEE3XX	Elective 6	3-0-0	3	50	100	3		
20PCSEE3XX	Elective 7	3-0-0	3	50	100	3	--	--
OR								
20PCSEL302	Internship in Industry or R&D organization	** Min 4 weeks during vacation after 2nd sem	3	50	--	--	100	3
20PCSEL303	*** Project phase 1	0-0-15	9	50			50	3
Total		**13-0-15/ 10-4weeks-15)**	**22**	**250**	**400/ 300**		**50/150**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

***** SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

** The students are expected to undergo training in industry for a period of ***four weeks*** during the vacation immediately after completion of II Semester examination. A faculty is to be allotted to guide the student. A committee consisting of three faculty members shall evaluate the work carried out and the knowledge the students have acquired. **OR The students can take one elective course if they do not undergo internship.**

*** Project phase-I: The students are expected to formulate the problem and carry out the intensive literature survey along with preliminary investigations supporting the project phase-II in IV semester.

List of Electives:

Sl. No	Course code	Course Title
1.	20PCSEE325	Cloud Computing
2.	20PCSEE326	Software Defined Network
3.	20PCSEE327	Software Project Management
4.	20PCSEE328	Game Theory
5.	20PCSEE329	Human Computer Interface
6.	20PCSEE330	Applied Cryptography

Scheme of Teaching and Examination

IV Semester M. Tech

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
20PCSEL400	Project phase-II	0-0-20	22	100	--	--	100	3
Total		**0-0-20**	**22**	**100**	**--**	**--**	**100**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

***** SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

****** Project phase-II: The students are expected to work on a project for the full semester in an industry or an institution

Total Credits offered for the first year: 44

Total Credits offered for the Second year: 44

I – Semester

20PRMIC100	Research Methodology and IPR	(2-0-0) 2

Contact Hours: 26

Course Learning Objectives (CLOs):

The students are expected to learn about the need and types of research, problem formulation, literature review, measurement, scaling, data collection, testing of hypothesis, result interpretation and report writing. Further, the students shall know about the intellectual property rights, copy rights, trademarks, patents, patents filing procedure, infringement & remedies and information technology act etc.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Formulate** the research problem, carryout literature survey and decide the methodology.	-	1	-
CO-2	**Use** measurement and scaling and **carryout** data collection.	-	1	-
CO-3	**Test** the hypothesis, **interpret** & **analyze** the results and **write** the report.	2	3	-
CO-4	**Explain** the need of IPR, copy right, patents, trademarks, & the filing procedure and know about infringement, remedies and regulatory framework.	-	2	-

Mapping level:

POs	**PO-1**	**PO-2**	**PO-3**
Mapping Level	2	2.5	2

Prerequisites: Branch specific course on problem analysis (Preferred)

Contents:

1. **Research Methodology:** Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, importance of knowing how research is done, research process, criteria of good research and problems encountered by researchers in India. **2 Hrs**

   Defining the Research Problem: Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration. **1 Hr**

2. **Reviewing the literature:** Importance of the literature review in research, How to review the literature, searching the existing literature, reviewing the selected literature and writing about the literature reviewed. **2 Hrs**

   Research Design: Meaning of research design, need for research design, features of a good design, important concepts relating to research design, different research designs, basic principles of experimental designs, important experimental designs **3 Hrs**

3. **Measurement and Scaling:** Measurement in research, measurement scales, sources of error in measurement, scaling, meaning of scaling and important scaling techniques **2 Hrs**

   Data Collection: Collection of primary data, observation method, interview method, collection of data through questionnaires, collection of data through schedules, difference between questionnaires and schedules, collection of secondary data **2 Hrs**

4. **Testing of Hypotheses:** What is a Hypothesis? Basic concepts concerning testing of hypotheses, procedure for hypothesis testing, flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses **2 Hrs**

5. **Interpretation and Report Writing:** Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation and mechanics of writing a research report, precautions for writing research reports, plagiarism and its significance. **3 Hrs**

6. **Introduction to Intellectual Property Rights:** Meaning and conception of IPR, competing, rationale for protection, international conventions, world court. **1 Hr**

   Copy right: Historical evolution of the law on copy right, meaning, content, substance, ownership, primary, special rights, obligations, period, assignment and relinquishment of copy rights. License and application for registration of copy right. **1 Hr**

   Patents: Meaning of Patent, purpose and policy object of patent law, gains to inventor, application of patents, joint application, discovery and invention, patentable and non-patentable inventions, publications and public use, priority date and its purpose, procedure for obtaining patent. Stages of procedure, refusal to grant patent - consequence, protection period, drafting if claims, grant of patent and significance of date of patent and date of ceiling. Services available with patent office, jurisdiction, appellate authorities, powers and obligations of central government, patent agent and controller – not a civil court. **3 Hrs**

I**ndustrial design:** Concepts & Significance **1 Hr**

Trademarks: Definitions and conceptions of Trademark, advantages of registration, marks which are not registrable, known and well-known trademarks, application for registration and procedure for registration, procedure and certification of Trademarks **1 Hr**

Infringement and Remedies: Meaning of infringement, acts of infringements, suit against infringement and defence against infringement, reliefs and certificate of validity. **1 Hr**

The information Technology Act: Definitions, certifying authority, meaning of compromise of digital signature, offences and penalties, applicability of IPRs, cybercrimes, adjudicating officer, violation, damages and penalties, Cyber regulation appellate tribunal, World Wide Web and domain names and cyber flying. Self-Study. **1 Hr**

Reference Books:

1. C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 4th Edition, 2018.
2. Ranjit Kumar, Research Methodology a step-by-step guide for beginners, SAGE Publications, 3rd Edition, 2011.
3. Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.
4. N. K. Acharya, Text book on Intellectual Property Rights, 4th Edition, Asia Law House, Hyderabad

20PMCSC100 Mathematical foundations of Computer Science (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):
Acquaint with principles of Probability theory, Random process, Linear Algebra, and apply the knowledge in the applications of Computer science and engineering applications.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs(1 to 6)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Apply** the idea of random variables (discrete/continuous) and probability distributions in analyzing the probability models arising in random processes.	-	3,6	-
CO-2	**Use** different techniques for estimating the parameters of a given distribution.	-	3,6	-
CO-3	**Understand** each technique and use appropriate method to analyze multivariate data.	-	3,6	-
CO-4	**Apply** Linear Algebra for decomposition and dimension-reduction of large data.	3,6	-	-
CO-5	**Apply** the mathematical concepts in fields of computer science and Engineering.	-	3,6	-

Mapping Level:

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	-	-	2.2	-	-	2.2

Prerequisites: Basic probability theory, Random variables and Statistical Averages.

