REGULATIONS AND SYLLABUS

(University Department)

MASTER OF PHILOSOPHY IN COMPUTER SCIENCE

(Outcome Based Education in M. Phil – Computer Science)

(under CBCS for University Department)

(Effect from the Academic year 2019-2020 and thereafter)

PERIYAR UNIVERSITY

(NAAC **'A' Grade –** State University **–** NIRF-83 – ARIIA -4)

SALEM-636 011

TAMILNADU, INDIA

CONTENTS

I. Program Objectives

It is a pre-research degree in Computer Science for Post Graduate in Computer Science/Computer Applications/Software Science/Computer Communication/Information Technology/Software Engineering/Theoretical Computer Science/Computer Technology/ or any other equivalent programme recognized by this University. It is aimed to explore the various research areas in Computer Science and Applications.

The major objectives of M.Phil. Computer Science course are:

PO1 - To impart knowledge in advanced aspects of all branches of Computer Science

PO2 - To acquire deep knowledge in the survey of literature.

PO3 - To acquire specific knowledge in the specialized research area of Computer Science.

PO4 - To train the students in various analytical techniques.

PO5 - To train the students with latest teaching and research methodologies

II. Eligibility:

Candidates who have qualified their Postgraduate degree in Computer Science / Computer Applications / Software Science / Computer Communication / Information Technology / Software Engineering / Theoretical Computer Science / Computer Technology / Information Science and Management / Information Technology and Management under 10+2+3 system of this University or any other University recognized by the Syndicate as equivalent thereto shall be eligible to register for the Degree of Master of Philosophy (M.Phil.) in Computer Science and undergo the prescribed course of study in an approved institution or Department of this University.

Candidates who have qualified their postgraduate degree on or after 1 January 1991 shall be required to have obtained a minimum of 55% of marks in their respective postgraduate degrees to become eligible to register for the Degree of Master of Philosophy (M.Phil.) and undergo the prescribed course of study in an approved institution or department of this University.

For the candidates belonging to SC/ST community and those who have qualified for the Master's degree before 01.01.1991 the minimum eligibility marks shall be 50% in their Master's Degree.

III. Duration:

The M. Phil. Programme spans over a period of one year from the commencement of the Programme comprising of two semesters.

IV. Course of Study:

There are three courses for semester I and Dissertation and viva-voce for semester II. The third course in the first semester shall be a **specialization related to the Dissertation.** The student in consultation with the research supervisor must select the third course and the research supervisor should frame the syllabus.

Structure of the Course

S.No		Paper Code	Title of the paper	Hours	L	T	P	C
FIRST SEMESTER								
Core Courses								
1		19URCSC0C01	Research methodology	72	4	1	0	4
2		19URCSC0C02	Advanced Computing Techniques	72	4	1	0	4
Elective Courses								
3	1	19URCSC0E01	Advanced Mobile Computing	72	4	1	0	4
	2	19URCSC0E02	Computer Vision Techniques	72	4	1	0	4
	3	19URCSC0E03	Advanced Wireless Networks	72	4	1	0	4
	4	19URCSC0E04	Advanced Data Analytics	72	4	1	0	4
	5	19URCSC0E05	Evolutionary Computing	72	4	1	0	4
	6	19URCSC0E06	Bio Computing	72	4	1	0	4
	7	19URCSC0E07	Advanced Data Mining Techniques	72	4	1	0	4
	8	19URCSC0E08	Forensics Computing	72	4	1	0	4
	9	19URCSC0E09	Advanced Computer Algorithms	72	4	1	0	4
	10	19URCSC0E10	Artificial Intelligence	72	4	1	0	4
	11	19URCSC0E11	Deep Neural Networks	72	4	1	0	4
	12	19URCSC0E12	Natural Language Processing	72	4	1	0	4
	13	19URCSC0E13	Quantum Computing	72	4	1	0	4
	14	19URCSC0E14	Advanced Machine Learning Techniques	72	4	1	0	4
	15	19URCSC0E15	High Performance Computing	72	4	1	0	4
	16	19URCSC0E16	Digital Image Analysis	72	4	1	0	4
SECOND SEMESTER								
4		19URCSC0C03	Dissertation					12

V. Scheme of Examinations:

Courses	**Number of Credits**	**Hours Per Week**	**Examination Duration (hrs)**	**Marks**		
				I. A	**ESE**	**Total**
Semester-I						
19URCSC0C01 Research Methodology	4	4	3	25	75	100

19URCSC0C02 Advanced Computing Techniques	4	4	3	25	75	100
19URCSC0E__ * Guide Syllabus (Elective)	4	4	3	25	75	100
Semester-II						
19URCSC0C03 Dissertation and Viva-Voce	12			50	50+ 100*	200

Total no. **Core course** of **Elective Course** Credits	20 04					
Grand Total	24					
Total Marks						500

\+ Evaluation by external examiner 100 Marks

* Joint viva-voce 50 Marks

(Research supervisor 25 Marks + External 25 Marks)

The distribution of marks for Internal Assessment and End Semester External Examinations will be 25% and 75% respectively. The Internal Assessment is distributed to tests, seminar and attendance as 10%, 10% and 5% respectively.

The Examination for courses I, II and III shall be held at the end of the first semester.

The Examination for specialization course will be conducted by the controller of examination along with courses I and II. Two different sets of question papers should be sent to the controller of examinations along with the syllabus for specialization course by the respective research supervisors.

Semester II - Dissertation and Viva Voce

The area of the Dissertation, which should be relevant to the specialization course, shall be intimated to the office of the controller of examinations within a month from the date of the commencement of the second semester. Candidates shall submit two copies of the Dissertation to the controller of examination through the Supervisor and Head of the Department concerned at the end of the second semester. The supervisor should submit a panel of four examiners along with the dissertation for the evaluation of specialization course, dissertation and to conduct the viva voce. The respective supervisors shall be an internal examiner. The viva board should consist of the research supervisor, head of the department and external examiner.

The Examiners who value the Dissertation shall report on the merit of Candidates as "Highly Commended"(75% and Above) or "Commended" (50% and Above and Below 75%) or "Not Commended" (Below 50%).

Submission or re-submission of the dissertation will be allowed twice a year.

VI. Pattern of Question paper

Time: 3 Hours Max.Marks - 75

PART-A: 5 × 5 = 25

(Answer all questions)
(One question from each unit with internal choice)

1. (a) or (b)
2. (a) or (b)
3. (a) or (b)
4. (a) or (b)
5. (a) or (b)

PAPER-B: 5 × 10 = 50

(Answer all questions)
(One question from each unit with internal choice)

6. (a) or (b)
7. (a) or (b)
8. (a) or (b)
9. (a) or (b)
10. (a) or (b)

VII. Dissertation / Project Work:

Part-II – Dissertation

The exact title of the Dissertation shall be intimated one month before the end of second semester. Candidates shall submit the Dissertation to the University through the Supervisor and Head of the Department at the end of the year from the commencement of the course which shall be valued by internal examiner (supervisor) and one external examiner appointed by the University from a panel of four names sent by the Supervisor through the Head of the Department at the time of submitting the dissertation.

Dissertation / Project Work

Dissertation / Project Work: 200 marks

Concise Dissertation	**150 marks**
Viva-Voce	**50 marks**
Total	**200 marks**

The examiners who value the dissertation shall report on the merit of candidates as "Highly Commended" (75% and above) or "Commended" (50% and above and below 75%) or "Not Commended" (below 50%).

If one examiner commends the dissertation and the other examiner, does not commend, the dissertation will be referred to a third examiner and the third valuation shall be final.

Submission or resubmission of the dissertation will be allowed twice a year.

VIII. Passing Minimum:

A Candidate shall be declared to have passed if he/she secures not less than 50% of the marks in each course.

IX. Restriction in number of chances:

No candidate shall be permitted to reappear for the written examination in any paper on more than two occasions or to resubmit a dissertation more than once. Candidates shall

have to qualify for the degree passing all the written papers and dissertation within a period of three years from the date of commencement of the course.

X. Conferment of Degree:

No candidate shall be eligible for conferment of the M.Phil. degree unless he/she is declared to have passed both the parts of the examination as per the Regulations.

XI. Qualifications for persons conducting the M.Phil. Course:

No teacher shall be recognised as a Supervisor unless he possesses a Ph.D. degree or two years of PG teaching experience after qualifying for M.Phil. Degree.

CORE COURSES

PAPER –I

Course 19URCSC0C01 RESEARCH METHODOLOGY 4 Credits

Course Objectives

- To understandard the importance of writing skills
- To learn the method of documentation
- To learn different types of methods for data analysis
- To understandard the importance of computational tools

Unit 1:Technical Writing

Basic Elements: Thesis Elements – Paper Elements – Order of Thesis and Paper Elements – Concluding Remarks – Identification of the Author and His Writing: Author's Name and Affiliation – Joint Authorship of a Paper: Genuine Authorship and Order of Authors. Identification of Writing: Title, Keyboards, Synopsis, Preface and Abstract – Typical Examples. Chapters and Sections: Introductory Chapters and Section – Core Chapters and Sections. Text-Support materials: Figures and Tables – Mathematical Expressions and Equations – References – Appendixes and Annexure – Listing of Materials. Numbering of elements: Pagination – Numbering of Chapters, Sections and Subsections – Numbering of figures and Tables – Equation Numbering – Appendix Numbering – Reference Numbering.

Unit 2: Near Set Theory

Introduction – Object Description – Sample Behaviour Description – Nearness of Objects – Near Sets – Near Sets and Verisimilitude – Fundamental Approximation Space –Lower Approximation of a Set – Upper Approximation of a Set – Boundary Region – Nearness Approximation Spaces – Sample Families of Neighbourhoods – Feature Selection Method – Overlap Function – Approach to Near Set Theory – Modification of our Approach to Near Sets – Medical Application.

