Academic Program: PG

Academic Year 2023-24

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 2023-24 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 Examinations – 2022
M.Tech., Computer Science and Engineering
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
22PRIC100	Research Methodology and IPR	3-0-0	3	50	100	3	-	-
22PCSC100	Applied Mathematics	4-0-0	4	50	100	3	-	-
22PCSC101	Advanced Algorithm	3-0-2	4	50	100	3	-	-
22PCSC102	Artificial Intelligence and Machine Learning	4-0-0	4	50	100	3	-	-
22PCSE1XX	Elective 1	3-0-2	4	50	100	3	-	-
22PCSL102	Artificial Intelligence and Machine Learning Lab	0-0-3	2	50	-	-	50	3
22PCSL103	Seminar	0-0-2	1	50	-	-	-	-
Total		**17-0-9**	**22**	**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:

Course Code	Course Title	L-T-P
22PCSE125	Image and Video Analytics	3-0-2
22PCSE126	Soft Computing	3-0-2
22PCSE127	Block Chain Technology	3-0-2

Scheme of Teaching and Examinations – 2022
M.Tech., Computer Science and Engineering
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
22PCSC200	Cryptography and Network Security	4-0-0	4	50	100	3	-	-
22PCSC201	Internet of Things	3-0-2	4	50	100	3	-	-
22PCSE2XX	Elective 2	3-0-0	3	50	100	3	-	-
22PCSE2XX	Elective 3	3-0-0	3	50	100	3	-	-
22PCSE2XX	Elective 4	3-0-0	3	50	100	3	-	-
22PCSL202	Cryptography and Network Security Lab	0-0-3	2	50	-	-	50	3
22PCSL203	Seminar	0-0-2	1	50	-	-	-	-
Total		**16-0-7**	**20**	**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:

Sub Code	Subject Title	L-T-P
22PCSE225	Data science	3-0-0
22PCSE226	Deep Learning	3-0-0
22PCSE227	Data Visualization	3-0-0
22PCSE228	Wireless Networks & Mobile Computing	3-0-0
22PCSE229	Virtual Reality	3-0-0
22PCSE230	High Performance Computing	3-0-0
22PCSE231	Distributed Systems	3-0-0

Scheme of Teaching and Examinations – 2022
M.Tech., Computer Science and Engineering
III Semester M. Tech.

Course Code	Course Title	Teaching		Examination				
				CIE	Theory (SEE)		Practical (SEE)	
		L-T-P (Hrs/Week)	Credits	Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
22PCSC300	Cloud computing concepts & Application Development	4-0-0	4	50	100	3		
22PCSE3XX	Elective 5	3-0-0	3	50	100	3		
22PCSE3XX	Elective 6	3-0-0	3	50	100	3		
22PCSE3XX	Elective 7	3-0-2	4	50	100	3	-	-
OR								
22PCSL302	Internship in Industry or R&D organization	** Min 4 weeks during vacation after 2nd sem	4	50	-	-	100	3
22PCSL303	*** Project phase 1	0-0-6	6	50	-	-	50	3
Total		**13-0-8/10-4weeks-6)**	**20**	**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:

Sub Code	Subject Title	L-T-P
22PCSE325	Data Stream Mining	3-0-2
22PCSE326	Software Defined Network	3-0-0
22PCSE327	Software Project Management	3-0-0
22PCSE328	Human Computer Interface	3-0-0
22PCSE329	Natural Language Processing and Text Mining	3-0-2
22PCSE330	Metaverse Fundamentals	3-0-0
22PCSE331	Sematic Web	3-0-0

Scheme of Teaching and Examinations – 2022
M.Tech., Computer Science and Engineering
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
22PCSL400	Project phase-II	0-0-22	18	100	--	--	100	3
22PCSEOA1	**BOS recommended ONLINE course (NPTEL,MOOC)	-	Audit (PP)	-	-	-	-	-
22PCSEOA2	**BOS recommended ONLINE course	-	Audit (PP)	-	-	-	-	-
Total		**0-0-22**	**18**	**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: 42
Total Credits offered for the Second year: 38

