Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and detailed Syllabus (DJ19)

of

Honors Degree Program

in

Intelligent Computing

Revision: 1 (2022)

With effect from the Academic Year: 2022-2023

Scheme for Honors in Intelligent Computing: Department of Computer Engineering
(Academic Year 2022-2023)

Sr.	Course Code	Course	Teaching Scheme (hrs.)				Continuous Assessment (A) (marks)			Semester End Assessment (B) (marks)					(A+B)	Total Credits
			Th	P	T	Credits	Th	T/W	Total CA (A)	Th / Cb	O	P	O & P	Total SEA (B)		
		Sem V														
1	DJ19CEHN1C1	Nature Inspired Computing	4	--	--	4	25	--	25	75	--	--	--	75	100	4
		Sem VI														
2	DJ19CEHN1C2	Ubiquitous Computing	4	--	--	4	25	--	25	75	--	--	--	75	100	4
3	DJ19CEHN1L1	Ubiquitous Computing Laboratory	--	2	--	1	--	25	25	--	--	--	25	25	50	1
		Sem VII														
4	DJ19CEHN1C3	Bayesian Computing	4	--	--	4	25	--	25	75	--	--	--	75	100	4
5	DJ19CEHN1L2	Bayesian Computing Laboratory	--	2	--	1	--	25	25	--	--	--	25	25	50	1
		Sem VIII														
6	DJ19CEHN1C4	Intelligent Security System	4	--	--	4	25	--	25	75	--	--	--	75	100	4
		Total	16	4	0	18	100	50	150	300	0	0	50	350	500	18

Scheme for Honors in Intelligent Computing: Department of Computer Engineering
(Academic Year 2022-2023)
Assessment Scheme

Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (hrs.)
Theory	One Term test (based on 40 % syllabus)	25 each (Avg.25)	1
	Second Term test (next 40 % syllabus) / presentation / assignment / course project / group discussion / any other.		as applicable
Audit course	Performance in the assignments / quiz / power point presentation / poster presentation / group project / any other tool.	--	
Laboratory	Performance in the laboratory and documentation.	25	
Tutorial	Performance in each tutorial & / assignment.	25	
Laboratory &Tutorial	Performance in the laboratory and tutorial.	25	

The final certification and acceptance of term work will be subject to satisfactory performance upon fulfilling minimum passing criteria in the term work / completion of audit course.

Semester End Assessment (B):

Course	Assessment Tools	Marks	Time (hrs.)
Theory / * Computer based	Written paper based on the entire syllabus.	75	3
	* Computer based assessment in the college premises.		
Oral	Questions based on the entire syllabus.	25	as applicable
Practical	Performance of the practical assigned during the examination and the output / results obtained.	25	2
Oral & Practical	Project based courses - Performance of the practical assigned during the examination and the output / results obtained. Based on the practical performed during the examination and on the entire syllabus.	as per the scheme	2

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Honors in Intelligent Computing   **Semester: V**

Program: Computer Engineering

Course: Nature Inspired Computing (DJ19CEHN1C1)

Pre-requisite: --

1. Algorithms

Objectives:

1. To learn how natural and biological systems influence computational field

2. To understand the strengths and weaknesses of nature-inspired algorithms

3. To learn the functionalities of various Bio-inspired optimization algorithms

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

1. Understand the natural phenomena that inspire the algorithms

2. Apply nature-inspired algorithms to optimization

3. Select the appropriate strategy or optimal solution based on bio-inspired algorithms

Bayesian Computing (DJ19CEHN1C1)		
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	08
2	**Artificial Neural Networks** Biological Nervous Systems, Artificial Neural Networks, Neuron Models, Architectures, Supervised learning: Perceptron algorithm, Back Propagation Algorithm, Unsupervised learning: Self-organizing maps, ART, Reinforcement learning	09
3	**Evolutionary Computing – Genetic Algorithms** Basic Principles of Genetics, Fitness Function; Selection: Selective Pressure, Random Selection, Proportional Selection, Tournament Selection, Rank-Based Selection, Boltzmann	09