Contents:

1. **Probabilty**: Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, probabilistic inequalities, Markov chains. **12 Hrs**

2. **Sampling:** Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood**.** **10 Hrs**

3. **Statistics:** Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal components analysis**,** The problem of overfitting model assessment. **10 Hrs**

4. **Linear Algebra:** Computation of Eigen values and Eigen vectors of real symmetric matrices- Given's method. Orthogonal vectors and orthogonal bases. Gram-Schmidt orthogonalization process. QR decomposition, singular value decomposition, least square approximations**.** **10 Hrs**

5. **Computer science and engineering applications:** Applications to varying fields of CSE like bioinformatics, soft computing, machine learning, data mining, computer vision, Network protocols, analysis of Web traffic, computer security, operating systems, distributed systems. **10 Hrs**

Reference Books:

1. Verma, Foundation Mathematics for Computer Science, 1986

2. K. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.

3. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 2011

4. Richard Bronson, "Schaum's Outlines of Theory and Problems of Matrix Operations", McGraw-Hill, 1988.

20PCSEC101 Advanced Algorithms (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course focuses on asymptotic performance of algorithms, familiarity with major algorithms and data Structures, apply important algorithmic design paradigms and design efficient algorithms in common engineering design situations.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs(1 to 6)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Analyze** time complexities of algorithms using asymptotic analysis and amortized analysis.	-	3	-
CO-2	**Establish** and solve recurrences using tree method, master method, and substitution method.	-	3	-
CO-3	**Design** and **implement** solutions to engineering problems using Graph algorithms.	3	2	4,6
CO-4	**Demonstrate** number-theoretic algorithms.	-	2,3	4,6
CO-5	**Implement** and **analyze** string matching algorithms.	3	2	4,6
CO-6	**Explain** algorithms for solving geometric problems	-	3	6
CO-7	**Explain** and **analyze** randomized algorithms	-	3	-

Mapping Level:

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	-	2	2.3	1	-	1

Pre requisites: Knowledge of Data Structures

Contents:

1. **Review of Analysis Techniques:** Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods **12 Hrs**
2. **Graph Algorithms:** Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite Matching **10 Hrs**
3. **Number -Theoretic Algorithms:** Elementary notions, GCD, Modular Arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, RSA cryptosystem, Primarily testing, Integer factorization **10 Hrs**
4. **String-Matching Algorithms:** Naïve string Matching, Rabin - Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm, Boyer – Moore algorithms **10 Hrs**
5. **Computational Geometry:** Line segment properties, finding whether any pair of segments intersects, convex hull, closest pair of points**.** **05 Hrs**

   Probabilistic Analysis and Randomized Algorithms: The hiring problem, Indicator random variables, Randomized algorithm **05 Hrs**

Reference Books:

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein "Introduction to Algorithms", 3rd Edition, Prentice -Hall of India, 2010.
2. Kenneth A. Berman, Jerome L. Paul "Algorithms", Cengage Learning, 2002
3. Ellis Horowitz, SartajSahni, S.Rajasekharan "Fundamentals of Computer Algorithms", 2nd Edition, Universities press, 2007

20PCSEC102 Artificial Intelligence and Machine Learning (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):
Objective of this course is to make student knowledge-full enough to determine when an AI approach is appropriate for a given problem, identify the appropriate representation, reasoning mechanism, models, algorithms, implement and evaluate it.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs(1 to 6)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Understand** the world, behavior of agents and problem solving aspects of agents.	-	3,4	-
CO-2	**Demonstrate** the representation and usage of knowledge using First order logic.	-	3,4	-
CO-3	**Understand** the decision making process even with incomplete, inconsistent and ever changing facts.	-	3,4	-
CO-4	**Understand** the strengths and weaknesses of many popular machine learning approaches with awareness to SVM and Neural Networks in machine learning.	-	3,4	-
CO-5	**Understand** and **apply** unsupervised algorithms for clustering, able to interpret appropriateness of among the three learning styles and performance of a simple learning system on a real-world dataset.	-	3,4,5	-

Mapping Level:

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	-	-	2	2	2	-

Prerequisites: Knowledge of Logic, Discrete Mathematic, Programming fundamentals.

Contents:

1. **What is AI (Artificial Intelligence)?** : The AI Problems, The Underlying Assumption, What are AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means Ends Analysis. **10 Hrs**
2. **Knowledge Representation Issues:** Representations And Mappings, Approaches To Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning. **10 Hrs**
3. **Symbolic Reasoning Under Uncertainty**: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability and Bays' Theorem, Certainty Factors And Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory **10 Hrs**
4. **Introduction to Statistical Decision Theory** - Regression, Classification, Bias Variance Linear Regression, Multivariate Regression, Subset Selection,
   logistic regression Linear Models for Classification, Decision Trees, Regression Trees **11 Hrs**
5. **Perceptron, Support Vector Machines, Neural Networks** - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization, Training & Validation, Parameter Estimation - MLE, MAP, Bayesian Estimation
   Unsupervised learning and clustering – k-means clustering, hierarchical clustering **11 Hrs**

Reference Books:

1. Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
2. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2009.
3. The Elements of Statistical Learning, by Trevor Hastie, Robert Tibshirani, Jerome H. Friedman (freely available online)
4. Pattern Recognition and Machine Learning, by Christopher Bishop (optional)
5. Mitchell Tom, Machine Learning. McGraw Hill, 1997

20PCSEE125 Image Processing and Computer Vision (3-0-2) 4

Contact Hours: 39+13

Course Learning Objectives

This course focuses on basic principles of digital image processing and computer vision to implement solutions for image processing problems.