Unit 3: Rough set Theory

Introduction – Approximation spaces – Decision systems and Decision Trees – Closure operators and Rough sets. Rough set based Feature selection : Introduction – Dependency function based approaches – Rough set based Attribute Reduction (RSAR) – VPRS (Variable Precision Rough sets (VPRS) –Dynamic Reducts – Entropy based reduction(EBR) – Discernibility Matrix based Approaches

Unit 4: Soft set Theory

Soft sets – Operations on Soft sets – Union, Intersection, AND operation – OR operation –Properties on soft set operations – Matrix representation of soft sets – Operations on Soft Matrices –Parameter reduction of Soft sets and its algorithm- Multi-soft sets – Decomposition of Multi-valued Information Systems – Soft Set Approach for Conflict Analysis

Unit 5: Analytical Methods (Omit Theorems and Proof)

Correlation Analysis

Introduction – types of correlation – scatter diagram method – correlation graph method – coefficient of correlation – Spearman's Rank Correlation Coefficient - coefficient of concurrent deviation – correlation coefficient by the method of least square – Error of the coefficient of correlation – coefficient of determination.

Regression Analysis

Introduction – graphic methods for studying regression – algebraic method of studying regression – Regression equation in case of correlation table –standard error of estimate – ratio of estimate.

Text Books

Unit – 1:

B.N. Basu, "Technical Writing", PHI, Pvt., Ltd., New Delhi, 2007.
(Chapters: 4, 5, 6, 7, 8)

Unit – 2:

1. James F. Peters, "Near Sets: General Theory about Nearness of Objects", Applied Mathematical Sciences, Vol.1, No. 53, PP 2609-2629, 2007.
2. M.E. Abd El-Monsef, H.M. Abu-Donia, and E.A. Marei, "Special Approach to Near Set Theory", Hindawi Publishing Corporation, Mathematical Problems in Engineering, Vol. 2011, Article ID 168501, 10 pages, 2011.

Reference Books:

1. Christopher Henry and James F. Peters, "Arthritic Hand-Finger Movement Similarity Measurements: Tolerance Near Set Approach", Hindawi Publishing Corporation, Computational and Mathematical Methods in Medicine, Vol. 2011, Article ID 569898, 14 Pages, 2011.
2. James F. Peters, "Fuzzy Sets, Near Sets, and Rough Sets for your Computational Intelligence Toolbox", Foundations of Computational Intelligence Volume 2, Volume 202 Foundations of Computational Intelligence, Springer, PP 3-25, 2009.

Unit – 3:

1. Aboul Ella Hassanien, ZbigniewSuraj, Dominik Slezak andPawanlingras, Rough Computing, Theories, Technologies, and Applica
2. Dan A. Simovici ,ChabaneDjeraba, " Mathematical Tools for Data Mining" Springer,2008(Unit IV - Chapter 9).tions, Information Science reference, New York, 2008.

Unit – 4:

1. Onyeozili, I. A., Gwary T. M, "A Study of the Fundamentals of Soft Set Theory", International Journal of Scientific & Technology Research Volume 3, Issue 4, April 2014.
2. Edi Sutoyo*, MungadMungad, Suraya Hamid, TututHerawan, "An Efficient Soft Set-Based Approach forConflict Analysis, PLoS ONE,11(2), 2016
3. ZhiKonga, LiqunGaoa, LifuWanga, Steven Li, "The normal parameter reduction of soft sets and its algorithm", Computers and Mathematics with Applications 56 (2008) 3029-3037.
4. M. Irfan Ali, Feng Feng, Xiaoyan Liu, Won Keun Min, M. Shabir,"On some new operations in soft set theory",Computers and Mathematics with Applications,57 (2009) 1547-1553.

Unit – 5:

1. K. R. Gupta, Statistics – Volume 1, Atlantic Publishers and Distributers, 2014.

   (Chapters 8 and 9).

Reference Books

1. Daniel T. Larose , Chantal D. Larose, Data mining and Predictive analytics, Second Ed., Wiley Publication, 2015
2. Jason Bell, Machine Learning:Hands-On for Developers and Technical Professionals, Wiley Publication, 2015.
3. Johannes Ledolter, DATA MINING AND BUSINESS ANALYTICS WITH *R*, Wiley & Sons, 2015.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Develop different format of Journal Papers and Thesis using technical writing skills	K4
CO2	Apply and Analyze Feature Selection techniques based on Near Set Theory	K4
CO3	Apply and Analyze Feature reduction techniques based on Rough sets and soft sets	K4
CO4	Construct decision rules for classification based on Rough sets and soft sets	K5
CO5	Calculate and interpret the research output with correlation Analysis and Regression Analysis	K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	M	S
CO2	M	M	S	M	S
CO3	M	M	M	S	S
CO4	M	M	S	M	S
CO5	M	M	S	S	M

S- Strong; M-Medium

PAPER –II

Course 19URCSC0C02 ADVANCED COMPUTING TECHNIQUES 4 Credits

Course objectives

- To understand the importance of computing methods
- To learn the computing techniques from nature
- To understand the importance of evolutionary computing
- To learn the importance of optimization methods

Unit 1: Particle Swarm Optimization

Basic PSO – Social network structures – Basic variations – PSO parameters – Single solution PSO – ACO meta heuristic – Applications: Travelling Salesman Problem

Unit 2 : Evolutionary Computing Methods

Introduction: Generic evolutionary algorithm – Representation : The chromosome – Initial population – Fitness function – Selection – Reproduction operators - Stopping conditions – Evolutionary vs Classical optimization – Canonical genetic algorithm – Cross over – Mutation – Control parameters – GA variants – Evolutionary programming: Basic programming – Operators – Strategy parameters – Evolutionary programming implementations- Evolutionary strategies: (1+1) - ES – Evolutionary Strategy algorithm – Parameters and Adaptation – Operators - Basic differential evolution.

Unit 3: Deep Learning

Definitions and background – A three-way categorization – Deep networks for unsupervised or generative learning – Deep networks for supervised learning – Hybrid deep networks.

Unit 4: Deep Auto encoders -Unsupervised Learning

Introduction – Use of deep auto encoders to extract speech features – Stacked denoising auto encoders – Transforming auto encoders – Pre-Trained Deep Neural Networks – A Hybrid: Restricted Boltzmann machines – Unsupervised layer-wise pre-training – Interfacing DNNs with HMMs.

Unit 5: Mobile Computing

Mobility Models in Adhoc Networks – Introduction - Random-Based Mobility Models - The Random Waypoint Model - Stochastic Properties of Random Waypoint Model - Mobility Models With Geographic Restriction - Pathway Mobility Model - Obstacle Mobility Model. Routing in Mobile Adhoc Networks – Proactive Routing Protocols – DSDV – GSR – FSR - Reactive Routing Protocols–DSR-AODV.

Text Books

Unit 1:

Andries P Engelbrecht, "Computational Intelligence – An Introduction" Second Edition, John Wiley & Sons, Ltd, 2007

Chapters – 16.1 to 16.5, 17.1, 17.5.1

Unit 2:

Andries P Engelbrecht, "Computational Intelligence – An Introduction" Second Edition, John Wiley & Sons, Ltd, 2007

Chapters - 8, 9 .1 to 9.5, 11.1 to 11. 4, 12.1 to 12.4, 13.1

Unit 3 and Unit 4:

Text Book:

1. Li Deng, Dong Yu, Deep Learning: Methods and Applications, Foundations and Trends in Signal Processing, Volume 7, Microsoft Research Publication, ISSN: 1932-8346. Chapters: 1,3,4,5

Unit 5:

Text Books

1. Fan Bai and Ahmed Helmy, "A survey of Mobility Models", University of Southern California,U.S.A.(Chapter 1)
2. Misra, Woungang, "Guide to Wireless Ad Hoc Networks", Springer International Edition, 2011, (Chapter 4)

References

1. Blum, Christian, Merkle and Daniel, Swarm Intelligence Introduction and Applications, 2008
2. Maurice Clerc, Particle Swarm Optimization, ISTE, 2013
3. Andrea E. Olsson, PSO – Theory, Techniques and Applications, 2011
4. Aleksandar Lazinica, Particle Swarm Optimization, Intech Publisher, 2011
5. Konstantinos E. Parsopoulos and Michael N Vrahatis, PSO and Intelligence : Advances and Applications, IGI Global – Premier Reference Source, 2010
6. Dan Simon, Evolutionary Optimization Algorithms – Biologically Inspired and Population based approaches to computational intelligence, Wiley Publications, 2013

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Learners can easily describe the characteristics and functions of PSO. Apply and formulate the algorithm for real time applications.	K2-K6
CO2	Describe the basics of Genetic algorithm with its representations. Experiment and design variations in genetic algorithm for various research problem Analyze the statistical data.	K2-K6
CO3	Apply the deep learning algorithms to a given problem and report on the expected accuracy of these models that can be achieved by applying the models.	K3-K4
CO4	To evaluate and create deep learning models generated from data for real world domain	K5-K6
CO5	Mobility models analyzed the movements of mobile users with different Routing Algorithm in MANET Network.	K4, K5

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**S**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**M**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**M**
CO5	**M**	**M**	**S**	**S**	**M**

S- Strong; M-Medium

PAPER –III
ELECTIVE PAPERS

The students must select the course from advanced research areas in computer science and the syllabus should be framed by the respective research supervisor. The syllabus along with two different sets of question papers may be communicated to the controller of examinations. The semester examination for specialization Course will be conducted by the controller of examinations along with courses I and II.

19URCSC0E01 ADVANCED MOBILE COMPUTING 4 Credits

Course Objectives:

- To introduce the Advancement of Mobile Computing and look at current trends.
- To study the various approaches in Mobile Ad hoc security.
- To study on Theory Research in Seamless Mobility.
- Examine Systems Research in Seamless Mobility.

