Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Scheme for Honours in Intelligent Computing (Computer Engineering) (Autonomous) (DJR23 Scheme)

Sr. No.	Course Code	Course	Teaching Scheme				Semester End Examination (SEE)						Continuous Assessment (CA)			Aggregate (A + B)	Credits Earned	
			Theory (Hrs)	Practical (Hrs)	Tutorial (Hrs)	Credits	Duration (Hrs)	Theory	Oral	Practical	Oral & Practical	SEE (Total)	Theory	Term Work Total	CA Total			
Semester III																		
1	**DJR23CCH2301**	Soft Computing	3			3	2	60				60	40		40	100	3	3
Semester IV																		
2	**DJR23CCH2401**	Optimization Techniques	3			3	2	60				60	40		40	100	3	4
	DJR23CLH2401	Optimization Techniques Laboratory		2		1			25			25		25	25	50	1	
Semester V																		
3	**DJR23CCH2501**	Ubiquitous Computing	3			3	2	60				60	40		40	100	3	4
	DJR23CLH2501	Ubiquitous Computing Laboratory		2		1			25			25		25	25	50	1	
Semester VI																		
4	**DJR23CCH2601**	Intelligent Security System	3			3	2	60				60	40		40	100	3	3
Semester VII																		
5	**DJR23CCH2701**	Bayesian Computing	3			3	2	60				60	40		40	100	3	4
6	**DJR23CLH2701**	Bayesian Computing Laboratory		2		1			25			25		25	25	50	1	
		Total	**15**	**6**		**18**	**10**	**300**	**75**			**375**	**200**	**75**	**275**	**650**	**18**	**18**

Program: Computer Engineering **S.Y B.Tech.** **Semester: III**

Course: Soft Computing (DJR23CCH2301)

Course Objectives:	
1	To become familiarized with advanced Neural network
2	To be able to design Fuzzy Inference systems and familiarized with Fuzzy Rough set theory and hybrid systems.
3	To become familiarized with learning, associative memories and adaptive resonance theory
4	To become familiarized with applications of advanced soft computing.

Course Outcomes: At the end of the course, learner will able to	
1	Understand the constituents and characteristics of soft computing.
2	Design fuzzy logic controller for various systems.
3	Design neural networks for applications using supervised and unsupervised.
4	Understand and apply hybrid systems to real world problems.

Prerequisite: Basic Mathematics, Neural Network basics, Fuzzy sets and Fuzzy Logic basic

Sr. No.	**Module**	**Content**	**Hours**
1	**Introduction**	Introduction to soft Computing: Introduction, Fuzzy Computing, Neural Computing, Associative Memory, adaptive Resonance Theory, applications.	5
2	**Fuzzy Systems**	Fuzzy sets, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference systems, **Fuzzy Controller**: Table based controller, Mamdani fuzzy controller, Takagi-Sugeno controller. **Rough Set theory**: Concept of Discernibility, Vagueness in Rough Sets, Uncertainty in Rough Sets Introduction to type-2 fuzzy sets	10

3	**Neural Network**	**Fundamentals of Neural Networks:** Types of Learning, Linear Separability, Learning rules **Supervised Learning**: SDPTA, SCPTA, MCPTA, Error Back propagation training algorithm **Unsupervised Learning**: Self-Organizing Maps, Learning Vector Quantization, Radial Basis Function Networks	12
4	**Pattern Association**	**Associative Memory Network**: Description, Auto-associative Memory, Bidirectional Associative memory, Hetero-associative memory, **Adaptive Resonance Theory**: Stability Plasticity Dilemma, ART Networks, ART1	8
5	**Hybrid system**	Neuro Fuzzy hybrid systems: ANFIS, CANFIS, Fuzzy Associative Memories, simplified Fuzzy ARTMAP	4

Text Books:

1. Introduction to Artificial Neural Systems, Jacek M. Zurada, West Publication

2. Neuro-Fuzzy and Soft Computing, J.S.R Jang, C.T. Sun and E. Mizutani, PHI

3. Fundamentals of Neural Networks, Laurene Fausett, Pearson.

4. Principles of Soft Computing, S. N. Sivanandam, S.N. Deepa, Wiley, 2nd edition

Reference Books:

1. Neural Networks A Classroom Approach, Satish Kumar, Second Edition, McGrawHill.
2. Elements of Artificial Neural Networks, Kishan Mehrotra, Shilkuri K. Mohan, Sanjay Ranka, Second Edition, PRI

Program: Computer Engineering **S.Y B.Tech.** **Semester: IV**

Course: Optimization Techniques (DJR23CCH2401)

Course: Optimization Techniques Laboratory (DJR23CLH2401)

Pre-requisite:

1. Basic database concepts
2. Concepts of algorithm design and analysis

Course Objectives:

1. Introduce students to the principles and applications of bio-inspired optimization techniques.
2. Develop understanding of evolutionary algorithms, swarm intelligence, and ant colony optimization.
3. Build proficiency in implementing and analyzing various natural computing approaches.
4. Enable students to apply optimization techniques to solve real-world engineering problems.