I – Semester

22PRIC100 Research Methodology and IPR (3-0-0)3

Contact Hours: 39

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 6)**		
		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/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
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. **3 Hrs**
   Defining the Research Problem: Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration. **2 Hrs**
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. **3 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 **4 Hrs**
3. **Measurement and Scaling:** Measurement in research, measurement scales, sources of error in measurement, scaling, meaning of scaling and important scaling techniques **3 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 **3 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 **3 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. **4 Hrs**

6. **Introduction to Intellectual Property Rights:** Meaning and conception of IPR, competing, rationale for protection, international conventions, world court. **2 Hrs**

   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.

   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. **5 Hrs**

   I**ndustrial design:** Concepts & Significance **2 Hrs**

   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 **2 Hrs**

   Infringement and Remedies: Meaning of infringement, acts of infringements, suit against infringement and defence against infringement, reliefs and certificate of validity. **2 Hrs**

   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

22PCSC100 Applied Mathematics (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):

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	**Use** statistical technique and use appropriate method to analyze multivariate data.	3,6	-	-
CO-2	Determine Type-1 and Type-11 errors and test for goodness of fit using different methods. Explain Markov chains and describe stochastic process	-	-	3,6
CO-3	**Understand** vector spaces and related topics arising in magnification and rotation of images.	-	-	3,6
CO-4	**Apply** the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems.	-	3,6	-
CO-5	**Apply** Linear Algebra for decomposition and dimension-reduction of large data..	-	3,6	-

Mapping Level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	-	-	1.8	-	-	1.8

Pre-requisites:

1. Basic probability theory.
2. Random variables.(discrete and continuous)
3. To obtain Statistical Averages.

Contents:

1. **Statistics:** Statistical Inference: Introduction to multivariate statistical models: Curve fitting (Linear and Non-linear), Weighted least square approximation (Linear & Non Linear) Regression analysis: Linear, Non Linear & multiple regression. Correlation analysis: Correlation, rank correlation, Correlation for bivariate frequency distribution. The problem of over fitting model assessment. **10 Hrs**
2. **Probability: Sampling theory**: Testing of hypothesis by z test, t-student test, chi square - test. Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities.
   Markov chains: Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chains **12 Hrs**
3. **Vector Spaces:** Vector spaces; subspaces Linearly independent and dependent vectors Basis and dimension; coordinate vectors-Illustrative examples. Linear transformations, Representation of transformations by matrices **10 Hrs**
4. **Symmetric and Quadratic Forms:** Diagonalization, Quadratic forms, Constrained Optimization, The Singular value decomposition. Applications to image processing and statistics, Principal Component Analysis **10 Hrs**
5. **Orthogonality and least squares:** Inner product, orthogonal sets, orthogonal projections, orthogonal bases. Gram-Schmidt orthogonalization process. QR factorizations of a matrices, least square problems, applications to linear models (least square lines and least square fitting of other curves). **10 Hrs**

Reference Books:

1. Linear Algebra and its Applications David C. Lay, Steven R. Lay and J. J. McDonald Pearson Education Ltd 5 th Edition 2015.
2. Numerical methods for Scientific and Engg. Computation ,M K Jain, S.R.K Iyengar, R K. Jain New Age 2014 International 6th Ed.,
3. Probability, Statistics and Random Process, T. Veerarajan Tata Mc-Graw Hill Co 3 rd Edition 2016.

22PCSC101 Advanced Algorithms (3-0-2) 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	**Explain and analyze** 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 Multithreaded algorithms	-	3	-

Mapping Level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	-	2.0	2.3	1.0	-	1.0

Pre requisites: Knowledge of Data Structures

Contents:

1. **Review of Analysis Techniques:** Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods **8L**
2. **Graph Algorithms:** Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite Matching **8L +8P**
3. **Number -Theoretic Algorithms:** GCD, Modular Arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, RSA cryptosystem, Primarily testing, Integer factorization **8L+8P**
4. **String-Matching Algorithms:** Naïve string Matching, Rabin - Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm, Boyer – Moore algorithms **8L+2P**
5. **Probabilistic Analysis and Randomized Algorithms:** The hiring problem, Indicator random variables, Randomized algorithm **4L+6P**
   Multithreaded Algorithms : The basics of dynamic multithreading, Multithreaded matrix multiplication **3L+2P**