Course Outcomes:

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs(1 to 6)		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** and **analyze** the principles of Digital Image Processing with image sensing and acquisition techniques, Image formation, image representation	-	3,4	1
CO-2	**Apply** different morphological operations on an image.	3	4	1
CO-3	**Explore** and **apply** different image representation techniques for shape recognition	4	-	-
CO-4	**Comprehend** and **Apply** different segmentation techniques for computer vision.	3	4	-
CO-5	**Apply** Hough Transform for line, circle, and ellipse detections using 3D vision techniques	2, 3	5	6

Mapping Level

Pos	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	1	3	2.75	2.5	2	1

Pre-requisites: Knowledge of: Basics of statistics, Linear Algebra, computer graphics

Contents:

1. **The Image, its mathematical and physical background:** Overview, Linear integral transforms Image formation physics. **Image Pre-processing:** Pixel brightness Transformations, Geometric transformations, Local Pre-processing, Image restoration **8 Hrs**
2. **Mathematical Morphological:** Preliminaries, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms **7 Hrs**
3. **Representation and description:** Representation, Boundary descriptors, Regional descriptors, Using PCA for description. **Shape representation and description:** Region identification, Contour-based shape representation and description, Region-based shape representation and description. **Texture:** Statistical texture description, Synthetic texture description, Hybrid texture description methods **8 Hrs**
4. **Segmentation:** Thresholding, Edge-based segmentation, Region-based segmentation, Matching, Mean Shift Segmentation, Active Contour model. The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness, Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples. **8 Hrs**
5. **The Geometry of Multiple Views:** Two Views, Stereopsis: Reconstruction, Human Stereposis, Binocular Fusion, Using More Cameras, Segmentation by Clustering: What Is Segmentation? Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering **8 Hrs**

List of Assignments :

1. Point processing in spatial domain
    a. Negation of an image
    b. Thresholding of an image
    c. contrast Stretching of an image
2. Bit Plane Slicing
3. Histogram Equalization
4. Histogram Specifications
5. Zooming by interpolation and replication
6. Filtering in spatial domain a. Low Pass Filtering b. High Pass Filtering c. Median filtering
7. Hit-or-Miss Transformation
8. Object Recognition: based on decision theoretic methods, Structural recognition
9. Experiment on Edge detection Algorithm
10. Experiment on Linear Filters
11. Experiment on Segmentation
12. Experiment on Geometry

Reference Books:

1. Rafael C Gonzalez and Richard E. Woods: Digital Image Processing, Pearson Publication,4th Edition 2017
2. A. K. Jain: Fundamentals of Digital Image Processing, Pearson, 2004.
3. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomson Learning, Brooks/Cole, 2001
4. Rafael C Gonzalez and Richard E. Woods: Digital Image Processing, Using MATLAB, PHI 2nd Edition 2005.
5. D. A. Forsyth and J. Ponce; Computer Vision: A Modern Approach; Pearson Education; 2003.
6. Richard Szeliski; Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.

20PCSEE126 Block Chain Technology (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course focuses on understanding emerging abstract models for Blockchain Technology and familiarizes the functional/operational aspects of crypto currency ecosystem. Identify major research challenges and technical gaps existing between theory and practice in crypto currency domain.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level (2)	Slight level (1)
CO-1	**Demonstrate** the basics of Block chain concepts using modern tools/technologies.	-	3, 4, 5	1
CO-2	**Analyze** the role of block chain applications in different domains including cyber security.	-	3, 5	-
CO-3	**Evaluate** the usage of Block chain implementation/features for the given scenario.	-	1, 3, 4	-
CO-4	**Exemplify** the usage of bitcoins and its impact on the economy.	3	-	-
CO-5	**Analyze** the application of specific block chain architecture for a given problem	3	2	6

Mapping Level:

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	1.5	2	2.4	2	2	1

Prerequisites: Programming and Data Structures

Contents:

1. Introduction to Blockchain, How Blockchain works, Blockchain vs. Bitcoin, Practical applications, public and private key basics, pros and cons of Blockchain, Myths about Bitcoin **10 Hrs**
2. Blockchain: Architecture, versions, variants, use cases, Life use cases of Blockchain, Blockchain vs. shared Database, Introduction to crypto currencies, Types, Applications. **11 Hrs**
3. Concept of Double Spending, Hashing, Mining, Proof of work. Introduction to Merkel tree, Privacy , payment verification , Resolving Conflicts , Creation of Blocks **10 Hrs**
4. Introduction to Bitcoin, key concepts of Bitcoin, Merits and De Merits Fork and Segwits, Sending and Receiving bitcoins, choosing bitcoin wallet, Converting Bitcoins to Fiat Currency **10 Hrs**
5. Introduction to Ethereum, Advantages and Disadvantages, Ethereum vs. Bitcoin, Introduction to Smart contracts, usage, application, working principle, Law and Regulations. Case Study **11 Hrs**

Reference Books:

1. Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions by Arshdeep Bikramaditya Signal, Gautam Dhameja (Priyansu Sekhar Panda., APress.)
2. Blockchain Applications: A Hands-On Approach by Bahga, Vijay Madisetti
3. Blockchain by Melanie Swan, OReilly.
4. Bitcoin and Cryptocurrency Technologies by Aravind Narayan. Joseph Bonneau, princton
5. Bitcoin and Blockchain Basics: A non-technical introduction for beginners by Arthu.T Books

20PCSEL102 Artificial Intelligence and Machine Learning Lab (0-0-3) 2

Contact Hours: 39

Course Learning Objectives (CLOs):

To provide hands on support to the students' study to determine when an AI approach is appropriate for a given problem, identify the appropriate representation and reasoning mechanism models, algorithms, implement and evaluate it.