UNIT 1: Introduction

Wireless transmission – Frequencies for radio transmission– Signals -– Antennas - Signal propagation: Path loss of radio signals - Additional signal propagation effects - Multi-path propagation – Multiplexing - Modulation-Spread spectrum - SDMA-FDMA-TDMA-CDMA-GSM System Architecture-Handover-Security.

UNIT 2: Mobile Systems

Satellite Systems: Applications – Basics – Routing – Localization – Handover - WLAN-IEEE802.11: System Architecture- Mobile IP: Goals, assumptions and requirements – entities and terminology – packet delivery – Agent discovery – Registration – Tunneling and encapsulation Recent technologies

UNIT 3: MANET Security

Security in Wireless Ad Hoc Networks – Intrusion Detection in Mobile Ad Hoc Networks – Security Threads in Ad Hoc Routing Protocols – Trust Management in Mobile Ad hoc Networks.

UNIT 4: SEAMLESS MOBILITY

Integration of Heterogeneous Wireless Access Networks – Network Selection for Heterogeneous Wireless Access Networks – Modeling and performance analysis of Voice Admission Control in Next Generation Heterogeneous Mobile Networks – Energy Saving aspects for Mobile Device Exploiting Heterogeneous Wireless Networks.

UNIT 5: RESEARCH ON SEAMLESS MOBILITY

A Comprehensive approach to Vertical handoff in heterogeneous wireless networks - The Seamless mobility of heterogeneous networks based on the Markov decision process-A Reliable Seamless Handoff scheme based on Enhanced MADM methods –-PROMETHEE and AHP: Then Design of Operational Synergies in Multicriteria Analysis - Vertical Handover Analysis Using Modified MADM Method in LTE.

Reference Books:

1. Jochen Schiller, "Mobile Communication" ,Pearson Education, Second Edition, 2009.
2. Sudip Misra etl., "Guide to Wireless Ad Hoc Networks", Springer International Edition, 2009.
3. Ekram Hossain, "Heterogeneous Wireless Access Networks: Architecture and Protocols, Springer, 2008.
4. Stefano Basagni and et.al., "Mobile Ad Hoc Networking: Cutting Edge Directions", IEEE Press, WILEY Publications, 2013

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand and identify the GSM, Satellite and WLAN Architecture model for mobile computing.	K2
CO2	Understand the Advanced Mobile Computing research in Seamless Mobility and MANET Security.	K2
CO3	Understanding the characteristics of Seamless Mobility for Heterogeneous networks	K2
CO4	The ability to develop Seamless Mobility of Heterogeneous networks based on various methods for real time applications.	K3, K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	S	S	S	M
CO3	S	S	S	M	S
CO4	S	S	S	S	M

S- Strong; M-Medium.

19URCSC0E02 COMPUTER VISION TECHNIQUES 4 Credits

Course Objectives:

- To provide complete knowledge on Computer Vision Techniques, such as Image formation models, Edge detection, Shape Segmentation, 2D and 3D Vision Formation, Feature Extraction and Motion Estimation, Morphological concepts and basic understanding of Computer Vision concepts.
- To understand these concepts and implement them empirically.

UNIT I

Introduction: What is Computer vision - Difference between Computer Vision and Image Processing - Low – level, Middle- level, High level - Overview of Diverse computer vision applications: Document Image Analysis, Biometrics, Object Recognition, Object Tracking, Medical Image Analysis, Content - Based image retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality.

UNIT II

Image Formation Models: Intensity Images - Image Focusing- Thin Lenses-Aberrations- Geometric Image Formation-Photometric Image Formation-Diffuse Component-Specular Component-Ambient Component-Complete Shading Model-Camera model and camera calibration - Binocular imaging system - Multiple views geometry - Geometric Primitives - Structure determination - Shape from shading.

UNIT III

Feature Extraction and Segmentation: Edge detection -Corner and Interest Point Detection - Mathematical Morphology: Dilation and Erosion–Texture - Segmentation: Contour and Region, Deformable Curves and Surfaces, Snakes and Active Contours – Split and Merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT IV

2D and 3D Vision Formation: Human Visual System - Stereoscopic Acquisition Systems - Scale-space Vision - The Three-Dimensional World - Horaud's Junction Orientation Technique - Tackling the Perspective n-point Problem - Obtaining Unique Solutions to the Pose Problem - Invariants and Perspective: Differential and Semi-differential Invariants - Vanishing Point Detection.

UNIT V

Applications: Application of Circular Convolution - 2D Correlation – Comparison of different image transforms – Zooming Operations - Zooming through Linear Interpolation – Performance Metrics in Image Restoration –Pseudo Color – Color Image Segmentation.

Reference Books:

1. D. Forsyth and J. Ponce ,Computer Vision - A modern approach, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill, 2011.

2. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA). Springer, 2010.

3. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012.

4. Bogusław Cyganek and J. Paul Siebert, An Introduction to 3D Computer Vision Techniques and Algorithms, John Wiley & Sons, 2009.

5. S. Jayaraman, S. Esakkirajan, T.Veerakumar, Digital Image Processing, Tata McGraw Hill, Fourth Edition, 2011.

6. E. Trucco and A. Verri, Introductory Techniques for 3D Computer Vision, Publisher: Prentice Hal, 1998.

7. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Addison Wesley Longman, Inc., 1992.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To implement fundamental image processing techniques required for computer vision	K4
CO2	Analyze Image formation process Extract features	K4-K5
CO3	Create and Analyze segmentation from images and do analysis of images	K4-K5
CO4	Generate 2D and 3D models from images	K3
CO5	Develop Computer Vision applications using computer vision techniques	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	S	S
CO2	M	S	S	S	M
CO3	S	S	S	M	S
CO4	S	S	S	S	M
CO5	M	S	M	S	S

S- Strong; M-Medium.

19URCSC0E03 ADVANCED WIRELESS NETWORKS 4 Credits

Course objectives:

- To provide a deep knowledge on fundamental concepts, design issues and the advanced development in wireless networks.
- To enable the students to learn the various protocols and to implement in the various research problem

Unit - I

Introduction: Fundamentals of Wireless Communication technology – Electromagnetic Spectrum – Radio propagation mechanism – characteristics of wireless channel – Fundamentals of WLANs – Bluetooth – Cellular concept – Cellular architecture – Wireless Internet – Mobile IP

Unit - II

Ad hoc network: Introduction – MAC Protocols: Issues – Classification of MAC protocols – Contention based MAC protocols – Ad hoc Routing protocols : Efficient flooding mechanisms – Hierarchical routing protocols – Power aware routing protocols – Multicast routing protocols.

Unit – III

Mesh based Multicast routing protocols: On demand – Dynamic core based – Forwarding group – Neighbour supporting protocol – Core-assisted mesh protocol – Energy efficient multicasting protocols – Multicasting with QoS guarantees – Application dependent multicasting – Secure routing in ad hoc networks.

Unit - IV

Sensor Network: Introduction– Characteristics - Applications of Sensor Network – Issues and Challenges in designing Sensor Network – Hardware and Software – Standards -Sensor Network architecture – Classification of WSN – Protocol stack – Routing and Data dissemination - Data gathering.

Unit - V

Vehicular Ad hoc networks: Introduction – VANET Infrastructures – Architecture – Applications – Routing Protocols – Data dissemination – Bio Inspired routing protocols - Mobility model.

Reference books:

1. C.Siva Ram Murthy, B.S Manoj, "Ad hoc wireless networks – Architecture and Protocols," PHI, 2010.
2. Zun Zhang, Abbas Jamalipour, " Wireless Sensor Network – A Networking Perspective", John Wiley Publications, 2009

3. H. Hartenstein, K. Laberteaux, "VANET – Vehicular Applications and Internetworking Technologies", John Wiley publications, 2010
4. Salim Bitam, Abdelhamid Mellouk, "Bio Inspired Routing Protocols for Vehicular ad hoc networks" John Wiley – ISTE, 2014

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Learners can easily express the basics of wireless technologies with its functional architecture. Evaluate and discriminate the get basic knowledge and features of wireless network and its technology	K2 –K5
CO2	Experiment and Compare the various ad hoc network routing Protocols ad hoc network along with its routing protocols.	K3, K4
CO3	Learners can easily design and evaluate novel routing algorithm for their research problem.	K3-K6
CO4	Express and relate the basics of Sensor network and Vehicular network	K3,K4
CO5	Researchers can analyze and construct the routing protocols for their research problem	K4-K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**S**	S	M
CO2	**M**	**S**	**S**	**S**	**M**
CO3	**M**	**S**	**S**	**S**	**S**
CO4	**S**	**M**	**S**	**M**	**M**
CO5	**S**	**S**	**S**	**S**	**M**

S- Strong; M-Medium.

19URCSC0E04 ADVANCED DATA ANALYTICS 4 Credits

Course Objectives:

- To enable learners to develop expert knowledge and analytical skills in current and developing areas of analysis statistics, and machine learning
- To conduct independent research and analysis in the field of data analytics.
- To enable the learner to identify, develop and apply detailed analytical, creative, problem solving skills.