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

22PCSC102 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	**Recognize** 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	**Appreciate** the decision making process even with incomplete, inconsistent and ever changing facts.	-	3,4	-
CO-4	**Realize** 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/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	-	-	2.0	2.0	2.0	-

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

Contents:

1. Introduction to Artificial Intelligence: Introduction, Intelligent Agents , Solving problems by searching, Beyond Classical search, Adversarial Search. **10 Hrs**
2. Knowledge, Reasoning and Planning: Logical agents, First order logic, inference in First order logic, Classical planning, Planning and acting in Real world, Knowledge representation. **10 Hrs**
3. Uncertain Knowledge and reasoning: Quantifying uncertainty, Probabilistic reasoning, Probabilistic reasoning over time, Making simple decisions **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 Reinforcement learning **11 Hrs**

Reference Books:

1. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2009
2. Elaine Rich and Kevin Knight “Artificial Intelligence”, 2nd Edition, Tata Mcgraw-Hill, 2005.
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)

22PCSE125 Image and Video Analytics (3-0-2) 4

Contact Hours:52

Course Learning Objectives (CLOs):

This course is designed for post graduate level as an elective course, focuses on the principle, concepts, and representations in image and video analytics.

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 preprocessing techniques for better understanding of images	-	3,4	-
CO-2	Apply spatial filtering to images for the preprocessing purposes	-	3,4	-
CO-3	Apply color transformations to image and video data	-	3,4	-
CO-4	Make use of detection and classification methods for image and video data	-	3,4	-
CO-5	Apply and analyze the techniques through case studies	-	3,4,5	-

Mapping Level:

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

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

Contents:

1. Digital image representation- Visual Perception- Sampling and Quantization- Basic Relations between Pixels- Mathematical Tools Used in Digital Image Processing: Fundamental Operations –Vector and Matrix Operations- Image Transforms (DFT, DCT, DWT, Hadamard). **8L+6P**
2. Fundamentals of spatial filtering: spatial correlation and convolution-smoothing blurring- sharpening- edge detection - Basics of filtering in the frequency domain: smoothing-blurring- sharpening--Histograms and basic statistical models of image **8L+6P**
3. Detection of Objects of Interest, Tracking of Objects of Interest in a Sequence of Images, Tracking Objects of Interest Through a Camera Network. **8L+6P**
4. Biometric Techniques Applied to Video Surveillance, Vehicle Recognition in Video Surveillance, Activity Recognition **7L+4P**
5. Unsupervised Methods for Activity Analysis and Detection of Abnormal Events, Analysis of Crowded Scenes in Video, Detection of Visual Context, Example of an Operational Evaluation Platform: PPSL **8L+4P**

Reference Books:

1. R.C. Gonzalez, R.E. Woods, Digital Image Processing, Pearson, 2009
2. Jean-Yves Dufour, Intelligent Video Surveillance Systems, Wiley, 2013
3. Rick Szelisk, Computer Vision: Algorithms and Applications, Springer, 2011
4. Härdle W, Müller M, Sperlich S, Werwatz, A, Nonparametric and Semi parametric Models, Springer, 2004

22PCSE126 **Soft Computing** **(3-0-2) 4**

Contact Hours:52

Course Learning Objectives (CLOs):

The main objective of the course is to expose the students to soft computing, various types of soft computing techniques, and applications of soft computing.

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/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.0	1.8	1.6	-	-	-

Pre-requisites: Knowledge of computer programming, engineering mathematics

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. **8L+6P**
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. **8L+6P**
3. **Unsupervised learning networks :**
   Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vector quantization, counter propagation networks, adaptive resonance theory network **8L+6P**
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 **8L+6P**
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 **7L+2P**

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.
4. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 1st Edition, 2019.