Course Outcomes:

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Understand** the world, behavior of agents and problem solving aspects of agents	-	3,4	-
CO-2	**Demonstrate** the representation and usage of knowledge using First order logic.	-	3,4	-
CO-3	**Understand** the decision making process even with incomplete, inconsistent and ever changing facts	-	3,4	-
CO-4	**Understand** the strengths and weaknesses of many popular machine learning approaches with awareness to SVM and Neural Networks in machine learning	-	3,4	-
CO-5	**Understand** and **apply** unsupervised algorithms for clustering, able to interpret appropriateness of among the three learning styles and performance of a simple learning system on a real-world dataset.	-	3,4,5	-

Mapping Level:

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	-	-	2.0	2.0	2.0	-

Course Contents:

This course is in line with the theory course 20PCSEC102. There will be one Problem with the Knowledge Representation and four problems on Machine Learning (Linear Regression, Multilinear regression, Decision Tree, K-means clustering). The problems to be composed by the faculty announce to the students. The student will analyse the problem, justify the requirement of AI Approach for the solution, choose the platform or technology for implementations and demonstrate all the steps involved like pre-processing the dataset, importing the dataset, Spitting the dataset into the training set and test set, training the model on the training dataset, predicting the test set results, Visualising the Training set results, Visualising the test set results, etc where ever applicable. The students will submit implementation, conduction and observation write up for each problem. An internal examination and 5 problems work will be used to grade the student's performance in this course.

Associated Lab Assignments (Sample):

1. Represent facts and relationships of any famous epic of your choice using first order logic, implement and demonstrate some queries.
2. Build a decision tree for the case of SDMCET students' performance based on the IA-1, IA-2, IA-3, CTA, Attendance, SEE marks (optional) and classifying them into one of the Grade S, A, B, C, D, E & F. Study of precision of classification by including the 10^{th}, 12^{th} and CET/COMED-K into consideration.
3. Given the features of an email like , Sender's email ID, Number of typos in the email, Occurrence of words like "offer", "prize", "free Gift", classify the email as Spam or not. Use the feature vector to train a Logistic classifier which emits a score in the range 0 to 1. If the score is more than 0.5, we label the email as spam. Otherwise, we don't label it as spam. (From https://magoosh.com/).
4. Linear and polynomial regression one more
5. A Hospital Care chain wants to open a series of Emergency-Care wards within a region. We assume that the hospital knows the location of all the maximum accident-prone areas in the region. They have to decide the number of the Emergency Units to be opened and the location of these Emergency Units, so that all the accident-prone areas are covered in

the vicinity of these Emergency Units. The challenge is to decide the location of these Emergency Units so that the whole region is covered. Here is when K-means Clustering comes to rescue! (From : https://www.edureka.co/blog/k-means-clustering/)

20PCSEL103	Seminar-I	(0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs): The objective of the seminar is to inculcate self-learning, enhance communication skill, motivated to reach high standards and become self-confident, involve in group discussion and present the ideas before the audience.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Communicate** effectively on a technical topic	1,3	2	4
CO-2	**Prepare** presentation slides and Report using industry standard tools.	1,3	2	4
CO-3	**Involve** in technical group discussion actively.	1,3	2	4
CO-4	**Interact and Manage** discussions with class audience.	1,3	2	4

Mapping Level

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	3	2	3	1	-	-

Seminar Guidelines:

Each student, under the guidance of a Faculty, is required to

i) Choose a topic of his/her interest relevant to the Course of Specialization.

ii) Carryout literature survey, organize the subject topics in a systematic order.

iii) Prepare the report using LATEX tool/Microsoft word.

iv) Present the seminar topic at least for 30 minutes through power point slides.

v) Answer the queries and involve in debate/discussion lasting for about 10 minutes.

vii) Submit two copies of the report.

viii) Preferably, the seminar contents should not be studied in their regular courses.

ix) Participation in the seminar by all post graduate students of the same program shall be mandatory.

x) The internal assessment marks shall be awarded by a committee consisting of at least two staff members (including guide) and shall be based on the evaluation of the seminar report, presentation skill and Question/Answer session and quality of report.

II – Semester

20PCSEC200 Advanced Computer Networks (4-0-0) 4

Contact Hours: 52

Course Learning Objectives

This course focuses on advanced concepts of Computer Networks, protocols, internetworking and congestion algorithms.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Demonstrate** systematic and critical understanding of the theories, principles and practices of computer networks.	-	3	-
CO-2	**Explain** and **apply** switching and Internetworking mechanisms.	-	1,3	4
CO-3	**Explain** intra-network and internetwork routing algorithms.	1	3	4
CO-4	**Demonstrate** a systematic and critical understanding of end-to-end issues.	1	3	4
CO-5	**Explain** congestion control techniques.	1	3	4

Mapping Level

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.75	-	2	1	-	-

Prerequisites: Basic Knowledge of Computer Networks.

Contents:

1. **Foundation:** Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait , Sliding Window, Concurrent Logical Channels. **10 Hrs**
2. **Internetworking I:** Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork?, Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels. **10 Hrs**
3. **Internetworking- II:** Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6 (IPv6), Mobility and Mobile IP **12 Hrs**
4. **End-to-End Protocols:** Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery. **10 Hrs**
5. **Congestion Control and Resource Allocation Congestion**-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System (DNS), Electronic Mail (SMTP, POP, IMAP, MIME), World Wide Web (HTTP), Network Management (SNMP) **10 Hrs**

Reference Books

1. Larry Peterson and Bruce S Davis "Computer Networks: A System Approach", 5th Edition, Elsevier 2014.
2. Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture", 6th Edition, PHI 2014.
3. Uyless Black, "Computer Networks, Protocols, Standards and Interfaces" 2nd Edition - PHI.
4. Behrouz A Forouzan, "TCP /IP Protocol Suite" 4th Edition – Tata McGraw-Hill