Unit I

Introduction to Big Data Analytics: Big Data Overview -State of the Practice in Analytics - Key Roles for the New Big Data Ecosystem - Examples of Big Data Analytics – Summary

Unit II

Data Analytics Lifecycle: Data Analytics Lifecycle Overview - Phase 1: Discovery - Phase 2: Data Preparation - Phase 3: Model Planning - Data Exploration and Variable Selection - Phase 4: Model Building - Phase 5: Communicate Results - Phase 6: Operationalize

Unit III

Advanced Analytics Theory and Methods: Clustering: Overview of Clustering - K-means - Additional Algorithms

Advanced Analytics Theory and Methods: Association Rules: Overview - Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - An Example: Transactions in a Grocery Store - Validation and Testing – Diagnostics

Unit IV

Advanced Analytics Theory and Methods: Regression: Linear Regression - Logistic Regression - Reasons to Choose and Cautions - Additional Regression Models

Advanced Analytics Theory and Methods: Classification: Decision Trees - Naïve
Bayes - Diagnostics of Classifiers - Additional Classification Methods

Unit V

Advanced Analytics Theory and Methods: Time Series Analysis: Overview of Time Series Analysis - ARIMA Model - Additional Methods

Advanced Analytics- Technology and Tools: MapReduce and Hadoop: Analytics for Unstructured Data - The Hadoop Ecosystem – NoSQL

Reference Books:

1. EMC Educational Services "Data Science & Big Data Analytics - Discovering, Analyzing, Visualizing and Presenting Data", John Wiley & Sons, Inc., 2015
2. Anil Maheshwari, "Data Analytics", McGraw Hill Education, 2017.
3. Lillian Pierson, Data Science For Dummies, 2nd Edition, For Dummies Publisher, 2015
4. Prateek Gupta, Data Science with Jupyter, BPB 1st Edition, 2019

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To understand the Big Data Analytics, Key Roles for the New Big Data Ecosystem, Big Data Analytics Life Cycle.	K1-K2
CO2	To design, develop and implement advanced data analytics tools for different types of data	K3-K4
CO3	To develop skills of using advanced analytics theory, methods, technology and tools for solving real time problems.	K4-K5
CO4	To gain experience of doing independent study and research.	K5-K6
CO5	To implement Big Data analytics projects in Hadoop framework.	K5-K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**S**	**S**	**S**	**S**
CO2	**M**	**S**	**S**	**S**	**M**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**M**
CO5	**S**	**S**	**M**	**S**	**S**

S- Strong; M-Medium.

19URCSC0E05 EVOLUTIONARY COMPUTING 4 Credits

Course objectives:

- Understand the underlying principles of evolutionary computation.
- Learn the theoretical foundations of evolutionary computation.
- Learn evolutionary strategies and Swarm Intelligence based algorithms such as Artificial Bee Colony Algorithm , Cuckoo Search and Bat Algorithm

Unit I

Introduction: Computation Inspired by Nature – Biological Processes – Evolution Versus Learning – Swarm Intelligence – Heuristics, Metaheuristics, and Hyper-Heuristics – optimization. **Simulated Annealing:** Introduction – Basic Simulated Annealing – Variants of Simulated Annealing.

Unit II

Evolutionary Strategies: Introduction – Basic Algorithm – Evolutionary Gradient Search and Gradient Evolution. **Parallel Evolutionary Algorithms:** Master-Slave Model – Island Model – Cellular EAs – Cooperative Co-evolution – Cloud Computing – GPU Computing.

Unit IV

Bee Metaheuristics: Introduction – Artificial Bee Colony Algorithm – Marriage in Honeybees Optimization – Bee Colony Optimization. **Bacterial Foraging Algorithm:** Introduction - Bacterial Foraging Algorithm. - Harmony Search Algorithm

Unit V

Swarm Intelligence: Glowworm-Based Optimization – Firefly Algorithm - Group Search Optimization – Shuffled Frog Leaping – Cuckoo Search – Bat Algorithm- Social Spider Optimization – Krill Herd Algorithm – Cockroach-Based Optimization

Unit V

Memetic Algorithms – Introduction – Cultural Algorithms – Tabu Search – Scatter search – **Search based on Human Behaviours** - Seeker optimization algorithm – Teaching Learning based optimization.

Reference Books:

1. Ke-Lin Du and M.N.S. Swamy, "Search and Optimization by Metaheuristics Techniques and Algorithms Inspired Nature", Birkhauser, 2016.
2. Albert Y. Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.
3. **Dario Floreano** and **Claudio Mattiussi, "**Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies**", MIT Press, 2010.**
4. Kalyanmoy Deb , Multi-Objective Optimization using Evolutionary Algorithms , Wiley Student Edition, 2010

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain evolutionary computation techniques and methodologies set in the context of modern heuristic methods. • Apply various evolutionary computation methods and algorithms for particular classes of problems. • Develop evolutionary algorithms for real-world applications.	K1, K3
CO2	Understand the context of modern heuristic methods.	K2
CO3	Apply various evolutionary computation methods and algorithms for particular classes of problems	K3
CO4	Analyze and compare various evolutionary computation methods	K4
CO5	Develop evolutionary algorithms for real-world applications	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**M**	**M**	**M**
CO2	**S**	**M**	**M**	**M**	**S**
CO3	**M**	**M**	**M**	**S**	**S**
CO4	**M**	**M**	**M**	**S**	**S**
CO5	**M**	**M**	**S**	**S**	**S**

S-Strong; M-Medium; L-Low

19URCSC0E06 BIO COMPUTING 4 Credits

Course objectives:

- To establish a basic understanding and appreciation of the issues and problems of computational biology.
- To provide an introduction to programming for biological data and use of a range of web-based Bio-computing utilities.
- To expose students to algorithmic thinking, Problems solving and impart moderate skills in programming.

Unit I

Introduction to Molecular Biology: DNA, RNA and protein - Genome, Chromosome, and Gene – Replication and Mutation of DNA – Central Dogma – Transcription (Prokaryotes) - Transcription (Eukaryotes) – Translation – Post translation Modification (PTM) – Population Genetics – Basic Biotechnological Tools – Restriction Enzymes – Sonication – Cloning – PCR – Brief History of Bioinformatics.

Unit II

Sequence Similarity and suffix Tree: Introduction – Global Assignment Problem – Needleman-Wunch Algorithm – Running time Issue – Space Efficiency Issue – More on Global Alignment – Local Alignment – Semi-Global Alignment – Scoring Function – Scoring function for DNA – Scoring Function for Protein. **Suffix Tree:** Introduction – Simple Applications of a Suffix Tree – Construction of a Suffix Tree – Suffix Array.

Unit III

Genome Alignment and Database Search: Introduction – Maximum Unique Match (MUM) – Mutation Sensitive Alignment – Concepts and definitions – The Idea of the Heuristic Algorithm – Experimental Results – **Database Search:** Introduction – Biological database – Database Searching – Types of Algorithms – Smith-Waterman Algorithm – FastA – BLAST – Q-gram Alignment based on Suffix Array – Locality-Sensitive Hashing.

Unit IV

Multiple Sequence Alignment and Genome Rearrangement: Introduction – Formal Definition of the Multiple Sequence Alignment Problem – Methods for Solving the MSA Problem – Dynamic Programming Method – Progressive Alignment Method. **Genome Rearrangement:** Introduction – Types of Genome Rearrangements – Computational Problems – Sorting an Unsigned Permutation by Reversals.

Unit V

Motif Finding: Introduction – Identifying Binding Regions of TFs – Motif Model – The Motif Finding Problem – Scanning for Known Problem – Statistical Approaches. **RNA Secondary Structure Prediction:** Introduction – Obtaining RNA Secondary Structure Experimentally – Structure Prediction with the Assumption That There is no pseudoknot – Nussinov Folding Algorithm. **Peptide Sequencing:** Introduction – Obtaining the Mass Spectrum of a Peptide – Modeling the Mass Spectrum of a Fragmented Peptide.

Reference books:

1. Wing-Kin Sung, "Algorithms in Bioinformatics – A Practical Introduction", CRC Press, 2010.
2. Seiffert, U. (Udo) Jain, L. C. Schweizer, P. (Patrick), "Bioinformatics using computational intelligence paradigms", Springer, 2004.
3. Kelemen, Arpad, *Abraham, Ajith*, Chen, Yuehui (Eds.), "Computational
4. Intelligence in Bioinformatics", Springer, 2008.
5. Sushmita Mitra, Sujay Datta, Theodore Perkins , George Michailidis,
6. "Introduction to Machine Learning and Bioinformatics", CRC Press, 2008.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of Central Dogma of Biology and DNA structure and encoding	K2
CO2	Design Genome based projects by understanding the computational complexity of Bioinformatics problems and the usage of NCBI and available Bio informatics tools.	K3
CO3	Become an efficient and optimal analyzer of this ever-growing biological dataset and yield important knowledge to have direct consequences on the biological aspects	K4
CO4	Apply various Bio computing methods for various problems	K3
CO5	Create new Bio computing models for Genome alignment , Motif finding and sequence similarity	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	S	S	M	S	S
CO3	M	M	S	S	S
CO4	M	M	S	S	S
CO5	M	M	S	S	S

S-Strong; M-Medium

19URCSC0E07 ADVANCED DATA MINING TECHNIQUES 4 Credits

Course Objectives:

- To introduce the advanced concepts of Data Mining Techniques and various Algorithms used for building models from Datasets, involve learning a collection of techniques for extracting patterns and trends.
- To deal with real time computing solutions for data intensive applications.

Unit I - Data Understanding Concepts of Learning, Classification, and Regression:

Introductory Comments – Classification Knowledge Representation: Data Representation and their Categories: General Insights - Categories of Knowledge Representation - Granularity of Data and Knowledge Representation Schemes - Sets and Interval Analysis -Fuzzy Sets as Human- Centric Information Granules - Shadowed Sets - Rough Sets - Characterization of Knowledge Representation Schemes - Levels of Granularity and Perception Perspectives - The Concept of Granularity in Rules

Unit II - Data Preprocessing

Feature Extraction and Selection Methods: Introduction - Feature Extraction - Feature Selection Discretization Methods: Why Discretize Data Attributes? - Unsupervised Discretization Algorithms - Supervised Discretization Algorithm

Unit III - Data Mining: Methods for Constructing Data Models

Unsupervised Learning: Clustering: From Data to Information Granules or Clusters - Categories of Clustering Algorithms - Similarity Measures- Hierarchical Clustering - Objective Function-Based Clustering – Grid-Based Clustering - Self-Organizing Feature Maps - Clustering and Vector Quantization - Cluster Validity - Random Sampling and Clustering as a Mechanism of Dealing with Large Datasets

Unsupervised Learning: Association Rules: Introduction - Association Rules and Transactional Data -Mining Single Dimensional, Single-Level Boolean Association Rules - Mining Other Types of Association Rules

Unit IV - Supervised Learning

Statistical Methods: Bayesian Methods – Regression Decision Trees, Rule Algorithms, and Their Hybrids: What is Inductive Machine Learning? - Decision Trees - Rule Algorithms - Hybrid Algorithms.