Outcomes: On successful completion of course learner will be able to:

1. Apply genetic algorithms, particle swarm optimization, and ant colony optimization to solve complex optimization problems.
2. Evaluate and select appropriate optimization algorithms based on problem characteristics.
3. Implement bio-inspired algorithms using appropriate programming tools and frameworks.
4. Analyze optimization results and performance metrics to improve algorithm efficiency.

Optimization Techniques (DJS23CCH2401)		
Unit	**Description**	**Duration**
1	**Introduction to Natural Computing** From nature to natural computing, sample idea, Philosophy of natural computing, Natural computing approaches, Natural Phenomena, Models, and Metaphors, From Nature to Computing and Back Again, General Concepts – Individuals, Entities, Agents; Parallelism and Distributivity; Interactivity; Adaptation; Feedback; Self-Organization; Bottom-Up Vs Top-Down	05
2	**Evolutionary Computing – Genetic Algorithms** Basic Principles of Genetics, Fitness Function; Selection: Selective Pressure, Random Selection, Proportional Selection, Tournament Selection, Rank-Based Selection, Boltzmann Selection, Elitism; Reproduction Operators: Crossover	08

	operator, Mutation; Application: Pattern Recognition, Numerical Function Optimization.	
3	**Swarm Intelligence**: Particle Swarm Optimization: Basic Particle Swarm Optimization: Global Best PSO, Local Best PSO, Velocity Components; Basic PSO parameters, Single Solution Particle Swarm Optimization: Guaranteed Convergence PSO, Social-Based Particle Swarm Optimization, Hybrid Algorithms, Sub-Swarm Based PSO, Multi-Start PSO Algorithms, Repelling Methods, Binary PSO; Application	08
4	**Ant Algorithm**: Simple Ant Colony Optimization, Ant Colony Optimization Meta-Heuristic, Cemetery Organization and Brood Care, Division of Labor, Application: Travelling Salesman Problem	06
5	**Advanced Bio-inspired Optimization Techniques:** Artificial Bee Colony (ABC) Algorithm - based on foraging behavior of honey bees, Firefly Algorithm - inspired by the flashing behavior of fireflies, Cuckoo Search - based on brood parasitism of cuckoo species, Bacterial Foraging Optimization - inspired by bacteria seeking nutrients	06
6	**Hybrid Optimization and Applications in Data Analysis:** Memetic Algorithms - combining population-based methods with local search, Multi-objective Optimization - techniques for problems with competing objectives, Self-adaptive Parameter Control - advanced methods for algorithm tuning, Parallel and Distributed Optimization - scaling up optimization approaches, Applications in Data Science - practical uses in classification, clustering, feature selection, etc.	06
	Total	39

Optimization Techniques Laboratory (DJR23CLH2401)	
Exp.	**Suggested experiments**
1.	Implementation of different selection methods in Genetic Algorithms and performance comparison
2.	Solving the Traveling Salesman Problem using Genetic Algorithms with different crossover and mutation operators
3.	Implementation of Particle Swarm Optimization for benchmark function optimization

4.	Comparison of Global Best PSO and Local Best PSO on multimodal functions
5.	Implementation of Ant Colony Optimization for path finding and route optimization
6.	Solving resource allocation problems using Ant Colony Optimization
7.	Implementation of Artificial Bee Colony algorithm for continuous function optimization
8.	Application of Firefly Algorithm for feature selection in classification problems
9.	Implementation of Cuckoo Search for constrained optimization problems
10.	Comparison of multiple bio-inspired algorithms on a standard benchmark suite
11.	Development of a hybrid optimization algorithm combining two bio-inspired techniques
12	Optimization of machine learning model hyperparameters using bio-inspired techniques

Batchwise laboratory work of minimum 8 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Books Recommended:

1. Yang, X.S., "Nature-Inspired Optimization Algorithms," 2nd Edition, Elsevier, 2021
2. Engelbrecht, A.P., "Computational Intelligence: An Introduction," 3rd Edition, Wiley, 2022
3. Eiben, A.E. and Smith, J.E., "Introduction to Evolutionary Computing," 3rd Edition, Springer, 2023
4. Weise, T., "Global Optimization Algorithms - Theory and Application," 3rd Edition, Self-Published, 2021