20PCSEC201 Distributed Systems (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course focuses on the learning perspectives to know the design principles of distributed architectures and to prepare design solutions using industry relevant technology.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Elucidate** the functional characteristics of various components of distributed system architecture.	-	4	-
CO-2	**Explain** the functioning of various communication protocols, synchronization strategies and **develop** a simple distributed system using appropriate technology.	4	-	2
CO-3	**Explain** the principles of consistency models and **differentiate** between various fault handling techniques in distributed system.	-	4	-
CO-4	**Explain** the principles of distributed object based strategies necessary for a distributed system.	-	3, 4	-
CO-5	**Explain** the characteristics of various components of an industry relevant product used in building distributed file system and **demonstrate** storage and retrieval operations.	4	1, 5	-

Mapping Level

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2	1	2	2.4	2	-

Prerequisites: Knowledge of Computer Networks and Operating Systems

Contents:

1. Goals, Types of distributed systems, Architectural styles, System architectures, Architectures versus Middleware, Threads, Virtualization, Clients, Servers and Code migration **10 Hrs**

2. Remote procedure call, Message-oriented communication, Stream-oriented communication, Multicast communication, Names, Identifiers and Addresses, Structured naming, Clock synchronization, Logical clocks, Mutual exclusion, Global positioning of nodes and Election algorithms **12 Hrs**

3. Data centric consistency models, Client centric consistency models, Replica management, Consistency protocols, Process resilience, Reliable client server communication, Reliable group communication, Distributed commit and Recovery. **10 Hrs**

4. Distributed object based systems, Architecture, Processes, Communication, Naming, Synchronization, Consistency and replication, Fault tolerance and Security. **10 Hrs**

5. Distributed file systems, Architecture, Processes, Communication, Naming, Synchronization, Consistency and replication, A case study on distributed file system used in industry with relevant technology/platform **10 Hrs**

Reference Books:

1. Andrew S Tanenbaum & Maarten van Steen, "Distributed Systems Principles and Paradigms", Second Edition, 2007, Pearson Prentice Hall.
2. Tom White, "Hadoop: The Definitive Guide", Fourth Edition, 2015, O'Reilly.
3. George Coulouris, Jean Dollimore, Tim Kindberg & Gordon Blair, "Distributed Systems Concepts and Design", Fifth Edition, 2012, Addison-Wesley.
4. Pradeep K .Sinha, Distributed Operating Systems PHI,Eastern Economy Edition,2012

20PCSEE225 Internet of Things (3-0-2) 4

Contact Hours: 39+13

Course Learning Objectives (CLOs):

This course provides insights on IoT architecture, communication protocols, sensor networks and applications of IoT. It addresses security and privacy challenges faced by IoT. It also focuses on setting up of an IoT ecosystem to implement use cases by applying the key concepts of IoT.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Describe** IoT service-oriented architecture and its components.	-	-	3, 6
CO-2	**Demonstrate** the use of IoT protocols for developing applications related to smart spaces.	-	1	3, 6
CO-3	**Explain** WSN and UAV (Unmanned Aerial Vehicles) network architecture for interconnectivity and communication among heterogeneous IoT devices.	-	-	3, 6
CO-4	**Explore** the challenges faced in IoT with respect to privacy and security and **provide** theoretical/practical solutions.	2	1, 5	3, 6
CO-5	**Set up** an IoT ecosystem and **implement** various use cases by applying the key concepts of IoT.	1	3	6

Mapping Level

PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.34	3.0	1.2	-	2.0	1.0

Prerequisites: Knowledge of block chain technology.

Contents:

1. **Introduction to IoT and networking:** What is IoT; IoT overview; Applications of IoT; Sensing - what is a sensor and transducer, sensor types; Actuation - what are actuators, actuator types, IoT networking: Basics of IoT networking; components of IoT; service-oriented architecture of IoT. **7 L+ 4 P**
2. **IoT Protocols:** IoT Protocols- MQTT, SMQTT, CoAP, XMPP, AMQP; Communication Protocols- IEEE 802.15.4, ZigBee, 6LoWPAN, HART, Bluetooth, Zwave, ISA 100.11 A **7 L+ 4 P**
3. **WSNs and UAV (Unmanned Aerial Vehicles) Networks:** WSNs - what is wireless sensor network, concepts and challenges, node behavior; Applications of WSNs - Target/Object Tracking, Agriculture; UAV Networks - features, constraints, advantages, topologies.
   M2M Communication and Interoperability in IoT: M2M communication - concepts, features, applications, node types, M2M area management; Interoperability in IoT - challenges, types of interoperability - syntactic and device interoperability. **7 L+6 P**
4. **Internet of Things Security & Privacy:** Introduction, IoT Security Challenges, IoT Security Requirements, IoT Three-Domain Architecture, Cloud Domain Attacks and Countermeasures, Fog Domain Attacks and Countermeasures, Sensing Domain Attacks and Countermeasures, Future Directions.
   The Blockchain in IoT: Consensus Algorithms in IoT, Blockchain Applications in IoT, M2M Transactions, Energy Management, Supply Chain Management, Healthcare, Retail, Automotive and Transportation, Smart City, Identity, Authentication, and Access Management, Other Blockchain IoT Applications, Blockchain Security in IoT, Trust Between Nodes, Malicious Activity and Cryptographic Principles, IoT Security and Blockchain Advantages **9 L+ 6 P**
5. **Implementation of IoT with Raspberry Pi:** Raspberry Pi- architecture, components, blinking LED, image processing with Raspberry Pi; Interfacing various sensors with Raspberry Pi.
   Demonstration of blockchain technology: Ethereum IDE, Blockchain demo Anders, writing smart contracts using solidity language, Building DApp for blockchain, Use cases of IoT using blockchain. **9 L+ 6 P**

List of Assignments:

1. Write python program to collect and display sensor data (temperature, humidity, LDR, ultrasonic) from Raspberry Pi microcontroller on the console.
2. Write python program to send the sensor data to the cloud using freely available cloud frameworks and visualize the collected data on the cloud.
3. Write programs to perform basic data analytics on the collected sensor data.
4. Write python program to control the sensors deployed through cloud, using one of the protocols – MQTT, SMQTT, CoAP, XMPP, AMQP.

