Variants of GA, Applications, Ant Colony Optimization, Particle Swarm Optimization, Artificial Bee Colony Optimization, concept of multi-objective optimization problems (MOOPs), Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.

Readings:

1. Simon S. Haykin, Neural Networks, Prentice Hall, 2nd edition.
2. B. Yegnanrayana, “Artificial Neural Networks” , PHI.
3. Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House,1994
4. Zimmermann, “Fuzzy Set Theory and its Application”, 3rd Edition.
5. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall, 1998.
6. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill, 1997.
7. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y, 1989.

MCSE307: QUANTUM COMPUTING AND ITS APPLICATIONS [3-0-1]

Course Objectives: This course provides a foundation for quantum computing, Post-Quantum Cryptography and quantum machine learning. It covers the fundamental concepts of quantum mechanics, quantum algorithms, and their applications in various areas, including cryptography, cybersecurity, machine learning, finance, the energy sector, etc. Students will gain a theoretical understanding of quantum computing and practical skills in implementing quantum algorithms for various tasks.

Course Learning Outcomes: On completing this course, the student will be able to:

CO1: Understand the basic principles of quantum mechanics and their relevance to quantum computing.
CO2: Comprehend quantum algorithms and their applications.
CO3: Apply quantum optimization techniques in problem-solving.
CO4: Demonstrate practical skills in quantum computing in various areas, including cryptography and machine learning.

Syllabus:

Unit-I Fundamentals of Quantum Computing: Mathematical foundations: Vectors, Vector space, Inner product; Qubits, Introduction to quantum mechanics and its relevance to Quantum gates, superposition principle, and entanglement Quantum parallelism and interference, No cloning theorem, quantum teleportation.

Unit-II Post-Quantum Security: Deutsch-Jozsa algorithm, Simon's algorithm, Bernstein-Vazirani, RSA algorithm and factorization attack on RSA, Shor's algorithm for integer factorization, Grover's algorithm for unstructured search, Hash preimage attack with Grover’s algorithm, Quantum Fourier transform and its applications, Harrow–Hassidim–Lloyd (HHL) algorithm, Quantum attack resistant Digital Signatures.

Unit-III Quantum Machine Learning and Optimization: Quantum machine learning (QML) models – QSVM, QNN, QCNN, Quantum Linear Regression, Variational Quantum Classifier (VQC), Quantum k-means clustering; kernel methods, Quantum Boltzmann Machines; Quantum optimization techniques: QAOA, quantum annealing.

Unit-IV: Introduction to quantum simulation tools and platforms: Google CIRQ, Amazon Braket, IBM Qiskit, Pennylane, Q#, Tensorflow quantum, Tket/pyket, XACC, Project Q, Quantum Development Kit (QDK).

Readings:

1. Elias F. Combarro, Samuel González-Castillo, and Alberto Di Meglio. A Practical Guide to Quantum Machine Learning and Quantum Optimization: Hands-on Approach to Modern Quantum Algorithms. Packt Publishing Ltd, 2023.
2. Noson S. Yanofsky and Mirco A. Mannucci. Quantum computing for computer scientists. Cambridge University Press, 2008.
3. Douglas R. Stinson and Maura B. Paterson. Cryptography, Theory and Practice, CRC Press, 2019.
4. Santanu Pattanayak. Quantum Machine Learning with Python: Using Cirq from Google Research and IBM Qiskit. Apress, 2021.
5. Santanu Ganguly. Quantum Machine Learning: An Applied Approach. Apress, 2021.
6. https://docs.quantum.ibm.com/
7. https://quantumai.google/cirq/experiments/textbook_algorithms

MCSE308: SOFTWARE QUALITY ASSURANCE AND TESTING [3-0-1]

Course Objectives:

Course Learning Outcomes : On completion of this course, the student will be able to:
CO1: understand quality management processes.
CO2: understand the importance of standards in the quality management process and role of SQA function in an organization.
CO3: gain knowledge of statistical methods and process for software quality assurance
CO4: understand the need and purpose of software testing. CO5: model the quantitative quality evaluation of the software products.

Syllabus :
Unit-I Introduction: Concept of Software quality, product and process quality, software quality metrics, quality control and total quality management, quality tools and techniques, quality standards, defect management for quality and improvement.
Unit-II Designing software quality assurance system: Statistical methods in quality assurance, fundamentals of statistical process control, process capability, Six-sigma quality.
Unit-III Testing: Test strategies, test planning, functional testing, stability testing and debugging techniques.
Unit-IV Reliability: Basic concepts, reliability measurements, predictions and management.
Readings:

1. N.S. Godbole, Software Quality Assurance: Principles and Practice for the New Paradigm (2nd Ed.), Narosa Publishing, 2017.