	Selection, Elitism; Reproduction Operators: Crossover operator, Mutation; Application: Pattern Recognition, Numerical Function Optimization.		
4	**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	09	
5	**Ant Algorithm**: Simple Ant Colony Optimization, Ant Colony Optimization Meta-Heuristic, Cemetery Organization and Brood Care, Division of Labor, Application: Travelling Salesman Problem	08	
6	**Artificial Immune Models:** Natural Immune System: Classical view, Antibodies and Antigens, White Cells, Immunity types, Network Theory, Danger Theory; Artificial Immune Models: Artificial Immune system algorithm, classical view models, Clonal Selection Theory: CLONALG; Network Theory Models; Danger Theory Models; Application: Intrusion Detection	09	
	Total	**52**	

Books Recommended:

Text Books:

1. L. N. de Castro, "Fundamentals of Natural Computing: Basic Concepts, Algorithms and Applications", 2006, CRC Press, ISBN-13: 978-1584886433
2. Andries P. Engelbrecht, "Computational Intelligence an Introduction", Wiley, 2nd Edition
3. Tom Mitchell, Machine Learning, McGraw Hill, 1997, 0-07-042807-7

Reference Books:

1. D. Floreano and C. Mattiussi, "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", 2008, MIT Press, ISBN-13: 978-0262062718
2. Russell C. Eberhart, Yuhui Shi, James Kennedy, "Swarm Intelligence: The Morgan Kaufmann Series in Evolutionary Computation", 1st Edition, ISBN-13: 978- 1558605954
3. Sam Jones (Editor), "Bio Inspired Computing-Recent Innovations and Applications", Clanrye International; 2nd edition (2 January 2015), ISBN-10: 1632400812

4. Yang Xiao (Editor), "Bio-Inspired Computing and Networking", CRC Press,

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Program: Department of Computer Engineering
Course: Ubiquitous Computing (DJ19CEHN1C2)

Pre-requisite: --
  2.   Networking Basics

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:
  4.   Describe the characteristics of Ubiquitous computing

  5.   Analyze the strength and limitations of the current tools, devices and communications

  6.   Identify human interaction behavior with systems in a ubiquitous environment

  7.   Explore the trends and problems of current ubiquitous computing systems.

Unit	Description	Duration
	Ubiquitous Computing (DJ19CEHN1C2)	
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.	8
2	**Smart Devices and Services:** Service Architecture Models, Service Provision Life-Cycle, Smart Mobile Devices, Smart Card Devices.	10
3	**Human–Computer Interaction:** User Interfaces and Interaction for Widely Used Devices, Hidden UI Via Basic Smart Devices	8
4	**Context-Aware Systems**: Modelling Context-Aware Systems, Mobility Awareness, Spatial Awareness	8
5	**Management of Smart Devices**: Managing Smart Devices in Virtual Environments, Managing Smart Devices in Human User-Centred Environments, Managing Smart Devices in Physical Environments.	10
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..	8
	Total	**52**

List of 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:
4. Stefan Poslad, "Ubiquitous Computing, Smart Devices, Environment and Interaction," Wiley.
5. John Krumm, "Ubiquitous Computing Fundamentals," CRC Press.

Reference Books:
5. Adam Greenfield, "Everyware: The Dawning Age of Ubiquitous Computing," Pearson Education.
6. Genco and Sorce, "Pervasive Systems and Ubiquitous Computing," WIT Press.

Web References:
1. http://www.cs.cmu.edu/~anind/courses/ubicomp-f2009/some-compsci-issues-ubicomp.pdf

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Course: Bayesian Computing (DJ19CEHN1C3)

Pre-requisite:
1. Mathematics and statistics
2. Familiar with Programming using R/Python

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 inferences 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 (DJ19CEHN1C3)
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,	09
2	Bayesian Computation: 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,	08

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,	08
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	**10**
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 .	**09**
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.	**10**
	Total	**52**

List of 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

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Pre-requisite:
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 (DJ19CEHN1C4)		
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	10
2	**Firewall Design and Implementation:** • Firewall Definition, History, and Functions, • Firewall Operational Models, • Basic Firewall Architectures, • Process of Firewall Design, • Implementation, and Maintenance, • Firewall Policy Formalization with Rules, • Firewalls Evaluation and Current	10
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	8
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	8

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	6
6	**Adversarial Machine Learning:** • Adversarial Machine Learning Definition, • Adversarial Attack Taxonomy, • Defense Strategies, • Investigation of the Adversarial Attacks Influence on the Classifier Performance Use Case, Generative Adversarial Networks. • Adversarial Auto Encoders	6
	Total	52

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

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