5. Write python program to make use of one of the communication protocols – IEEE 802.15.4, ZigBee, 6LoWPAN, HART, Bluetooth, Zwave, ISA 100.11 A, to establish communication link between two or more Rasberry Pi units/clusters.
6. Realization of IoT communication protocols – IEEE 802.15.4, ZigBee, 6LoWPAN, HART, Bluetooth, Zwave, ISA 100.11 A, using Centiki OS and Cooja/NS3 Network Simulator.
7. Use solidity language to write and deploy smart contracts using the cloud IDEs – Ethereum Remix, Ethereum Studio.

Reference Books:

1. Pethuru Raj, Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms and Use Cases", CRC Press,2017.
2. Arshdeep Bahga, Vijay Madisetti ,"Internet of Things – A Hands-on Approach", Universities Press, 2015.
3. Ammar Rayes, Samer Salam, "Internet of Things From Hype to Reality – The Road to Digitalization", Second Edition, ISBN 978-3-319-99515-1, Springer Nature Switzerland AG 2017, 2019.
4. Research Papers on recent trends in IoT.

20PCSEE226 Deep Learning (3-0-2) 4

Contact Hours: 39+13

Course Learning Objectives

This course focuses on the concepts of Deep Learning and its applications in solving real life problems.

Course Outcomes:

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Explain and Apply** the basic principles of Neural Network.	3	1	6
CO-2	**Explain** regularization strategies and optimization techniques for Deep Models.	-	1	6
CO-3	**Design** the architecture of CNN for the given problem scenario.	3	1,2	5,6
CO-4	**Design** the architecture of RNN for the given problem scenario.	3	1,2	5.6
CO-5	**Explain** Linear Factor Models and Auto encoders.	-	-	6

Mapping Level

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2	2	3	-	1	1

Pre-requisites: Knowledge of Linear Algebra, Machine Learning.

Contents:

1. **Deep Feed forward Networks** : Introduction to Neural Network, Multilayer Perceptron, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms, Historical Notes **8 Hrs**

2. **Regularization for Deep Learning and Optimization for Training Deep Models.** Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problem, Dataset Augmentation, Noise Robustnes, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop, and Manifold Tangent Classifier.How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms **8 Hrs**

3. **Convolution Neural Networks :** The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuroscientific Basis for Convolutional Networks, Convolutional Networks and the History of Deep Learning **8 Hrs**

4. **Sequence Models: Recurrent and Recursive Nets (RNN) :**
   Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory **8 Hrs**
5. **Deep Learning Research :** Linear Factor Models, Autoencoders; Probabilistic PCA and Factor Analysis, Independent Component Analysis (ICA), Slow Feature Analysis, Sparse Coding, Manifold Interpretation of PCA, Undercomplete Autoencoders, Regularized Autoencoders, Representational Power, Layer Size and Depth, Stochastic Encoders and Decoders, Denoising Autoencoders, Learning Manifolds with Autoencoders, Contractive Autoencoders, Predictive Sparse Decomposition, Applications of Autoencoders **7 Hrs**

Lab Experiments:

Implementation of following algorithms on given problem scenario;

1. Neural Networks
2. Convolution Neural Networks
3. Recurrent and Recursive Networks

Reference Books:

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, An MIT Press book,2016
2. Deep Learning with Python, Francois Chollet, Manning Publications,2017, **ISBN-10,** 9781617294433.
3. Dive into Deep Learning Release 0.8.0 Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, 2020.

20PCSEE227	Data Science	(3-0-2) 4

Contact Hours: 39+13

Course Learning Objectives (CLOs):

This course focuses on the concepts of Data Science with special emphasis on industry relevant tools for statistical analysis of social networks.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Explain** the limitations of transactional databases and hence the need for new framework to manage the big data.	-	3	-
CO-2	**Explain** the importance of big data and its applications in various fields.	-	3	-
CO-3	**Solve** a given problem by applying a suitable machine learning technique.	3	1	-
CO-4	**Analyze** the given problem through statistical modeling using industry relevant tools.	-	4	-
CO-5	**Explain** the importance of social networks and their graph representations.	-	1,3	-

Mapping Level

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.0	-	2.25	2.0	-	-

Prerequisites: Knowledge of Statistics and Java Programming at introductory level.

Contents:

1. **Introduction to Data Science:** Revision of RDBMS, Definition, Applications, Data Science life cycle, Components of Data Science, NoSQL **8 Hrs**
2. **Big Data and Analytics:** Distributed File System – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications, Algorithms using map reduce. **Hadoop and its architecture:** Apache Hadoop and Ecosystem, Moving data in and out of Hadoop, Understanding inputs and outputs of Map Reduce **8 Hrs**
3. **Modeling methods:** Choosing and evaluating models, Mapping problems to machine learning, Evaluating clustering models, Validating models, Cluster analysis – K means algorithm, Naïve Bayes algorithm, Memorization methods – Linear and logistic regression. **8 Hrs**
4. **Introduction to R programming:** Reading and getting data into R,Ordered and unordered factors,Arrays and matrices,Lists and data frames, Reading data from files, Probability distributions, Statistical models in R,Manipulating objects, Data distribution **8 Hrs**
5. **Mining of Social Network Graphs:** Social networks as graphs, Clustering of social network graphs, Direct Discovery of Communities, Partitioning of Graphs, Finding overlapping communities, Simrank, Neighbourhood properties of graphs **7 Hrs**

Practice programs :

1) Use hadoop fs command to interact with HDFS to
    a. Review the commands available for HDFS.
    b. Copy file foo.txt from local disk to the user's directory in HDFS.
    c. Get a directory listing of the user's home directory in HDFS.
    d. Get a directory listing of the HDFS root directory.
    e. Display the contents of the HDFS file user/fred/bar.txt
    f. Move that file to the local disk and name it as baz.txt
    g. Create a directory called input under the user's home directory.
    h. Delete the directory input and all its contents.

2) Map Reduce:
    a. Create a JOB and submit to cluster.
    b. Track the information.
    c. Terminate the job.
    d. Counters in MR jobs with examples.
    e. Map only Jobs and generic map examples.

