Adani University, Ahmedabad

Faculty of Engineering Sciences and Technology (FEST)
Department of Computer Science and Engineering (AI-ML)

Course Code	:	
Course Name	:	Soft Computing
Pre-requisites, if any:		Strong Mathematical background, Proficiency with Algorithms, Programming skills in C, Python, MATLAB, Critical thinking, and problem-solving skills.
Credit Points	:	4 (3-0-2)
Offered	:	B.Tech in CSE (AI-ML)
Semester	:	VII (Professional Core Course)

Course Coordinator:

Full Name: Dr. Diya Vadhwani
Faculty and Address with room number: 4th Floor
Faculty Room: 4t Floor
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Consultation Times: 10:00-5:00 Monday to Friday

Course Objectives:

Introduce the student with a conceptual foundation for different computing paradigms, Multi-objective Optimization, Genetic Algorithm, Swarm Intelligence, and Immunocomputing to solve real-time problems.

Course Outcomes:

Sr. No	CO Statement
CO-1	Ability to explain the essential concepts of computing and different types of computing.
CO-2	Ability to solve multi-objective optimization problems and Multi-Objective Evolutionary Algorithm.
CO-3	Ability to understand concepts of Genetic Algorithm and Fuzzy Logic
CO-4	Ability to apply knowledge of evolutionary algorithms to solve real-time problems using swarm intelligence and immunocomputing.

Course Outline:

Unit	Content	Hrs.
1	**Introduction to Computing:** Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of soft computing techniques. **Computing Inspired by Nature:** Evolutionary Computing, Hill Climbing and Simulated Annealing, Darwin's Dangerous Idea, Genetics Principles, Introduction to Standard Evolutionary Algorithms.	11
2	**Multi-objective Optimization Problem Solving:** Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.	7
3	**Genetic Algorithms:** Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures. GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using GAs. **Fuzzy Logic & Fuzzy Reasoning:** Fuzzy sets, Fuzzy Relations, Defuzzification, Fuzzy inference system,	12
4	**Swarm Intelligence:** Introduction - Ant Colonies, Ant Foraging Behavior, Ant Colony Optimization, SACO and scope of ACO algorithms, Ant Colony Algorithm (ACA), Swarm Robotics, Foraging for food, Social Adaptation of Knowledge, Particle Swarm Optimization (PSO). **Immunocomputing:** Introduction- Immune System, Physiology and main components, Pattern Recognition and Binding, Immune Network Theory- Danger Theory, Evaluation Interaction- Immune Algorithms	12

Method of delivery:
Face-to-face lectures, self-study material, class practice, assignments, quizzes, presentations, etc.

Study time:
3 hrs. lecture, 2 hrs. lab

CO-PO Mapping (Course outcome with Program Outcomes):

PO 1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6. The engineer and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to professional engineering practice.

PO 7. Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO 9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	2	1	3	0	0	0	0	2
CO-2	3	3	3	3	2	1	2	0	0	0	0	2
CO-3	3	3	3	3	3	1	2	0	0	0	2	2
CO-4	3	3	3	3	3	1	3	0	0	0	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) 0: None

Blooms Taxonomy and Knowledge Retention:
(Blooms taxonomy has been given for reference)

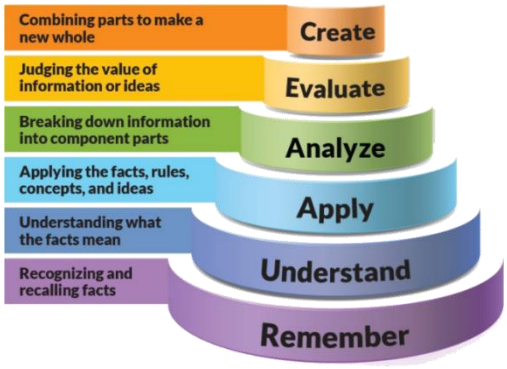

Figure 1: Blooms Taxonomy

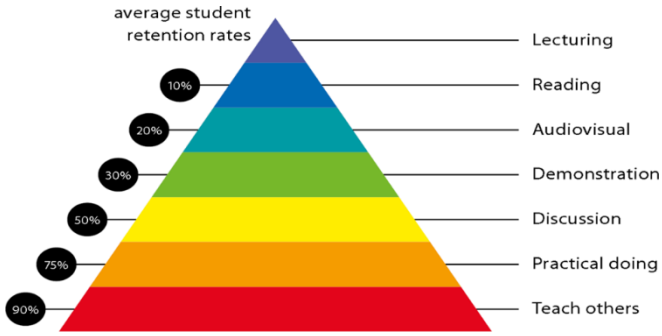

Figure 2: Knowledge retention

Remember	Understand	Application	Analysis	Evaluate	Create
30	30	25	15	-	-

Graduate Qualities and Capabilities Covered
(Qualities graduates harness crediting this Course)