Unit V - Supervised Learning

Neural Networks: Introduction - Biological Neurons and their Models - Learning Rules - Neural Network Topologies - Radial Basis Function Neural Networks

Text Mining: Introduction - Information Retrieval Systems - Improving Information Retrieval Systems

Reference Books:

1. Krzysztof J. Cios, WitoldPedrycz, Roman W. Swiniarski and Lukasz A. Kurgan, "Data Mining A Knowledge Discovery Approach", Springer, 2007.

2. David L. Olson and DursunDelen, "Advanced Data Mining Techniques", Kindle Edition, 2008.

3. Galit Shmueli, Peter C. Bruce , Mia L. Stephens Nitin R. Patel ,Data Mining for Business Analytics: Concepts, Techniques, and Applications with JMP Pro, Wiley Publication, 2016.

4. Jiawei Han Micheline Kamber Jian Pei, Data Mining: Concepts and Techniques, 3rd Edition, 2011.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept advanced data mining and data processing	K1-K2
CO2	To design, formulate, solve and implement advanced data mining techniques for building the data models	K4-K5
CO3	To develop skills of using recent data mining software for solving practical problems.	K3-K4
CO4	Analyze various data mining functionalities for research.	K4-K5
CO5	To gain experience of doing independent study and research using advanced data mining	K5-K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	S	S
CO2	M	S	S	S	M
CO3	S	S	S	M	S
CO4	S	S	S	S	M
CO5	S	S	M	S	S

S- Strong; M-Medium.

19URCSC0E08 FORENSICS COMPUTING 4 Credits

Course objectives:

- To provide a deep knowledge on fundamental concepts of Computer forensics and Investigation methods.
- To provides a taster in understanding how to conduct investigations to correctly gather, analyze and present digital evidence to both business and legal audiences

Unit – I

Introduction – Types of Computer forensics – forensics skills – importance of forensics – Evidence Acquisition: Lab requirements – Laboratory layout, management and access – Extracting from device – skimmers

Unit – II

Network forensics: Log files – Traffic investigation – Router forensics: Router function – Router attack and investigation – Advanced persistent attack – Investigating network attack - Tools - Mobile forensics: Procedure for Handset evidence – Handset forensics – Flasher box

Unit – III

Website forensics: Attack indication – Type of attack – Web log – Web attack investigation – Investigating FTP servers - IIS logs - Apache logs - Windows based servers - Intrusion Detection - Security strategies - Web page defacement - Investigating static and IP address

Unit – IV

Internet forensics: Introduction – investigation steps – tracking and investigating email – online crime – capturing online communications – Application password crackers: Introduction – Password terminology – Password cracker – Password cracking methods – System password cracking – Application software password cracking – Default password Database

Unit – V

Investigations: Evidence analysis – Capturing the data image – Extracting information from Data – Passwords and Encryption – Website evidence –Document Investigation

Reference books:

1. Dr. Darren Hayes, "A Practical guide to Computer forensics investigations", Pearson Education Inc., 2015
2. M.G. Solomon, D. Barrett, N. Broom, "Computer forensics Jump start™", SYBEX Inc. 2005,
3. "Computer forensics-Investigating networks intrusions and cyber crime" Course technology, EC-Council Press, Cengage learning, 2010.
4. "Computer forensics-Investigating Hard disk, File and Operating Systems" Course technology, EC-Council Press, Cengage learning, 2010.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Get basic knowledge on the principle, instrumentation and applications of rotational, vibrational and electronic spectroscopy	K4
CO2	Elucidate the structure of the compounds more precisely with NMR spectral data and also able to use ESR spectra for the effective detection of free radicals.	K4
CO3	To determine nuclear transition frequencies and relaxation times and then to relate those to a property of a material using NQR as well as to use Mossbauer spectroscopy to get an idea on the magnetic properties	K4
CO4	Using the absorption and diffraction spectroscopy for the structure elucidation of inorganic complexes.	K3
CO5	Understand the principles and applications of electro analytical techniques in the studies of properties of materials	K2

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**M**	**S**	**S**	**S**
CO2	**M**	**S**	**S**	**S**	**M**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**M**
CO5	**M**	**S**	**M**	**S**	**S**

S- Strong; M-Medium.

19URCSC0E09 ADVANCED COMPUTER ALGORITHMS 4 Credits

Course Objectives:

- Enable students to explore advanced topics in algorithmic and complexity theory
- Engage in analysis and design of complex algorithms for real-world problems in application domains
- Learn and evaluate advanced / novel algorithm design strategies
- Understand study problems in algorithmic or complexity theory by analyzing known approaches and their limitations.

UNIT 1: Algorithms on Graphs

Minimum – coat spanning trees – Depth-first search – Biconnectivity – Depth-first search of a directed graph – Strong connectivity – Path-finding problems – A transitive closure algorithm – A shortest-path algorithm – Path problems and matrix multiplication – single-source problems – Dominators in a directed acyclic graph: putting the concepts together.

UNIT 2: Matrix Multiplication and Related Operations

Basics – Strassen's matrix-multiplication algorithm – Inversion of matrices – LUP decomposition of matrices – Applications of LUP decomposition – Boolean matrix multiplication.

UNIT 3: The Fast Fourier Transform and its Applications

The discrete Fourier transform and its inverse – The fast Fourier transform algorithm – The FFT using bit operations – Products of polynomials – The Schonhage - Strassen inter-multiplication algorithm.

UNIT 4: The Integer and Polynomial Arithmetic

The similarity between integers and polynomials – Integer multiplication and division – Polynomial multiplication and division – Modular arithmetic – Modular polynomial arithmetic and polynomial evaluation – Chinese remaindering – Chinese remaindering and interpolation of polynomials – Greatest common divisors and Euclid's algorithm – An asymptotically fast algorithm for polynomial GCD's – Integer GCD's – Chinese remaindering revisited – Sparse polynomials.

UNIT 5: Pattern-Matching Algorithms

Finite automata and regular expressions – Recognition of regular expression patterns – Recognition of substrings – Two-way deterministic pushdown automata – Position trees and substring identifiers.

Reference Books

1. Aho, Hopcroft, Ullman, "The Design and Analysis of Computer Algorithms", Addison Wesley,1998.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Second Edition Person, 2011.
3. Manas Ranjan Kabat, "Design and Analysis of Algorithms", PHI Learning, 2016.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, Hardcover, 2001.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Students should develop a theoretical understanding of Algorithms on Graphs with practical problem solving skills.	K2
CO2	Students should gain a good understanding on a wide range of advanced algorithmic problems, their relations and variants with Matrix Multiplication and	K2
CO3	Students should gain a good understanding the Integer and Polynomial Arithmetic problems with solutions.	K2
CO4	Students should develop the Fast Fourier Transform and Pattern-Matching Algorithms with its applications and related to real time problems.	K3-K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**M**	**M**	**M**
CO2	**S**	**S**	**S**	**M**	**M**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**M**

S- Strong; M-Medium.

19URCSC0E10 ARTIFICIAL INTELLIGENCE 4 Credits

Course Objectives:

- The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence.
- To impart basic proficiency in representing difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing.
- To introduce advanced topics of AI such as planning, Bayes networks, natural language processing, Robotics.

UNIT I

Introduction to AI: What is AI? – Foundations of AI – History of AI – The State of the art.**-Solving Problems by Searching**: Problem Solving Agents – Example Problems – Searching for Solution – Uninformed Search Strategies – Informed Search Strategies – Heuristics Functions - **Beyond Classical Search**: Local search algorithms and optimization problems – Local Search in continuous spaces - Searching with nondeterministic actions – Searching with Partial Observations.

UNIT II

Logical Agents: Knowledge based Agents – Logic – Propositional Logic – Propositional Theorem Proving – Effective Propositional model checking – Constraint Satisfaction problems (CSP): Defining CSP- Constraint Propagation – Backtracking Search for CSPs – Local Search for CSPs - **First Order Logic**: Syntax and Semantics – Using First order Logic - Knowledge Engineering - **Inference in First Order Logic**: Unification and Lifting – Forward Chaining – Backward Chaining – Resolution. **-Classical Planning**: Algorithms for Planning as State Space Search – Planning Graphs.

UNIT III

Knowledge Representation: Ontological Engineering – Categories and Objects – Events – Reasoning Systems for Categories – Reasoning with Default Information – **Quantifying Uncertainty:** Acting under Uncertainty – Basic Probability Notation – Bayes' Rule – **Probabilistic Reasoning:** Representing Knowledge in an Uncertain Domain –The Semantics of Bayesian Networks – Exact Inference in Bayesian Networks – Approximate Inference in Bayesian Networks – First order Probability Models. **Probabilistic Reasoning over time:** Hidden Markov Models – Dynamic Bayesian Networks.

UNIT IV

Making Simple Decisions: The Basis of Utility Theory – Utility Functions – Decision Networks – Decision Theoretic Expert Systems – **Making Complex Decision**: Game theory –**Learning from Examples:** Forms of Learning – Supervised Learning – Decision Trees – Regression and Classification with Linear Models – ANN – SVM – Ensemble Learning – Practical Machine Learning. – **Knowledge in Learning**: A Logical Formulation of Learning – Explanation based Learning. – **Learning Probabilistic Models**: Statistical Learning –Learning with Complete Data – Hidden Variables: EM Algorithm.