22PCSE127 Block Chain Technology (3-0-2) 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	**Analyze** the role of Block chain Technology in the real world.	-	3, 4, 5	1
CO-2	**Analyze** and understand the architecture of block chain technology and its dependent cryptographic aspects.	-	3, 5	-
CO-3	**Evaluate** the usage of Block chain implementation / features using different cryptocurrencies.	-	1, 3, 4	-
CO-4	**Exemplify** the usage of Ethereum and smart contracts in blockchain implementation.	3	-	-
CO-5	**Setting** Up a Private Ethereum Network and building smart contracts using decentralized applications.	3	2	6

Mapping Level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	1.5	2.0	2.4	2.0	2.0	1.0

Prerequisites: Programming and Data Structures, Cryptography, Computer Networks

Contents:

1.	Introduction to Blockchain, centralized vs. decentralized Systems, Layers of Blockchain, why is Blockchain Important? Blockchain Uses and Use Cases.	**7L+6P**
2.	How Blockchain works: Blockchain architecture, Basics of Cryptography: Symmetric Key Cryptography, Asymmetric Key Cryptography, Cryptographic Hash Functions, Diffie-Hellman Key Exchange, versions, variants, Blockchain vs. Database, Concept of Double Spending. Introduction to crypto currencies, Types, Applications**.**	**8L+6P**
3.	How Bitcoin Works: The Bitcoin Blockchain, The Bitcoin Network, Bitcoin Scripts, Bitcoin Wallets, Blockchain vs. Bitcoin, Practical applications. Interacting with the Bitcoin Blockchain	**8L+4P**
4.	How Ethereum Works: From Bitcoin to Ethereum, Enter the Ethereum Blockchain, Ethereum Smart Contracts, Ethereum Virtual Machine and Code Execution, Interacting Programmatically with Ethereum- Sending Transactions	**8L+4P**
5.	Building an Ethereum DApp: Setting Up a Private Ethereum Network, Creating the Smart Contract, Deploying the Smart Contract, Client Application Case Study.	**8L+6P**

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
6. https://www.guru99.com/blockchain-tutorial.html
7. https://developer.ibm.com/technologies/blockchain/gettingstarted/

22PCSL102 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(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	**Comprehend** the decision making process even with incomplete, inconsistent and ever changing facts	-	3,4	-
CO-4	**Recognize** the strengths and weaknesses of many popular machine learning approaches with awareness to SVM and Neural Networks in machine learning	-	3,4	-
CO-5	**Appreciate** 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/PSOs	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/)

22PCSL103	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/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	3.0	2.0	3.0	1.0	-	-

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.

22PCSC200 Cryptography & Network security (4-0-0) 4

Contact Hours:52

Course Learning Objectives (CLOs):

This course is at postgraduate level for 52 contact hours/4 credits with focus on Principles of Cryptographic algorithms including secret key cryptography, hashing and message digests, and public key algorithms, Network security issues involving standalone computers, locally networked computers and remotely networked computers, Use of cryptographic techniques to establish security in modern information- and communication systems.

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	**Know** the various network security attacks and **knowledge** on encryption techniques to achieve data confidentiality.	-	3	-
CO-2	**Apply** different security solutions for a given system using private and public key cryptography.	-	1,3	4
CO-3	**Identify** the need for key management and message authentication services	1	3	4
CO-4	**Identify** and understand the requirement and usage of security services and hash functions	1	3	4
CO-5	**Recognize** various protocols for network security to protect against the threats in the networks.	1	3	4
CO-6	**Implement** any cryptographic algorithm using higher level programming languages.			

Mapping Level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.75	-	2.0	1.0	-	-

Prerequisites: Computer Networks, Discrete Mathematical Structure, Data Structures.

