SANKALCHAND PATEL UNIVERSITY
।। अथातो ज्ञानजिज्ञासा ।।

Ph. D. Program
(July-2019 batch)

Subject Code: 1RI3000102	**Subject Title: Essentials of Disciplinary Research Subject-1** **Subject Sub-Title:** Artificial Intelligence in Mechanical Robotic Systems
Pre-requisite Subject	The candidate/reader should have the background CAD/CAM and robotic field

Objectives of course:

- To understand the Artificial Intelligence to design mechanical robot
- To understand the ability to carry of kinematic output from robotics

Learning outcomes:

- After completion of course, the student shall understand the Artificial Intelligence to design mechanical robots like humanoid, bio-robotics, agriculture robots etc.
- The student is able to analyze the application of Artificial intelligence with different mechanism.

Teaching Scheme (Credit Distribution)				**Assessment Scheme (Weightage)**	
Lecture	**Tutorial**	**Practical**	**Credit**	**Hall Exam**	**Continuous Evaluation**
3	--	--	4	**60%**	**40%**

Unit	Content	Lecture	Wt. (%)
1	Introduction to artificial intelligence and mechanical robots, Production systems and rules for some AI problems, Intelligent search methods.	3	5
2	Application of AI in mechanical engineering robotic system, Relation between AI & mechanical robots, Intelligent diagnostic system for reciprocating and rotary mechanism.	14	35
3	Machine learning, Expert system, Pattern Recognition, Neural Network, Deep Learning.	14	35
4	Inductive learning, learning decision trees, computational learning theory, Artificial neural networks.	4	15
5	Sensors in mechanical robotics: acoustic, optic, Pneumatic, Force sensors; Properties of different sensors, mechanical robotic visionary systems approach, Applications of vision based mechanical robotic systems.	7	10

List of Reference:

1. S. K. Saha, “Introduction to Robotics”, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
2. R. K. Mittal, I. J. Nagrath, “Robotics and Control”, Tata McGraw-Hill Publishing Company Ltd.
3. Artificial Intelligence in Design, Pham, D.T. (Ed.)
4. Artificial Intelligence in Engineering Design by Bozzano Luisa
5. Artificial Intelligence in Engineering Design: Design Representation and Models of Routine Design by D. Sriram & Christopher Tong

Review Presentation:

The student is expected to refer at least two peer reviewed journal papers related to this domain/subject. The student is expected to identify issues/challenges and emerging trends in the domain/subject. Student is supposed to explore various video lectures (E.g. NPTEL) available in the domain/subject. Student is required to make a review-presentation on the work carried out for the same.

Recommended sites for journal papers are (1) asmedigitalcollection.asme.org (2) springer.com (3) sciencedirect.com (5) ieeexplore.ieee.org (6) scholar.google.co.in or others of similar repute.

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Ph. D. Program
(July-2019 batch)

Subject Code: 1RI3000103	**Subject Title:** Essentials of Disciplinary Research Subject-2 **Subject Sub-Title:** Modeling, Simulation and Control of Non-Linear Dynamical Systems
Pre-requisite Subject	The candidate/reader should have the background mathematical modeling and basics of applied physics

Objectives of course:

- The course aims in identifying the methods of modeling and simulation.
- To understand the powerful tools which serve to indicate where both theory and experiment can be improved.
- To study the various control of non-linear dynamical system.

Learning outcomes:

- After completion of course, the student shall understand various modeling simulation and control methods of non-linear dynamical system.
- The student is able to understand the fuzzy logic, neural network and genetic algorithm in modeling and simulation in various applications.

Teaching Scheme (Credit Distribution)				Assessment Scheme (Weightage)	
Lecture	**Tutorial**	**Practical**	**Credit**	**Hall Exam**	**Continuous Evaluation**
2	--	--	2	**60%**	**40%**

Unit	Content	Lecture	Wt. (%)
1	**Introduction:** Modeling, simulation of non linear dynamic systems	6	20
2	**Fuzzy logic for modeling** 2.1 Fuzzy Set Theory 2.2 Fuzzy Reasoning 2.3 Fuzzy Inference Systems 2.4 Fuzzy Modeling	6	20
3	**Neural Networks for Control** 3.1 Backpropagation for Feed forward Networks 3.1.1 The backpropagation learning algorithm 3.1.2 Backpropagation multi layer perceptrons 3.2 Adaptive Neuro-Fuzzy Inference Systems 3.2.1 ANFIS architecture e 3.2.2 Learning algorithm 3.3 Neuro-Fuzzy Control 3.3.1 Inverse learning 3.3.2 Specialized learning 3.4 Adaptive Model-Based Neuro-Control 3.4.1 Indirect neuro-control 3.4.2 Direct neuro-control 3.4.3 Parameterized neuro-control	10	25
4	**Genetic Algorithms and Fractal Theory For Modeling and Simulation**	6	15

	4.1 Genetic Algorithms 4.2 Simulated Annealing 4.3 Basic Concepts of Fractal Theory		
5	**ADVANCED APPLICATIONS OF AUTOMATED MATHEMATICAL MODELLING AND SIMULATION** 5.1 Modeling and Simulation of Robotic Dynamic Systems 5.1.1 Mathematical modeling of robotic systems 5.1.2 Automated mathematical modeling of robotic dynamic systems 5.1.3 Automated simulation of robotic dynamic systems 5.2 Modeling and Simulation of Biochemical Reactors 5.2.1 Modeling biochemical reactors in the food industry 5.2.2 Automated mathematical modeling of biochemical reactors 5.2.3 Simulation results for biochemical reactors 5.3 Modeling and Simulation of International Trade Dynamics 5.3.1 Mathematical modeling of international trade 5.3.2 Simulation results of international trade 5.4 Modeling and Simulation of Aircraft Dynamic Systems 5.4.1 Mathematical modeling of aircraft systems 5.4.2 Simulation results of aircraft systems 5.5 Automated Mathematical Modeling of Robotic Dynamic Systems	14	20

List of Reference:

1. Modelling, Simulation and Control of Non-Linear Dynamical Systems, Taylor and Francis Inc.

Review Presentation:

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