3) Map Reduce (Programs): Using movie lens data
    a. List all the movies and the number of ratings.
    b. List all the users and the number of ratings they have done for a movie.
    c. List the movie IDs which have been rated.
    d. List all the users who have rated the movies.
    e. List of all the users with the max, min, and average ratings they have given for a movie.
    f. List all the movies with the max, min, and average ratings given by any user.

4) R programming - Examples

Reference Books:

1. Tom White, "Hadoop: The Definitive Guide", 3/e, O'Reilly, 2012.
2. Eric Sammer, "Hadoop Operations", O'Reilly, 2012.
3. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2018.
4. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing, 2013.
5. Jure Leskovec, Anand Rajaraman, Jeff Ullman, "Mining of Massive Datasets", 2nd Edition, Cambridge University Press, 2015

20PCSEE228 Wireless Networks & Mobile Computing (3-0-2) 4

Contact Hours: 39+13

Course Learning Objectives:

This course focuses on the concepts of wireless communication, propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication. It addresses CDMA, GSM, Mobile IP, WiMAX. It also deals with various tools/techniques available to develop different mobile Internet applications.

Course Outcomes:

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Explain** mobile computing architecture of GSM and GPRS.	-	3	-
CO-2	**Explain** issues related to mobility in computing environment.	-	4	-
CO-3	**Explain** Mobile operating systems and the operating environment for Palm OS, WinCE, Symbion, and Android	-	3, 4	-
CO-4	**Explain** the basic principles of mobile applications and **develop** simple mobile Internet applications.	3	2	-
CO-5	**Write** programs using MIDlet models.	3, 4	2	-

Mapping Level

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	-	2	2.5	2.33	-	-

Pre-requisites:

Knowledge of Computer Networks

Contents:

1. **Mobile Computing Architecture:** Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Wireless Networks: Global Systems for Mobile Communication (GSM and Short Service Messages (SMS): GSM Architecture, Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Introduction to SMS, SMS Architecture, SM MT, SM MO, SMS as Information bearer, applications, GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Billing and Charging in GPRS, Spread Spectrum technology, IS-95, CDMA versus GSM, Wireless Data, Third Generation Networks, Applications on 3G, Introduction to WiMAX. **10 Hrs**
2. **Mobile Client:** Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices. Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6 **5 Hrs**
3. **Mobile OS and Computing Environment**: Smart Client Architecture, The Client: User Interface, Data Storage, Performance, Data Synchronization, Messaging. The Server: Data Synchronization, Enterprise Data Source, Messaging. Mobile Operating Systems: WinCE, Palm OS, Symbian OS, Linux and Proprietary OS, Android; Client Development: The development process, Need analysis phase, Design phase, Implementation and Testing phase, Deployment phase, Development Tools, Device Emulators **6 Hrs**
4. **Building Mobile Internet Applications:** Thin client: Architecture, the client, Middleware, messaging Servers, Processing a Wireless request, Wireless Applications Protocol (WAP) Overview, Wireless Languages: Markup Languages, HDML, WML, HTML, cHTML, XHTML, VoiceXM. **10 Hrs**
5. **Introduction, CDC, CLDC, MIDP:** Programming for CLDC, MIDlet model, Provisioning, MIDlet lifecycle, Creating new application, MIDlet event handling, GUI in MIDP, Low level GUI Components, Multimedia APIs; Communication in MIDP, Security Considerations in MIDP. **8 Hrs**

Assignments :
Students should implement any 4 mobile Internet applications.

Reference Books:

1. Mobile Computing: Technology, Applications and Service Creation, Ashok Talukder, RoopaYavagal, Hasan Ahmed, 2nd Edition, Tata McGraw Hill, 2017.
2. Martyn Mallik: Mobile and Wireless Design Essentials, Wiley India, 2003
3. Raj Kamal: Mobile Computing, Oxford University Press, 2007.
4. ItiSahaMisra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009.

20PCSEE229 Soft Computing (3-0-2) 4

Contact Hours: 39+13

Course Learning Objectives (CLOs):

This course focuses on introductory concepts in evolutionary computing techniques like fuzzy systems and neural networks.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Explain** the philosophy of soft computing and architecture of neural network.	1	2, 3	-
CO-2	**Demonstrate** the working of supervised learning in neural networks.	1	2, 3	-
CO-3	**Demonstrate** the working of unsupervised learning in neural networks.	1	2, 3	-
CO-4	**Explore** the concepts, operations, properties of fuzzy logic, classical sets and fuzzification process.	-	1, 2	3
CO-5	**Comprehend** the principle and concepts of Defuzzification, Fuzzy arithmetic and measures.	-	1	2, 3

Mapping level:

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.6	1.8	1.6	-	-	-

Contents:

1. **Introduction to Soft Computing and Artificial Neural Network :**
   Neural networks, Application scope of neural networks, Fuzzy Logic, Genetic algorithm, hybrid systems, fundamental concepts of neural networks, evolution and basic model of artificial neural network, important terminologies of ANNs, McCulloch Pitts neuron, linear separability, Hebb network. **8 Hrs**
2. **Supervised Learning Networks :**
   Perceptron networks, Adaptive linear neuron, Multiple Adaptive linear neuron, Back – Propogation networks, Radial basis function networks, time delay neural networks, functional link networks, tree neural networks. . **8 Hrs**
3. **Unsupervised learning networks :**
   Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vector quantization, counter propagation networks, adaptive resonance theory network **8 Hrs**
4. **Introduction to Fuzzy Logic, Classical relations and Fuzzy relations and Membership functions:** Classical sets, fuzzy sets, Cartesian product of relations, classical relation, fuzzy relation, tolerance and equivalence relation, non-interactive fuzzy sets, features of membership functions, fuzzification, methods of membership value assignments. **8 Hrs**
5. **Defuzzification, Fuzzy Arithmetic and Fuzzy measures:** Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods, Fuzzy Arithmetic, extension principles, fuzzy measure, measure of fuzziness. **7 Hrs**

List of Assignments: The following tasks can be implemented in a language of your choice or any tools available:

1. Implement the **Hebb Network**.
2. Implement the **Perceptron Training Algorithm** for Multiple output classes.
3. Demonstrate the training process for MADALINE Network.
4. Implement the **Feedforward Back-Propagation Network**.
5. Implement the **Radial Basis Network**.
6. Implement the **Maxnet Network**.
7. Implement the **Kohonen self – organizing feature maps**.
8. Implement the **Full Counter Propagation Net**.
9. Implement the **Forward only Counter Propagation Net**.