Contents:

1. **Foundation: Introduction:** Security Attacks, Security Services, Security Mechanisms, and a Model for Network Security, Non cryptographic Protocol Vulnerabilities-DoS, DDoS, Session Hijacking and Spoofing, Software vulnerabilities- Phishing, Buffer Overflow, Format String Attacks, SQL Injection, Basics of Cryptography – Symmetric Cipher Model, Substitution Techniques, Transportation Techniques, Other Cipher Properties- Confusion, Diffusion, Block and Stream Ciphers. Classical Encryption Techniques: Block Ciphers and the data encryption standard **8Hrs**
2. **Secret Key Cryptography**: Data Encryption Standard(DES), Strength of DES, Block Cipher Design Principles and Modes of Operations, Triple DES, International Data Encryption algorithm, Blowfish, CAST-128, AES.
   Number Theory: Prime and Relatively Prime Numbers, Modular Arithmetic, Fermat's and Euler's Theorems, the Chinese Remainder Theorem, Discrete Logarithms.
   Public-Key Cryptography and cryptosystems: RSA, Diffie-hellman key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Zp. **11Hrs**
3. **Key Management and Distribution**: Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication,
   User Authentication: Remote user Authentication principles, Mutual Authentication, one way Authentication, remote user Authentication using Symmetric encryption, Mutual Authentication, one way

Authentication, Kerberos, Motivation , Kerberos version 4, Kerberos version 5 **11Hrs**

4. **Cryptographic Hash Functions:** Applications of Cryptographic Hash Functions, Secure Hash Algorithm, Message Authentication Codes – Message Authentication Requirements and Functions, HMAC, Digital signatures, Digital Signature Schemes, Authentication Protocols, Digital Signature Standards.

   Authentication Applications: Kerberos, Key Management and Distribution, X.509 Directory Authentication service, Public Key Infrastructure, Electronic Mail Security: Pretty Good Privacy, S/MIME. **10Hrs**

5. **IP Security:** Overview, Architecture, Authentication Header, Encapsulating Security Payload, Combining security Associations, Internet Key Exchange, Web Security: Web Security Considerations, Secure Sockets Layer and Transport Layer Security, Electronic Payment.

   System Security: Intruders, Intrusion Detection, Password Management, Malicious Software – Types, Viruses, Virus Countermeasures, Worms, Firewalls- Characteristics, Types of Firewalls,

   Placement of Firewalls, Firewall Configuration, Trusted systems.

   Web security - SQL injection, XSS, etc. Software security and buffer overflow. Malware types and case studies. Access control, firewalls and host/network intrusion detection. Network/host intelligence gathering and reconnaissance methods. **12Hrs**

Reference Books:

1. Cryptography and Network Security: Principles and Practice,5th edition, William Stallings, Pearson Education,2011
2. Network Security and Cryptography, Bernard Menezes, Cengage Learning, 2011
3. Cryptography and Network,2nd edition, Behrouz A.Fourouzan and Debdeep Mukhopadhyay,McGraw-Hill, 2010
4. Fundamentals of Network Security by Eric Maiwald, Dreamtech press.
5. Principles of Information Security, Whitman, Thomson.
6. Introduction to Cryptography, Buchmann, Springer.
7. Applied Cryptography. 2nd Edition, Bruce Schneier, Johnwiley & Sons

22PCSC201 Internet of Things (3-0-2) 4

Contact Hours:52

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

POs/PSOs	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.

22PCSE225 Data Science (3-0-0) 3

Contact Hours:39

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/PSOs	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 **6Hrs**
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. **8Hrs**
   Hadoop and its architecture: Apache Hadoop and Ecosystem, Moving data in and out of Hadoop, Understanding inputs and outputs of Map Reduce
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. **8Hrs**
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 **9Hrs**
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 **8Hrs**

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

22PCSE226 **Deep Learning** **(3-0-0) 3**

Contact Hours:39

Course Learning Objectives (CLOs):

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

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 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	**Explain and Apply** CNN functions and algorithms for the given problem scenario.	3	1,2	5,6
CO-4	**Explain** sequence models and its applications.	-	1,2	5.6
CO-5	**Explain** Linear Factor Models and Auto encoders.	-	-	6

Mapping Level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.0	2.0	3.0	-	1.0	1.0

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

Contents:

1. **Deep Feed forward Networks** : Introduction to Neural Network, Multilayer Perceptron, Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms **6Hrs**
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 Robustness, 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. **10Hrs**
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 **8Hrs**
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 **8Hrs**
5. **Deep Learning Research :** Linear Factor Models, Autoencoders; Probabilistic PCA and Factor Analysis, Independent Component Analysis (ICA), Sparse Coding, 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. **7Hrs**

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.