Reference Books:

1. Dorigo, M. and Stützle, T., "Ant Colony Optimization: Principles, Applications, and Extensions," 2nd Edition, MIT Press, 2022
2. Karaboga, D. and Akay, B., "Artificial Bee Colony Algorithm and Its Applications," Springer, 2021
3. Rao, R.V., "Teaching Learning Based Optimization Algorithm: And Its Engineering Applications," Springer, 2022
4. Coello Coello, C.A., Lamont, G.B., and Van Veldhuizen, D.A., "Evolutionary Algorithms for Solving Multi-Objective Problems," 3rd Edition, Springer, 2023
5. Simon, D., "Evolutionary Optimization Algorithms: Biologically Inspired and Population-Based Approaches to Computer Intelligence," 2nd Edition, Wiley, 2023

Program: Computer Engineering **T.Y.B.Tech.** **Semester: V**

Course: Ubiquitous Computing (DJR23CCH2501)

Course: Ubiquitous Computing Laboratory (DJR23CLH2501)

Pre-requisite: Knowledge of

1. **Computer Networks**

Objectives:

1. To understand characteristics of Ubiquitous Computing.
2. To understand the trends, strengths and weaknesses of systems in a ubiquitous environment.
3. To understand human interaction behavior with ubiquitous systems.

Outcomes: On completion of the course, the learner will be able to:

1. Describe the characteristics of Ubiquitous computing
2. Analyze the strength and limitations of the current tools, devices and communications
3. Identify human interaction behavior with systems in a ubiquitous environment
4. Explore the trends and problems of current ubiquitous computing systems.

Ubiquitous Computing (DJR23CCH2501)		
Unit	**Description**	**Duration**
1	**Introduction to Ubiquitous Computing:** Impact of digital world, Illustrative applications, Modelling the Key Ubiquitous Computing Properties, Ubiquitous System Environment Interaction, Architectural Design for Ubiquitous Computing Systems.	06
2	**Smart Devices and Services:** Service Architecture Models, Service Provision Life-Cycle, Smart Mobile Devices, Smart Card Devices.	07
3	**Human–Computer Interaction:** User Interfaces and Interaction for Widely Used Devices, Hidden UI Via Basic Smart Devices	07
4	**Context-Aware Systems:** Modelling Context-Aware Systems, Mobility Awareness, Spatial Awareness	07
5	**Management of Smart Devices:**	06

Ubiquitous Computing (DJR23CCH2501)		
Unit	**Description**	**Duration**
	Managing Smart Devices in Virtual Environments, Managing Smart Devices in Human User-Centred Environments, Managing Smart Devices in Physical Environments.	
6	**Challenges and Outlook:** Overview of challenges, smart devices, Smart Interaction, Smart physical environment device interaction, Smart human-device interaction, Human Intelligence versus machine intelligence, social issues.	06
	Total	**39**

Ubiquitous Computing Laboratory (DJR23CLH2501)	
Exp.	**Suggested experiments**
1	Applications for location-based messages
2	Context-Aware system
3	Human Computer Interaction
4	Ubiquitous Communication
5	Case study of Class Room 2030
6	Case study of Super Market
7	Case study of Hospital Management
8	Case study on evolution of smart devices

Books Recommended:

Text Books:

1. Stefan Poslad, “Ubiquitous Computing, Smart Devices, Environment and Interaction,” Wiley.
2. John Krumm, “Ubiquitous Computing Fundamentals,” CRC Press.

Reference Books:

1. Adam Greenfield, “Everyware: The Dawning Age of Ubiquitous Computing,” Pearson Education.
2. Genco and Sorce, “Pervasive Systems and Ubiquitous Computing,” WIT Press

Program: Computer Engineering **T.Y.B.Tech.** **Semester: VI**

Course: Intelligent Security Systems (DJR23CCH2601)

Pre-requisite: Knowledge of

1. Basic knowledge of Computer Networks
2. Basic knowledge of databases and operating systems.

Objectives:

1. To better understand how to apply artificial intelligence, machine learning, and data science in the computer security domain.
2. Introduce readers into the current state of an application of intelligent methodologies in computer security and information assurance systems design.
3. To get better prepared either to enter the workforce or to upgrade their skills.
4. Gain knowledge in the most trending area of the current computer science and will be able to employ it in solving cybersecurity problems.