Reference Books:

1. S.N. Sivanandam and S.N. Deepa, Principles of Soft Computing, 2nd Edition, Wiley, 2016.
2. Diliip Kumar Pratihar, Soft Computing: Fundamentals and Application, 2nd Edition, Alpha Science International Limitied, 2015.
3. Simon Haykin, Neural Networks and Learning Machines 3rd Edition, Pearson, 2016.

20PCSEE230 Natural Language Processing & Text Mining (3-0-2) 4

Contact Hours: 39+13

Course Learning Objectives (CLOs):

This course focuses on the concepts, techniques and applications of natural language processing and text mining.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Explain** the Concepts of mathematics and linguistic foundations of natural language processing	-	3	-
CO-2	**Explain** the concepts related to the processing of the words.	3	1	2,6
CO-3	**Explain** and **Apply** the techniques related to POS tagging of tokens in NLP.	3	1,4	2,6
CO-4	**Explain** and **Apply** the rules to model natural language.	3	1,4	2,6
CO-5	**Explain** the architecture and Operations of text mining.	-	1,3	-
CO-6	**Explain** and **apply** the text categorization and clustering techniques	3	1,4	2,6

Mapping Level

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2	1	2.66	2	-	1

Prerequisites: Statistics and Probability, Formal languages and automata

Course contents:

1. **Introduction**: Basics of Natural Language Processing, Mathematical Foundations, Linguistic Essentials, Corpus Based Work **7 Hrs**
2. **Words:** Collocations, Statistical Inference: n -gram Models over Sparse Data, Spelling correction, Advanced smoothing for language modeling, Word Sense Disambiguation-Methodological Preliminaries, Supervised & Unsupervised Disambiguation, Dictionary-Based Disambiguation **8 Hrs**
3. **Part-of-Speech** Tagging, Markov Models, Probabilistic Context Free Grammars , Probabilistic Parsing **8 Hrs**
4. **Introduction to Text Mining:** Overview of text mining, General Architecture, Core Operations, Preprocessing techniques, Document classification, Information extraction, Evaluation of performance, sentiment analysis **8 Hrs**
5. **Text Categorization:** Machine Learning Approach to Text Categorization. Latent Dirichlet Allocation for text classification, Latent Semantic Indexing, Probabilistic Latent Semantic Indexing Classification of Linked and Web Data, Text Clustering: Supervised and Unsupervised Clustering. Text Summarization Techniques, **8 Hrs**

List of Assignments:

1. Write program to a given problem scenario to demonstrate the following operations:
    a. Tokenization
    b. sentence segmentation
    c. spelling correction
    d. stemming
    e. lemmatization
    f. POS tagging
2. Implementation on applications of NLP like
    a. Text summarization,
    b. Chatbot,
    c. Machine translation etc and preparing the paper on the chosen topic.

Reference Books:

1. Christopher Manning "Foundations of Statistical Natural Language Processing," MIT Press, July 1999.
2. Dan Jurafsky, James H Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Pearson Education India,2nd edition (2013).
3. Ronen Feldman, James Sanger "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data," Cambridge University Press, 2007.
4. Sholom Weiss, NitinIndurkhya, Tong Zhang, Fred Damerau "Text Mining Predictive Methods for Analyzing Unstructured Information," Springer, paperback 2010.

20PCSEL202	Advanced Computer Networks Laboratory	(0-0-3) 2

Contact Hours: 39

Course Learning Objectives (CLOs):

This course focuses on working with scenarios related to client-server communication using standard IPCs and explore various network protocol functions using any of the standard network simulators.

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Write** programs using threads/processes to solve process conflicts	3	1,2,4	-
CO-2	**Implement** client server communication using Inter-process Communication tools.	3	1,2,4	-
CO-3	**Simulate** the working of existing routing protocols.	3	1,2,4	-
CO-4	**Simulate** a network and measure its performance using network simulation tool.	3	1,2,4	-

Mapping Level

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.0	2.0	3	2.0	-	-

List of experiments:

1. The experiments are based on use of threads/processes and various APIs to implement IPCs and solve process related conflict/system applications.
2. The experiments based on implementation of different network protocols and use of network sim

20PCSEL203	Seminar-II	(0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs):

The objective of the seminar is to inculcate self-learning, enhance communication skill, motivated to reach high standards and become self-confident, involve in group discussion and present the ideas before the audience.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs (1 to 6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Communicate** effectively on a technical topic	1,3	2	4
CO-2	**Prepare** presentation slides and Report using industry standard tools.	1,3	2	4
CO-3	**Involve** in technical group discussion actively.	1,3	2	4
CO-4	**Interact and Manage** discussions with audience.	1,3	2	4

Mapping Level

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	3	2	3	1	-	-

Seminar Guidelines:

Each student, under the guidance of a Faculty, is required to

i) Choose a topic of his/her interest relevant to the Course of Specialization.

ii) Carryout literature survey, organize the subject topics in a systematic order.

iii) Prepare the report using LATEX tool/Microsoft word.

iv) Present the seminar topic at least for 30 minutes through power point slides.

v) Answer the queries and involve in debate/discussion lasting for about 10 minutes.

vii) Submit two copies of the report .

viii) Preferably, the seminar contents should not be studied in their regular courses.

ix) Participation in the seminar by all post graduate students of the same program shall be mandatory.

x) The internal assessment marks shall be awarded by a committee consisting of at least two staff members (including guide) and shall be based on the evaluation of the seminar report, presentation skill and Question/Answer session and quality of report.