22PCSE227	Data Visualization	(3-0-0) 3

Contact Hours:39

Course Learning Objectives (CLOs):

This course focuses on to interpret data plots and understand visualization concepts, to explore the relationship between two continuous variables using scatter plots and line plots, to translate and present data correlations in a simple way.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1-6)		
		Substantial level(3)	Moderate level(2)	Slight level(1)
CO-1	**Appreciate** of key concepts of data visualization	4	3	6
CO-2	**Design** effective data visualization for visual mapping	4	3	6
CO-3	**Demonstrate** skills on creating visual representation of data	4	3	6
CO-4	**Understand** visualization classification and its techniques	4	3	6
CO-5	**Demonstrate** skills in creating different types of representation	4	3	6

Mapping Level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	-	-	2.0	3.0	-	1.0

Pre-requisites: Knowledge of programming

Contents:

1. Introduction of visual perception, visual representation of data, Gestalt principles, information overloads **8Hrs**
2. Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications. **8Hrs**
3. Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents **8Hrs**
4. Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization **8Hrs**
5. Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations **7Hrs**

Reference Books:

1. Ward, Grinstein Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters, Ltd, 1st Edition, 2010
2. Kieran Healy, Data Visualization: A Practical Introduction, 1st Edition, 2018
3. Andy Krik, Data Visualisation : A Handbook for Data Driven Design, 1st Edition, 2016

22PCSE228 Wireless Networks & Mobile Computing (3-0-0) 3

Contact Hours:39

Course Learning Objectives(CLOs):

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(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** 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	3	2	-
CO-5	**Write** programs using MIDlet models.	3, 4	2	-

Mapping Level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	-	2.0	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 **8 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. **5 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.

22PCSE229 **Virtual Realty** **(3-0-0) 3**

Contact Hours:39

Course Learning Objectives (CLOs):

This course is designed to give historical and modern overviews and perspectives on virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.

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 how VR systems work and list the applications of VR	1	2, 3	-
CO-2	Explain the design and implementation of the hardware that enables VR systems to be built	1	3	4
CO-3	Explain and model the geometric of virtual world	1	3	4
CO-4	Understand the system of human vision and its implication on perception and rendering.	1	3	4
CO-5	Explain the concepts of motion and tracking in VR systems	1	3	4

Mapping level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	3.0	-	2.0	1.0	-	-

Pre-requisites: Basic knowledge of computer graphics and mathematics

Contents:

1. **Introduction to Virtual Reality:** Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality **8 Hrs**
2. **Representing the Virtual World:** Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR. **8 Hrs**
3. **The Geometry of Virtual Worlds &The Physiology of Human Vision:** Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR. **8 Hrs**
4. **Visual Perception & Rendering:** Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates **8 Hrs**
5. **Motion & Tracking**: Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Section Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies. **7 Hrs**

Reference Books:

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009

22PCSE230 High Performance Computing (3-0-0) 3

Contact Hours:39

Course Learning Objectives (CLOs):

This 39-hour course intends to provide introductory knowledge of parallel architecture, design and analysis of parallel algorithms and parallel programming.

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 need for parallelism with scientific and business applications and scope for parallel computing.	1,3	2	5
CO-2	**Estimate** the performance of computing systems using Amdahl's law and SPEC rating.	1	2	-
CO-3	**Explain** the parallel computing architectures and models and their communication models, **Design** parallel algorithm for a given scenario.	1	-	6
CO-4	**Understand** the design principles of parallel algorithms.	3	2	-
CO-5	**Write** and **execute** the MPI and OpenMP programs.	2	-	-

Mapping level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	3.0	2.4	2.0	-	1.0	1.0

Prerequisites: Knowledge of

- Computer Organization
- High level Programming course
- Assembly Language Programming

Contents:

1	**Introduction to parallel computing:** Motivating Parallelism, Scope for Parallel Computing; Flynn's classification of architectures. Need for parallel computers Models of computation Analyzing parallel algorithms Expressing parallel algorithms **Self Study :**High end processors, GPUs etc.,	**6 Hrs**
2	**Performance Measurement Techniques:** Benchmark programs, SPEC ratings, Amdahl's law, Gustaffsons law.	**6 Hrs**
3	**Parallel Programming Platform:** Implicit parallelism, Limitations of Memory System Performance, Dichotomy of Parallel Computing, Physical organization of Parallel Platforms, Communication Costs in Parallel Machines, Inter Connection Networking and Routing.	**9 Hrs**
4	**Principles of Parallel Algorithm Design:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping techniques for load balancing, Methods for Containing Interaction Overhead, Parallel Algorithm Models.	**7 Hrs**
5	**Message Passing Programming:** Message passing Model, Message Passing Interface, Circuit Satisfiability, (MPI_Init, MPI_Comm_rank, MPI_Comm_size, MIP_Finalize, Compiling and Running MPI Programs), Introducing Collective Communication.	**5 Hrs**
6	**Shared Memory Programming:** Parallel for loop, declaring private variables, critical sections, Reductions, performance improvements, General data parallelisms	**6 Hrs**

Reference Books:

1. Introduction to Parallel Computing : Anant Grama, Anshul Gupta ,George Karpis,Vipin Kumar, second edition, 2011,Pearson
2. Parallel Programming: Michel J Quinn 2009 Tata McGrawHill
3. Jonathan Lazer et al "Research Methods in Human Computer Interaction", 2nd Edition, Morgan Kaufmann Publication 2017.

22PCSE231 **Distributed Systems** **(3-0-0) 3**

Contact Hours:39

Course Learning Objectives (CLOs):

This course is a 3 credit elective course as post graduate level which enables students to strengthen their understanding about various issues / challenges and therefore working principles of distributed system and get substantial experience of using industry relevant distributed system environment tools for application development.

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 issues / challenges and associated strategies for developing distributed application and environment.	1,3	-	-
CO-2	Explain the various design patterns used in distributed application and environment.	1,3	-	-
CO-3	Write a program using appropriate tools/ programming environment to create various primitives of a distributed application.	1,2, 3,6	4,5	-
CO-4	Write a complete distributed application using latest technologies used in the industry.	1,2,3,6	4	-

Mapping Level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	3.0	3.0	3.0	2.0	2.0	3.0

Prerequisites: Knowledge of Computer Networks, Database Management System, Operating Systems and Programming Language

Contents:

1. Goals, Types of distributed systems, Architectural styles, System architectures, Architectures versus Middleware, Threads, Virtualization, Clients, Servers and Code migration **8 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 **8 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. **8 Hrs**
4. Distributed object based systems, Architecture, Processes, Communication, Naming, Synchronization, Consistency and replication, Fault tolerance and Security. **8 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 **7 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

22PCSL202 Cryptography and Network Security Lab (0-0-3) 2

Contact Hours:39

Course Learning Objectives (CLOs):

This course focuses on learning different encryption techniques along with hash functions, MAC, digital signatures and their use in various protocols for network security and system security.

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	Implement several cipher encryption and decryption techniques	3	1,2,4	-
CO-2	Develop or modify various existing security algorithms	3	1,2,4	-
CO-3	Use different open-source tools for network security and analysis.	3	1,2,4	-

Mapping Level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.0	2.0	3.0	2.0	-	-

List of experiments:

1. Implement the following SUBSTITUTION & TRANSPOSITION TECHNIQUES concepts:
   a) Caesar Cipher
   b) Playfair Cipher
   c) Hill Cipher
   d) Vigenere Cipher
   e) Rail fence – row & Column Transformation

2. Implement the following algorithms
   a) DES
   b) RSA Algorithm
   c) Diffie-Hellman key exchange
3. Implement the Signature Scheme - Digital Signature Standard
4. Demonstrate how to provide secure data storage, secure data transmission for creating digital signature
5 Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w)

22PCSL203	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/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	3.0	2.0	3.0	1.0	-	-

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.