UNIT V

Natural Language Processing: Language Models – Text Classification – Information Retrieval – Information Extraction. – **Reinforcement Learning**: Passive Reinforcement Learning – Application of Reinforcement Learning. – **Natural Language for Communication:** Phrase Structure grammars – Syntactic Analysis – Machine Translation. – **Perception**: Image Formation – object Recognition – Reconstructing the 3D World. – **Robotics:** Robot Hardware – Robot Perception – Planning to Move and Uncertain Movements – Robotic Software architecture.

Reference Books:

1. Stuart Russel, Peter Norvig, "Artificial Intelligence: A Modern Approach – 3/e", Pearson Education.2014.
2. Stuart Russel, Peter Norvig, "Artificial Intelligence: A Modern Approach – 2/e", Pearson Education, 2003.
3. Elaine Rich, Kevin Knight, "Artificial Intelligence" 2/e, TMH, 1991.
4. Dan W. Patterson, "Introduction to Artificial Intelligence & Expert Systems", EEE, PHI, 1999.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.	K2
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.	K3
CO3	Demonstrate a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models, Robotics.	K2

CO4	Apply scientific method to models of machine learning and Robotics.	K3 & K6
CO5	Demonstrate and Construct models in discussions of AI, its current scope and limitations, and societal implications.	K5 & K6

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**M**	**M**	**S**	**M**	**S**
CO2	**M**	**S**	**S**	**S**	**M**
CO3	**S**	**M**	**S**	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**M**
CO5	**M**	**S**	**M**	**S**	**S**

S- Strong; M-Medium.

19URCSC0E11 DEEP NEURAL NETWORKS 4 Credits

Course Objectives

This course will stimulate students to,

- Learn the concepts of Deep Networks
- Understand and implement algorithms of Deep Neural Network
- Get insights about Deep Learning with its Applications
- Develop Models using Deep Learning Techniques

UNIT-I

Deep Networks: Modern Practices - Deep Feedforward Networks: Gradient-Based Learning – Hidden Units – Architecture Design – Back-Propagation and other Differentiation Algorithms – Regularization for Deep Learning: Dataset Augmentation -Noise Robustness – Semi Supervised Learning – Multitask Learning – Sparse Representation – Bagging ad Other Ensemble Methods – Dropout.

UNIT-II

Optimization: Basic Algorithms – Algorithms with Adaptive Learning Rates – Approximate Second-Order Methods – Optimization Strategies and Meta Algorithms – Convolution Networks: Convolution Operation – Pooling – Variants – Structured Outputs – Efficient Convolution algorithms – Random or Unsupervised Features – Sequence Modelling: Recurrent Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Recursive Neural Networks – Echo State Networks.

Unit-III

Computer Vision – Speech Recognition – Natural Language Processing – Deep Learning Research: Linear Factor Models: Probabilistic PCA and Factor Analysis – ICA – Manifold Interpretation of PCA – Autoencoders: Regularized Autoencoders – Stochastic Encoders and Decoders – Contractive Autoencoders – Representation Learning: Greedy Layer-Wise Unsupervised Pretraining.

UNIT-IV

Monte Carlo Methods: Sampling and Monte Carlo Methods – Markov Chain Monte Carlo Methods – Gibbs Sampling – Comforting the Partition Function: The Log-Likelihood Gradient – Stochastic Maximum Likelihood and Contrastive Divergence – Score Matching and Ratio Matching.

UNIT-V

Approximate Inference: Inference as Optimization – Expectation Maximization – Learned Approximate Inference – Deep Generative Models – Boltzmann Machines –

Deep Boltzmann Networks – Convolution Boltzmann Machines – Directed Generative Nets – Generative Stochastic Networks – Evaluating Generative Models.

Reference Books

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", The MIT Press, Cambridge, 2016
2. Li Deng and Dong Yu, "Deep Learning: Methods and Applications", Vol. 7, Nos. 3-4, Foundations and Trends in Signal Processing, 2013.
3. Josh Patterson & Adam Gibson, "Deep Learning – A Practitioner's Approach", O'Reilly, 2017.
4. Simon Haykin, "Neural Networks and Learning Machines" 3e, Pearson Education, 2009.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand algorithms including Back Propagation.	K2
CO2	Implement Optimization techniques	K3
CO3	Design and implement Deep Neural Networks	K3& K4
CO4	Evaluate and interrupt the results of algorithms	K5
CO5	Build intelligent applications using Neural Network concepts.	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**M**	**S**	**S**	**S**
CO2	**M**	**S**	**S**	**S**	**M**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**M**
CO5	**M**	**S**	**M**	**S**	**S**

S- Strong; M-Medium

19URCSC0E12 NATURAL LANGUAGE PROCESSING 4 Credits

Course objectives:

- To understand how key concepts from NLP and linguistics are used to describe and analyze language.
- To Learn about the data structures and algorithms used in NLP.
- To Analyze data is stored in standard formats
- To understand the methods and algorithms used to process different types of textual data

Unit I

Language Processing and Python: Computing with Language: Texts and Words - A Closer Look at Python - Computing with Language - Back to Python - Automatic Natural Language Understanding. **Accessing Text Corpora and Lexical Resources:** Accessing Text Corpora - Conditional Frequency Distributions - More Python: Reusing Code - Lexical Resources – WordNet.

Unit II

Processing Raw Text: Accessing Text from the Web and from Disk – Strings - Text Processing with Unicode - Regular Expressions for Detecting Word Patterns - Useful Applications of Regular Expressions - Normalizing Text - Regular Expressions for Tokenizing Text – Segmentation – Formatting. **Writing Structured Programs** – Sequences - Questions of Style – Functions - Doing More with Functions - Program Development - Algorithm Design - A Sample of Python Libraries.

Unit III

Categorizing and Tagging Words: Using a Tagger - Tagged Corpora - Mapping Words to Properties Using Python Dictionaries - Automatic Tagging - N-Gram Tagging - Transformation-Based Tagging - How to Determine the Category of a Word. **Learning to Classify Text:** Supervised Classification – Evaluation - Decision Trees - Naive Bayes Classifiers - Maximum Entropy Classifiers - Modeling Linguistic Patterns.

Unit IV

Extracting Information from Text: Information Extraction – Chunking - Developing and Evaluating Chunkers - Recursion in Linguistic Structure - Named Entity Recognition - Relation Extraction. **Analyzing Sentence Structure:** Some Grammatical Dilemmas - Context-Free Grammar - Parsing with Context-Free Grammar - Dependencies and Dependency Grammar - Grammar Development.

Unit V

Building Feature-Based Grammars: Grammatical Features - Processing Feature Structures - Extending a Feature-Based Grammar. **Analyzing the Meaning of Sentences:** Natural Language Understanding - Propositional Logic - First-Order Logic - The Semantics of English Sentences - Discourse Semantics.

Reference books:

1. Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python", O'Reilly, 2009.
2. NitinIndurkhya, Fred J. Damerau, "Handbook of Natural Language Processing", CRC Press, 2010.
3. Dwight Gunning, Sohom Ghosh, Natural Language Processing Fundamentals, Packt Publishers,2019.
4. Brian McMahan and Delip Rao, "Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning", O'Reilly, Firs edition, 2019.
5. Hobson Lane, Hannes Hapke, and Cole Howard, "Natural Language Processing in Action: Understanding, analyzing, and generating text with Python", Manning Publications, First edition, 2019.
6. Adarsha Shivananda and Akshay Kulkarni, "Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning Using Python", APress, 2019.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand semantics and pragmatics of English language for processing	K2
CO2	Write programs in Python to carryout natural language processing	K1
CO3	Demonstrate the Extraction of information from text and classification of text	K3
CO4	Demonstrate knowledge of the fundamental principles of natural language processing.	K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	S	S
CO2	M	S	S	S	M
CO3	S	S	S	M	S
CO4	S	S	S	S	M

S-Strong; M-Medium

19URCSC0E13 QUANTUM COMPUTING 4 Credits

Course objectives:

- To provide a deep knowledge on fundamental concepts of Quantum computing and its algorithm.
- To provides a better understanding to apply the various quantum computing algorithm.

Unit I

Quantum computer basics: Quantum information – Information processing – Quantum circuits – Quantum mechanics: General structure – Quantum states – Quantum bits and quantum gates: Single-qubit gates – Two qubit gates – Universal sets of gates – Quantum state transformations: Unitary transformation – Pauli transformation – Hadamard transformation – Multiple and single qubit transformation –Fourier transformation.

Unit II

Quantum measurement theory: Projective measurement – Composite systems – Generalized measurements – Positive operator-valued measures – Entanglement: Bells theorem – Bipartite systems – Entangles state – Pauli representation – Entangled fidelity – Density operator representation – Schmidt decomposition – Purification.

Unit III

Quantum algorithm: Quantum parallelism – Notions of complexity – Subroutine – Simple algorithms: Deutsch algorithm – Deutsch – Jozsa algorithm – Bernstein – Vazirani algorithm – Simon's algorithm – Machine models and complexity classes – Shor's algorithm – Grover's algorithm and Generalization

Unit IV

Quantum error correction: Framework for error correcting codes – CSS codes – Stabilizer codes – CSS codes as stabilizer codes – Fault tolerance and robust quantum computing: Setting the stage – Steane's code – Robust quantum computation

Unit V

Quantum cryptography: RSA encryption – Quantum cryptography – Controlled NOT attack – B92 Protocol – E 91 protocol – Cluster state quantum computing: Cluster states – Adjacency matrices – Stabilizer states – Entanglement witness – Cluster state processing.