Outcomes: On completion of the course, the learner will be able to:

1. Gain the knowledge and skills at the intersection of computer security and artificial intelligence, machine learning, and data science domain.
2. Upgrade their skills and better understand intelligent techniques.
3. Apply their knowledge and skills in computer security domain.

Intelligent Security Systems (DJR23CCH2601)		
Unit	**Description**	**Duration**
1	**Current Computer Security Landscape:** • The Current Security Landscape, • Computer Security Basic Concepts, • Sources of Security Threats, • Attacks Against IoT and Wireless Sensor Networks, • Introduction to Artificial Intelligence, Machine Learning and Data Science, • Fuzzy Logic and Systems, • Machine Learning, • Artificial Neural Networks (ANN), • Genetic Algorithms (GA), • Hybrid Intelligent Systems	06
2	**Firewall Design and Implementation:** • Firewall Definition, History, and Functions, • Firewall Operational Models,	07

Intelligent Security Systems (DJR23CCH2601)		
Unit	**Description**	**Duration**
	• Basic Firewall Architectures, • Process of Firewall Design, • Implementation, and Maintenance, • Firewall Policy Formalization with Rules, • Firewalls Evaluation and Current	
3	**Intrusion Detection Systems:** • Definition, Goals, and Primary Functions, • IDS from a Historical Perspective, • Typical IDS Architecture Topologies, • Components, and Operational Ranges, • IDS Types: Classification Approaches, • IDS Performance Evaluation, • Artificial Intelligence and Machine Learning Techniques in IDS Design, • Intrusion Detection Challenges and Their Mitigation in IDS Design and Deployment, Intrusion Detection Tools	07
4	**Anti Malware Systems:** • Malware Definition, History, and Trends in Development, • Malware Classification, • Spam, • Software Vulnerabilities, • Principles of Malware Detection and Anti-malware Protection, • Malware Detection Algorithms, • Anti-malware Tools	07
5	**Hackers and Ethical Users:** • Hacker's Activities and Protection Against, • Data Science Investigation of Ordinary Users' Practice, • User's Authentication, • User's Anonymity, • Attacks Against It and Protection	06
6	**Adversarial Machine Learning:** • Adversarial Machine Learning Definition, • Adversarial Attack Taxonomy,	06

Intelligent Security Systems (DJR23CCH2601)		
Unit	**Description**	**Duration**
	• Defense Strategies, • Investigation of the Adversarial Attacks Influence on the Classifier Performance Use Case, Generative Adversarial Networks. • Adversarial Auto Encoders	
	Total	**39**

Books Recommended:

Text Books:

1. Leon Reznik, Intelligent Security Systems: How Artificial Intelligence, Machine Learning and Data Science Work for and Against Computer Security, First Edition, Wiley, 2021

Reference Books:

1. David Foster, Generative Deep Learning: Teaching Machines to Paint, Write, Compose and Play, O'Reilly, 1st Edition, 2021
2. Rowel Atienza, Advanced Deep Learning with Keras,Packt Publishing, 1st Edition, 2018
3. Kerry J. Cox, Christopher Gerg, Managing Security with Snort & IDS Tools, O'Reilly Media, Inc,2004
4. J. Michael Stewart, Network Security, Firewalls and VPNs, Jones and Bartlett Publishers, 2nd Edition, July 2013

Program: Computer Engineering **Final Year B.Tech.** **Semester: VII**

Course: Bayesian Computing (DJR23CCH2701)

Course: Bayesian Computing Laboratory (DJR23CLH2701)

Pre-requisite: Knowledge of

1. Mathematics and statistics
2. R/Python Programming

Objectives:

1. To introduces the Bayesian approach to statistical inference for data analysis in a variety of applications.
2. To identify different types of priors, the use of the posterior distribution to perform different types of inferences using predictive distribution.
3. To introduce the fundamental ideas of Markov chain Monte Carlo (MCMC) methods that provides a reasonable approximation to the posterior distribution of interest.
4. To introduces the use of exchangeable models in a wide variety of modelling and application areas from a Bayesian viewpoint.
5. To apply the Bayesian models in regression modelling, Gibbs sampling.

Outcomes: On completion of the course, the learner will be able to:

1. Draw an inference from computing models and make use of posterior probability distribution over a set of hypotheses or models.
2. Provide new methodologies in the transmission of statistical ideas to assess robustness of inferences in particular applications.