General Graduate Qualities/ Attributes	Specific Faculty of Graduate Capabilities
Deep discipline knowledge & intellectual breadth: i. Graduates are able to apply domain knowledge from a strong understanding of the fundamentals and connect with the larger picture in the real world.	**Professional knowledge, grounding & awareness**
Creative, critical thinking, and problem-solving:	**Complex problems solving ability**

i. Graduates shall not be stuck in the silos of discipline. ii. Graduates shall be able to analyse a problem critically using their scientific temper. iii. Graduates shall be solution-centric solving problems innovatively.	**Intellectual and creative advances**
Digital mindset: i. Graduates shall be able to use technology to enable and enhance their effectiveness and efficiency in delivering outcomes.	**Information literacy, literature gathering & processing, and use of IT tools**
Teamwork and Communication Skills: i. Graduates shall be inclusive in a team acknowledging and appreciating the strengths of team members. ii. Graduates shall be able to communicate effectively to enhance collaboration and comradery.	**Team and individual work** **Written and Oral communications**
Professional and leadership readiness: i. Graduates shall be courteous, and conscientious and exhibit mastery over their domain of expertise. ii. Graduates shall exhibit leadership traits of inclusivity, empathy, understanding, and listening skills encouraging team spirit.	**Leadership role**
Human values: i. Graduates shall have the five fundamental values of truth, right conduct, peace, love, and non-violence as their core values whereby they do not adhere to practices that are immoral, unethical, and the like, thereby exhibiting global citizenship. ii. Graduates shall exhibit compassion, unity, and inclusivity in all their engagements.	**Professional Ethics and human values** **Intellectual integrity**
Self-awareness and emotional intelligence: i. Graduates shall be aware of their personality and conditionings for appropriate engagement with others. ii. Graduates shall be resilient without being distracted and detracked by anxiety, fear, superiority, or inferiority complex and other emotional entropy thereby possessing the ability to handle any situation with mental equipoise	**Examine the outcome of one's action, Learn from self-experience**
Sustainability mindset: Graduates shall be sensitive to the people and planet in their every approach.	**Sustainability, societal & environmental impacts**

Practical work:
Provide a list of practical assignments to be completed during the laboratory sessions

Course Practical List:

Sr. No	Practical List
1	Install Anaconda Navigator & understand the functionality for Jupyter Notebook. Install MATLAB.
2	Write A Program to implement the Hill Climbing.
3	Write A program to implement simulated annealing.
4	Implement a program to solve multi-objective optimization problem.
5	Implement a program to solve multi-objective optimization problem using Evolutionary Algorithm.
6	Implement Genetic Algorithm to solve real-life problem.
7	Implement Ant Colony Optimization to solve real-life problem.
8	Implement Particle Swarm Optimization to solve real-life problem.
9	Implement Pattern recognition to solve real-life problem.
10	Implement immune algorithm to solve real-life problem.

Lecture/tutorial times: (Give lecture times in the format below)

Lecture	**<Day>**	**<Time>**
Lab (Batch …)	**<Day>**	**<Time>**

Attendance Requirements:
The Code of Practice students states that it is the responsibility of students to attend all lectures, tutorials, seminars, and practical work as stipulated in the Course outline. Attendance of practical work exercises is compulsory and fulfills the attendance criteria as laid down in the AU regulations (90%).

Details of Referencing System to be used in Written Work:
American Psychological Association (APA)

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Attendance of practical work exercises is compulsory and fulfill the attendance criteria as laid down in the AU regulations.

Textbooks:

1. Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
2. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
3. Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.

Reference Books:

1. V. Kecman "Learning and soft computing" MIT press 2001.
2. A. Ghosh, S. Dehuri and S. Ghosh(eds), "multi-objective evolutionary algorithms for knowledge discovery from databases", Springer 2008.
3. Marco Dorrigo, Thomas Stutzle," Ant Colony Optimization", PHI,2005.

Additional Materials:

NPTEL Course: https://onlinecourses.nptel.ac.in/noc20_cs17/preview

Assessment Guidelines:

Your final course mark will be calculated from the following:

Theory Marks (100)	
End Semester Examination	: **50 Marks**
Continuous Evaluation	: **50 Marks**
Practical Marks (50)	
Practical Assessment	: **25 Marks**
Viva	: **25 Marks**

Supplementary Assessment: (Courses with Academic Empowerment ONLY)

Students who receive an overall mark below the passing benchmark as set-by instructor/ faculty will be considered for supplementary assessment in the semester concerned. The offer of supplementary assessment is not automatic and will be considered on a case-by-case basis. A precise form of supplementary assessment will be determined at the time the offer of a supplementary assessment is made. Students must make themselves available during the supplementary examination period to take up any offer of supplementary assessment as announced by the faculty.

Practical Work Report/Laboratory Journal:
A report on the practical work is due the subsequent week for evaluation by faculty after the completion of the class by each group.

Late Work:
Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 5% of the maximum mark per calendar day.

Format:
All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the year that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work:
Written assessment work will be retained by the Course coordinator/instruction/ faculty for two weeks after marking to be collected by the students.

Adani University and Faculty Policies:
Students should make themselves aware of Adani University and/or FEST Policies regarding plagiarism, special consideration, supplementary examinations, and other educational issues and student matters.

Plagiarism: Students should refer to the policy on Plagiarism available in the Calendar. Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea as if it is his or her own - if you have any doubts at all about what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be severely penalized, which has led to expulsion. Further information on plagiarism can be found in the Faculty Policy document.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment

Course schedule: (Mention quiz, assignment submission, breaks, etc. as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)

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