Reference books

1. Eleanor Rieffel, Wolfgang H. Polak, "Quantum computing: A Gentle introduction", MIT Press, England, 2011
2. Mikio Nakahara, Tetsuo Ohmi, "Quantum computing from Linear algebra to Physical realization", CRC Press – A Taylor and Francis book, 2008.
3. David Mc Mahon, "Quantum computing explained", John wiley and Sons, 2007
4. Mika Hirvensalo, "Quantum computing", Natural computing series, Springer-Verlag Berlin Heidelberg, 2001

5. Joachim Sotlze, Dieter suter, "Quantum computing – A short course from theory to experiment" Wiley-VCH, 2004.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Learners can able to understand and discriminate the features, importance and state transformation of Quantum computers.	K2-K4
CO2	Express and categorize the different Quantum measures with theoretical knowledge of Quantum computing operators. To apply measures in various operations of the Quantum Computers.	K2-K4
CO3	Learners can able to understand and examine the various Quantum algorithms. Modify and create hybrid algorithms for their research environment.	K2-K6
CO4	Illustrate and classify the errors in the Quantum computing. Frame, write error correction codes in the environment and evaluate codes using appropriate measures.	K3-K5
CO5	Acquire basics of Quantum cryptography and analyze the existing methods. Get the basics of cluster state quantum computing and examine the cluster state process in the different research problem	K2-K5

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**M**	M	**S**
CO2	**S**	**M**	**S**	**M**	**M**
CO3	**S**	**S**	**S**	**M**	**S**
CO4	**S**	**M**	**S**	**S**	**M**
CO5	**S**	**M**	**S**	**S**	**M**

S- Strong; M-Medium.

19URCSC0E14 ADVANCED MACHINE LEARNING TECHNIQUES

4Credits

Course Objectives:

- To introduce advanced concepts of machine learning techniques tensorflow package.
- To introduce the concept of learning patterns from data and develop a strong theoretical foundation for understanding state of the art Machine Learning algorithms.
- To implement Hidden Markov model, Recurrent Neural Networks, Sequence to Sequence Model etc.. using machine learning techniques

Unit-I

TensorFlow Essentials: Ensuring TensorFlow Works- Representing Tensors- Creating Operators- Executing Operators with Sessions- Using Variables- Saving, Loading and Visualizing the data using TensorFlow – Linear Regression- Polynomial Model-Regularization-Applications of Linear Regression

Unit-II

Classification: Introduction- Formal Notation-Measuring Performance –Using Linear Regression for classification - Using Logistic Regression – Multiclass Classifier-Applications of classifications-**Automatically Clustering Data:** Traversing files in TensorFlow-Extracting Features-KMeans Clustering- Segmentation- Clustering using SOM- Applications

Unit-III

Hidden Markov Model: Markov Model – Hidden Markov Model – Forward Algorithm – Viterbi decode- Uses of Hidden Markov Model- Applications-**AutoEncoders:** Neural networks- Autoencoders- Batch Training –Working with Images- Applications of Autoencoders

Unit-IV

Reinforcement Learning: Formal Notation-Applying Reinforcement Learning-Implementations- Applications of Reinforcement Learning- **Convolution Neural Networks (CNNs):** Drawbacks of Neural Networks- CNN- Preparing the image-Implementing a CNN in TensorFlow-Tips and Tricks to improve performance-Applications of CNN

Unit-V

Recurrent Neural Networks(RNNs): Contextual Information – Introduction of RNN- Implementing RNN- Predictive Model for Time Series data- Applications of RNN- **Sequence to Sequence Model:** Classifications- RNN- Classifications and RNN- Seq-to-Seq architecture – Vector Representations of Symbols- Putting it all altogether- Gathering Dialogue Data

Reference Books

1. NishantShukla, "Machine Learning with TensorFlow" ,MEAP Edition, Manning Publications, 2017.
2. Jason Brownlee, "Master Machine Learning Algorithms", 2016.
3. Abhishek Vijayvargia, "Machine Learning with Python Language", BPB, 2018 edition, 2018.
4. John Paul Mueller, Luca Massaron , "Machine Learning (in Python and R)" , For Dummies Publication, 2016.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of machine learning techniques for various algorithms	K1 K2
CO2	Develop an appreciation for what is involved in learning models from data.	K3-K4
CO3	Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.	K3-K4
CO4	To evaluate and create deep learning models generated from data for real world domain	K5-K6
CO5	To evaluate and create machine learning models generated from various research data.	K5-K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	M	S	S	S	M
CO3	S	S	S	M	S
CO4	S	S	S	S	M
CO5	S	S	S	S	S

S- Strong; M-Medium.

19URCSC0E15 HIGH PERFORMANCE COMPUTING 4 Credits

Course Objectives:

- To introduce the fundamentals of high performance computing with the graphics processing units and their architectures and corresponding programming environments.
- To introduce the learner to fundamental and advanced parallel algorithms through the GPU programming environments

Unit-I

Introduction to Novel Microprocessor Architectures : Introduction -Modern commercial multicore processors - Basic Components of a Computer - Characteristics of Modern Processors - Classification of Computer Architectures -Parallel Computer Memory Architectures - Measuring Performance -High-Performance Optimization Methods - Unconstrained Iterative Optimization Methods -Unconstrained Optimization Using Parallel Computing - Global Optimization Using Memetic Algorithms

Unit-II

Graphics Processing Unit Programming and Applications - CUDA: Compute Unified Device Architecture- CUDA Programming: Fractal Generation and display - GPU-based Conjugated Gradient Solution for Phase : Introduction – conjugate Gradient Method - Phase Field Model - Results

Unit-III

Parallel Computing Applied to a Diffusive Model : Introduction - Random Walk – Continuous Distributions -Solution via Finite Difference Approach - High Performance Computing Resources- A Parallel Implementation of the NSGA-II : Introduction – Basic Concepts - Genetic Algorithms - NSGA-II -Parallel Implementation of NSGA-II (PNSGA-II) - Results

Unit-IV

High-performance Navigation System for Mobile Robots -Introduction - Artificial Potential Field - Genetic Algorithms - High-performance Implementation - Phase 1: Simple navigation system with artificial potential field - Phase 2: Complete navigation system with artificial potential field and genetic algorithms -Phase 3: High-performance navigation system with artificial potential field and parallel genetic algorithms –Results -Quantum Computing- Introduction - Classic Computation – Basic Mathematics Used in Quantum Computing - Quantum Mechanic: Basic Principles - Elements of Quantum Computing

Unit-V

A Method Using a Combination of Ant Colony Optimization -Variants with Ant Set Partitioning-Introduction - Ant Colony Optimization (ACO) - Proposed Method – Methodology- Experiments - Simulation - **Variants of Ant Colony Optimization: A Metaheuristic for Solving the Traveling Salesman Problem** - Introduction - ACO Variants -Traveling Salesman Problem (TSP) -Elitist Ant System - Rank based ant system - Max-Min ant system - Ant Colony System (ACS) - Graphical Interface in Matlab - Sequential Processing - Parallel Processing - Simulation Results –Speedup

Reference Books

1. Oscar Montiel Ross and Roberto Sepúlveda Cruz, "High Performance Programming for Soft Computing", CRC Press, 2014
2. John Levesque,GeneWagenbreth , "High Performance Computing: Programming and Applications", First Edition, CRC Press, 2010
3. Charles Severance, Kevin Dowd, "High Performance Computing", OpenStaxCNX, 2010.
4. Roma A. Kudale and Snehal Kulkarni, "High Performance Computing", Vishwkarma Publications , 2016.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To introduce the fundamentals of high performance computing with the graphics processing units and their architectures.	K1 K2
CO2	To know and will be able to demonstrate the architectural features in the GPU hardware accelerators.	K3 K4
CO3	To design, formulate, solve and implement high performance versions of standard single threaded algorithms	K4 K5
CO4	To design and deploy large scale parallel programs on parallel Systems.	K5
CO5	To apply various advanced parallel algorithms through the GPU programming environments for research	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	M	S	S	S	M
CO3	S	S	S	M	S
CO4	S	S	S	S	M
CO5	S	S	M	S	S

S- Strong; M-Medium.

19URCSC0E16 Digital Image Analysis 4 Credits

Course Objectives:

- To provide complete knowledge on Computer Vision Techniques, such as Image transforms, Image enhancement in Spatial domain, Image enhancement in Frequency domain, Image restoration, Denoising, Image Segmentation, Object Recognition, Image Compression and basic understanding of Computer Vision concepts,.
- To understand these concepts and implement them empirically.

UNIT I

Introduction and Image Transforms: Introduction - Image Sampling - Quantisation - Resolution - Human Visual System - Classification of Digital Images - Image Types - Elements of an Image Processing System - Image File Formats - Applications of Digital Image Processing - Image Transforms: 2D Discrete Fourier Transform (DFT) - Properties of 2D-DFT - Types of Transform: Walsh – Hadamard - Haar - Slant – Discrete Cosine Transform (DCT) – Karhunen -Loeve Transform (KL Transform) - Singular Value Decomposition – Radon - Comparison of Different Image Transforms.

UNIT II

Image Enhancement and Restoration: Introduction - Spatial domain: Point Operation – Types of Point Operation - Histogram Manipulation - Linear and Non-Linear Gray-level Transformations - Local or Neighborhood Operation - Median Filter - High-pass Filtering or Image sharpening - Frequency Domain: Homomorphic Filter - Zooming Operation - Image Arithmetic - Image Restoration: Image Degradation - Classification of Image Restoration Techniques - Image Restoration Model - Linear and Non-Linear Image Restoration Techniques- Blind Deconvolution - Classification of Blind Deconvolution Techniques - Image Denoising: Classification of Noise in Image - Median Filtering - Trimmed Average Filter - Performance Metrics in Image Restoration.

UNIT III

Image Segmentation: Introduction – Classification of Image Segmentation Techniques – Region Approach to Image Segmentation – Clustering Techniques – Image Segmentation based on Thresholding – Edge-based Segmentation - Classification of Edges - Edge Detection - Edge Linking - Hough Transform - Active Contour - Watershed Transformation - Shape Representation - Classification of Shape-representation Techniques.