Bayesian Computing (DJR23CCH2701)		
Unit	**Description**	**Duration**
1	**Introduction to Bayesian Thinking:** Introduction, Learning About the Proportion of Heavy Sleepers, using a Discrete Prior, using a Beta Prior, Using a Histogram Prior, Prediction, Single-Parameter Models: Introduction, Normal Distribution with Known Mean but Unknown Variance, Estimating a Heart Transplant Mortality Rate, Bayesian Robustness, Mixtures of Conjugate Priors, A Bayesian Test of the Fairness of a Coin, Multiparameter Models: Introduction, Normal Data with Both Parameters Unknown, A Multinomial Model, A Bioassay Experiment, Comparing Two Proportions	06
2	**Bayesian Computation:**	07

Bayesian Computing (DJR23CCH2701)		
Unit	**Description**	**Duration**
	Introduction, Computing Integrals, Setting Up a Problem, A Beta-Binomial Model for Over dispersion, Approximations Based on Posterior Modes, The Example, Monte Carlo Method for Computing Integrals, Rejection Sampling, Importance Sampling, Sampling Importance Resampling	
3	**Markov Chain Monte Carlo Methods:** Introduction, Introduction to Discrete Markov Chains, Metropolis-Hastings Algorithms, Gibbs Sampling, MCMC Output Analysis, A Strategy in Bayesian Computing, Learning About a Normal Population from Grouped Data, Example of Output Analysis, Modeling Data with Cauchy Errors, Analysis of the Stanford Heart Transplant Data	07
4	**Hierarchical Modeling:** Introduction, Three Examples, Individual and Combined Estimates, Equal Mortality Rates? Modeling a Prior Belief of Exchangeability, Posterior Distribution, Simulating from the Posterior, Posterior Inferences, Bayesian Sensitivity Analysis, Posterior Predictive Model Checking, Model Comparison: Introduction, Comparison of Hypotheses, A One-Sided Test of a Normal Mean, A Two-Sided Test of a Normal Mean, Comparing Two Models, Models for Soccer Goals, A Test of Independence in a Two-Way Contingency Table	07
5	**Regression Models:** Introduction, Normal Linear Regression: The Model, The Posterior Distribution, Prediction of Future Observations, Computation, Model Checking, An Example. Model Selection Using Zellner's g Prior. Survival Modeling.	06
6	**Gibbs Sampling:** Introduction, Robust Modeling, Binary Response Regression with a Probit Link: Missing Data and Gibbs Sampling, Proper Priors and Model Selection, Estimating a Table of Means: A Flat Prior Over the Restricted Space, A Hierarchical Regression Prior, Predicting the Success of Future Students.	06
	Total	**39**

Bayesian Computing Laboratory (DJR23CLH2701)	
Exp.	**Suggested experiments**
1	Exploring student's dataset for 1. What is your gender? 2. What is your height in inches? 3. Choose a whole number between 1 and 10. 4. Give the time you went to bed last night. 5. Give the time you woke up this morning. 6. What was the cost (in dollars) of your last haircut, including the tip? 7. Do you prefer water, pop, or milk with your evening meal?
2	Implement a Discrete Prior, Beta Prior, Histogram Prior, Prediction model using R
3	Implement a model for Estimating a Heart Transplant Mortality Rate using R.
4	Implement a model for A Bioassay Experiment: consider data from Gelman et al. (2003), where one observes a dose level (in log g/ml), the number of animals, and the number of deaths for each of four groups.
5	Implement a Logistic Modeling A math department is interested in exploring the relationship between students' scores on the ACT test, a standard college entrance exam, and their success (getting an A or a B) in a business calculus class. Data were obtained for a sample of students
6	Implement a Beta-Binomial Model for Over dispersion using Cancer mortality data.
7	Estimation for the two-parameter exponential distribution: Using your simulated values from the posterior, find the posterior mean and posterior standard deviation.
8	Implement a Learning About a Normal Population from Grouped Data, using height and frequency data from student's dataset.
9	Implement a model for Analysis of the Stanford Heart Transplant Data.
10	Implement a model to test of Independence in a Two-Way Contingency Table.
11	Study of R to Interface with WinBUGS, a stand-alone software program for the Windows operating system.

Books Recommended:

Text Books:

1. Bayesian Computation with R, by Jim Albert. Springer, 2009, 2nd Edition. ISBN: 0387922970

2. Bayesian Data Analysis, by Andrew Gelman, John B. Carlin, Hal S. Stern, David B. Dunson, Aki Vehtari, and Donald B. Rubin. CRC Press/Taylor & Francis, 2013, 3rd Edition. ISBN: 9781439840955

Reference Books:

1. Bayesain Statistical Modelling, by Peter Congdon, Wiley Publications, 2nd Edition, ISBN-13 978- 0-470-01875-0 (HB)

Web References:

1. https://www.math.wustl.edu/~nlin/math459
2. Bayesian Statistics | Coursera