UNIT IV

Object Recognition: Introduction – Need for an Object Recognition System – Automated Object Recognition Systems - Patterns and Pattern Class – Selection of Measurement Parameters - Relationship between Image Processing and Object Recognition – Approaches to Object Recognition – Baye's Parametric Classification – Template-Matching-based Object Recognition - Non-Parametric Density Estimation - Applications of Object Recognition.

UNIT V

Image Compression: Introduction - Need for Image Compression – Redundancy in Images – Classification of Redundancy in Images – Image-Compression Scheme - Classification of Image-Compression Schemes - Fundamentals of Information Theory - Run-length Coding - Shannon-Fano Coding - Huffman Coding - Arithmetic Coding - Dictionary-based Compression - Predictive Coding - Transform-based Compression - Image-Compression Standard - Scalar Quantisation - Vector Quantisation -Types of Vector Quantisation - Wavelet-based Image Compression - Fractal Image Compression - Block Truncation Coding.

Reference Books:

1. S. Jayaraman, S. Esakkirajan, T.Veerakumar, Digital Image Processing, Tata McGraw Hill, Fourth Edition, 2011.(Chapters: 1,4,5 6,7,8,9)

2. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 2008.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand basic knowledge on the principle, fundamental digital image processing techniques	K2
CO2	Apply and Analyze Image noise removal, enhancement, compression for efficient storage and transmission	K3 & K4
CO3	Evaluate object extraction, representation and description for recognition or building computer vision.	K5
CO4	Construct the Image segmentation from images and do analysis of images.	K5 & K6
CO5	Develop applications using computer vision techniques.	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	S	S
CO2	M	S	S	S	M
CO3	S	S	S	M	S
CO4	S	S	S	S	M
CO5	M	S	M	S	S

S- Strong; M-Medium.

II-SEMESTER

PART II 19URCSC0C03

Dissertation and Viva-Voce

Candidates shall carry out research work in consultation with the guide/supervisor and submit the dissertation to the University through the Supervisor and Head of the Department at the end of the year from the commencement of the course which shall be valued by internal examiner (supervisor) and one external examiner appointed by the University from a panel of four names sent by the Supervisor through the Head of the Department at the time of submitting the dissertation.

XII. Model Question Paper

M.Phil., Degree – Computer Science

(For the candidates admitted from 2018-2019 onwards)

CORE COURSES

PAPER –I **Course 19URCSC0C01**

RESEARCH METHODOLOGY

Time: Three Hours Maximum:75 marks

PART –A: 5 × 5 = 25
(Answer all questions)
(One question from each unit with internal choice)

1. a) How an abstract differ from conclusion part of the thesis?

(OR)

b) How do you conclude review of literature part of the thesis?

2. a) Write short notes on Fuzzy Logic.

(OR)

b) Explain basic Fuzzy set operations.

3. a) What are the biological aspects that lead to the development of Artificial Neural Networks?

(OR)

b) Write a note on Learning Vector Quantization.

4. a) Explain the concept of Linear Separable.

(OR)

b) Compare perceptron with Hebb net.

5. a) Give a short note on Bayes Theorem.

(OR)

b) Write short notes on Conditionally Independent Features.

PAPER-B: 5 × 10 = 50
(Answer all questions)
(One question from each unit with internal choice)

6. a) Explain how different source of materials can be quoted and reference in the thesis.

(OR)

b) What are the Text support materials in a thesis? Explain each with example.

7. a) Discuss the role of linguistic variables and fuzzy relation in representing and interpreting fuzzy if-then rules.

(OR)

b) Discuss in detail about fuzzy reasoning.

8. a) Explain the basic building blocks of Artificial Neural Network.

(OR)

b) Explain the architecture and learning algorithm for feed forward back propagation network.

9. a) Write short notes on the following:
   a) Kohonen self-organizing maps.
   b) Hebb's rule

(OR)

b) Explain the architecture and training algorithm of Radial Basis Function Network(RBFN).

10. a) Explain the role of soft computing techniques in Culster Analysis.

(OR)

b) What the techniques used to estimate error rate? Explain.

Time: 3 Hours **Max.Marks - 75**

CORE COURSES

PAPER –II **Course 19URCSC0C02**

ADVANCED COMPUTING TECHNIQUES

PART –A: 5 × 5 = 25

(Answer all questions)

(One question from each unit with internal choice)

1. a) Discuss briefly on the Limitations of the Random Waypoint Model and other models.?

(OR)

b) Explain the Pathway Mobility Model with an example?

2. a) Explain the different categories of Optimization.

(OR)

b) Write a note on the components of Binary Genetic Algorithm.

3. a) What are the list of items that can be characterized when a combinatorial optimization problem is mapped.

(OR)

b) Explain the different procedures used in an ACO algorithm.

4. a) Define the following:

1) Approximation Space.

2) The p lower and p upper approximation.

(OR)

b) Explain the following:

1) Splitting Attribute.

2) Decision Tree

5. a) Write a short note on Fuzzy Equivalence classes.

(OR)

b) Explain briefly on Fuzzy Entropy.

PAPER-B: 5 × 10 = 50

(Answer all questions)

(One question from each unit with internal choice)

6. a) Explain in detail about the Non-uniform Spatial Distribution and Random Direction Model.

(OR)

b) Describe the Obstacle Mobility Model.

7. a) Explain the Natural Selection Method in Biological Optimization.

(OR)

b) Explain the Travelling Salesperson problem in Advanced Applications with examples.

8. a) Describe the Double Bridge Experiments.

(OR)

b) Explain in detail about the Ant System and its direct successors.

9. a) Describe about Closure Operators and Rough Sets.

(OR)

b) Explain the Rough Set based Attribute Reduction approach with an example.

10. a) Write the FR Quick Reduct Algorithm and explain how it works.

(OR)

b) Write the PSO-FS algorithm and explain how it works.

Time: 3 Hours Max.Marks - 75

ELECTIVE COURSES (GUIDE PAPER)

PAPER –III **Course 19URCSC0E0_**

COMPUTATIONAL ARTIFICIAL INTELLIGENCE

PART –A: 5 × 5 = 25

(Answer all questions)

(One question from each unit with internal choice)

1. a) Compare and contrast DWT and CWT.

   (OR)

   b) Illustrate the steps involved in signal de-noising using wavelet packets.

2. a) How to use RBFN for global optimization?

   (OR)

   b) How to construct and fine tune an RBFN?

3. a) Discuss the working principle of DWT for 1D, 2D, and 3D data

   (OR)

   c) How to use DWT for 1D Multilingual analysis?

4. a) Illustrate the working of Deep CNN for image processing

   (OR)

   b) Compare and contrast Tensor and Kernelized DSN

5. a) Elucidate the working principle of genetic algorithm

   (OR)

   b) Discuss Fruitfly algorithm with an example.

PAPER-B: 5 × 10 = 50

(Answer all questions)

(One question from each unit with internal choice)

6. a) Discuss the working of image de-nosing with DWT.

   (OR)

   b) How to compress an image with wavelet packets?

7. a) Explain the working of deep auto encoder with reinforcement learning.

   (OR)

   b) Discuss RBFN on the triple modular redundancy technology

8. a) Explain Fast Wavelet Transform with suitable example.

(OR)

b) Explain image enhancement with DWT.

9. a) Explain the architecture of Deep Stacking Network.

(OR)

b) Discuss the application of deep CNN for LVCSR

10. a) Elucidate Particle Swarm Optimization with an working example.

(OR)

b) Explain firefly algorithm with an example.

XIII. List of Question paper setters / Examiners

From Periyar University & Affiliated Colleges		Outside Periyar University	
S. No.	**Name and Address**	**S.No.**	**Name and Address**
1.	Dr. K. Thangavel Professor and Head Department of Computer Science Periyar University, Salem – 636 011	1.	Dr. M. Ramaswami, Professor, Department of Computer Applications, Madurai Kamaraj University Madurai.
2.	Dr. C. Chandrasekar Professor Department of Computer Science, Periyar University, Salem – 636 011	2.	Dr. S. Kannan, Professor, Department of Computer Applications, Madurai Kamaraj University Madurai.
3.	Dr. S. Sathish Assistant Professor Department of Computer Science Periyar University, Salem – 636 011	3.	Dr. P. Shanmugavadivu, Professor, Department of Computer Science and Applications, Gandhigram Rural Institute – Deemed University Gandhigram, Dindugaul – 624302.
4.	Dr. H. Hannah Inbarani Assistant Professor Department of Computer Science Periyar University, Salem – 636 011	4.	Dr. E. Chandra, Professor and Head, Department of Computer Science Bharathiar University, Coimbatore – 636 046.
5.	Dr. I. Laurence Aroquiaraj Assistant Professor Department of Computer Science Periyar University, Salem – 636 011	5.	Dr. T. Meyyappan Professor, Department of Computer Science, Alagappa University Karaikudi - 630003
6.	Dr. R. Rathi Priya Assistant Professor Department of Computer Science Periyar University, Salem – 636 011	6.	Dr. M. Balamurugan, Professor, School of Computer Science, Engineering & Applications, Khajamali Campus, Bharathidasan University, Trichy – 23.
7.	Dr. M. Malathi Assistant Professor Department of Computer Science Government Arts College, Salem – 636 007.	7.	Dr. R. Uthayakumar Professor, Department of Mathematics, Gandhigram Rural Institute, (Deemed to be University) Gandhigram - 624 302, Dindigul District, TAMIL NADU
8.	Mrs. A. Geetha Associate Professor Department of Computer Science JKKN College of Arts and Science, Kumarapalayam – 638 183	8.	Dr. S. Domnic Associate Professor, Department of Computer Application, National Institute of Technology (NIT), Tiruchirappalli – 620 015, Tamil Nadu.
		9.	Dr. P. Thiyagarajan, Assistant Professor, Head of the Department i/c Department of Computer Science, Central University of Tamil Nadu, Thiruvarur – 610 005.