



Shri Vile Parle Kelavani Mandal's

DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING

(Empowered Autonomous) Affiliated to the University of Mumbai



Department of Electronics & Telecommunication Engineering

Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

DJS23 HONORS Syllabus

Semester V

w.e.f. AY 2026-27



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DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING

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**DJS23 Scheme for Third Year for Honor/Minor Degree for Second year Undergraduate Program in Electronics and Telecommunication Engineering(Honors) : Semester V (Autonomous)
(Academic Year 2026-27)**

Sr	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)						Aggregate (A+B)	Credits Earned		
			Theory (Hrs)	Practical (Hrs)	Tutorial (Hrs)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Term Test 3 (TT3)	Term Test Total (TT1 + TT2 + TT3)	Termwork	CA Total (B)				
	Honors in Artificial Intelligence and Machine Learning																					
1	DJS23EH1301	Machine Learning	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	100	100	3	4	
2	DJS23EH1301L	Machine Learning Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	--	25	25	50	1		
	Total		3	2	--	4	4	60	25			85	15	15	10	40	25	125	150	4		

Honors in IoT & NextGen Networks																					
1	DJS23EH2301	AI powered IoT	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	--	100	3	

Honors in VLSI Design																					
1	DJS23EH3301	Digital VLSI	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	100	100	3	4
2	DJS23EH3301L	Digital VLSI Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	--	25	25	50	1	
	Total		3	2	--	4	4	60	25			85	15	15	10	40	25	125	150	4	

Honors in Robotics & Automation																					
1	DJS23EH4301	Robotics	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	100	100	3	4
2	DJS23EH4301L	Robotics Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	--	25	25	50	1	
Total			3	2	--	4	4	60	25			85	15	15	10	40	25	125	150	4	

Prepared by:
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Principal



Honors in Artificial Intelligence and Machine Learning		
Program: Electronics and Telecommunication Engineering		Semester: V
Course: Machine Learning (DJS23EH1301)		
Course: Machine Learning Laboratory (DJS23EH1301L)		

Pre-requisite:

1. Mathematics for AIML (DJS23ECH1301)
2. Artificial Intelligence (DJS23ECH1401)

Objectives: `

1. To introduce the concepts of computation learning theory and techniques of Machine Learning.
2. To become familiar with regression, classification and clustering tasks.

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

1. Understand and explain fundamental concepts of Machine Learning, its types, applications, and common challenges such as overfitting and inductive bias.
2. Apply regression techniques such as Linear, Polynomial, Lasso, Ridge, and Logistic Regression for predictive modeling and analyze performance using optimization techniques like Gradient Descent.
3. Design and implement decision tree-based models including ID3, Gini index, CART, and ensemble methods such as Random Forest and XGBoost for classification tasks.
4. Develop classification models using Bayesian approaches, evaluate classifier performance using appropriate metrics and validation methods, and perform model selection based on statistical testing.
5. Perform clustering using k-Means, k-Medoids, and hierarchical methods, and apply dimensionality reduction techniques such as PCA and LDA to handle high-dimensional data.

Machine Learning (DJS23EH1301)		
Unit	Description	Duration
1	Introduction to Machine Learning: Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps involved in developing a Machine Learning Application, Hypothesis and Inductive Bias, Overfitting and Under fitting, Bias and Variance Tradeoff.	08
2	Regression: Linear Regression, Least Minimum Slope (LMS) algorithm, Gradient Descent, Lasso and Ridge Regression. Polynomial Regression. Logistic Regression, Maximum Likelihood Function	09
3	Decision Trees & Classification: Introduction to decision tree, Learning Decision tree using ID3 and Gini index; CART. Introduction to Random Forest. Ensemble methods: Bagging and Boosting (XG Boost).	09
4	Classification: Bayesian Learning, Naïve Bayes, Bayesian Network: Representation in Bayesian, Belief Network, Inference in Bayesian Network, Applications of Bayesian Network. Classification Model Evaluation &	10



	Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost-Benefit and ROC Curves	
5	Introduction to Support Vector Machine: Support Vectors, Kernels: Linear, Polynomial and Radial Basis Function (RBF) Kernel	10
6	Clustering: Cluster Analysis and Requirements of Cluster Analysis Partitioning Methods: k-Means, k-Medoids Hierarchical Methods: Agglomerative, Divisive. Dimensionality Reduction: Dimensionality Reduction Techniques: Principal Component Analysis, LDA.	10
	Total	56

List of Laboratory Experiments: (Minimum 8 using Python)

Machine Learning Laboratory (DJS23EH1301L)	
Sr No.	Suggested Experiments:
1	Perform Linear Regression
2	Perform Logistic Regression
3	Perform Decision Tree using GINI
4	Perform CART decision tree algorithm.
5	Perform Ensemble methods
6	Perform Bayesian Classification.
7	Perform Support Vector Machine
8	Compare performance of classification algorithms
9	Perform K-means clustering
10	Mini project based on any machine learning application.

Self-Learning Plan:

The subject teacher will identify the self-learning topics and ensure that students develop a deeper understanding of their relevance to industry and society. Further, the details of the self-learning activity, assessment methods, and rubrics will be provided in the self-learning plan of the course.

Books Recommended:*Textbooks:*

1. Tom Mitchell — *Machine Learning* McGraw Hill, 2017
2. Ethem Alpaydin, — *Introduction to Machine Learning*, MIT Press, 2014.

Reference Books:

1. Kevin P. Murphy, *Machine Learning — A Probabilistic Perspective*, 2019
2. Andreas C. Müller and Sarah Guido- *Introduction to Machine Learning with Python: A Guide for Data Scientists*, O'reilly, 2019
3. Sebastian Raschka, *Python Machine Learning*, Third Edition 2019.
4. Aurelien Geron, *Hands-on Machine Learning with Scikit-Learn; Keras & TensorFlow* O'Reilly 2022.

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Checked by

Head of the Department

Principal

**Honors in IoT & 5G technology****Program: Electronics and Telecommunication Engineering****Semester: V****Course: AI powered IoT (DJS23EH2301)****Pre-requisite:**

1. Sensors & Actuators for IoT (DJS23EH2201)
2. IoT System Design (DJS23EH2251)

Objectives:

1. To provide understanding of fundamental integration of AI with IoT.
2. To provide understanding about challenges in integrating IoT with AI.

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

1. Understand the Intelligent IoT data.
2. Analyze the ML and data analytics techniques for IoT generated data.
3. Apply AI and IoT integration for IoT applications.
4. Analyze various security challenges in implementing Intelligent IoT applications.

AI powered IoT (DJS23EH2301)

Unit	Description	Duration
1	Introduction to AI powered IoT -Definition, characteristics of Intelligent IoT, Prerequisites of Intelligent IoT-Basics of Cyber Physical Systems (CPS). CPS and Intelligent IoT, M2M(Machine to machine) vs IoT, Role of ML(Machine learning) in Intelligent IoT.	04
2	IoT Data acquisition and Pre-processing techniques -Sensor network data collection, Data Preprocessing for machine learning, Feature Engineering with IoT Data, Variance Edge Computing for Machine Learning- Edge analytic and decision-making algorithms.	06
3	Machine Learning and Data Science in Industries Introduction, Validation Methods, Bias, comparing different Models to find the Best fit, Anomaly Detection, Forecasting, Deep Learning with IoT data; Strategies to organize data for Analytics; The Economics of IoT Analytics, Introduction to Edge AI.	08
4	IoT and AI Integration -Graphic Processing Unit(GPU), Tensor Processing Unit (TPU), case study on Google's TPU and the Edge TPU. TensorFlow Lite, ONNX Runtime, and Edge TPU for deployment of AI models.	08
5	Use cases for IoT: IoT for Entertainment and wearables, IoT for Manufacturing, IoT for Employee safety, IoT for healthcare, IoT for Logistics & Supply chain, Intelligent shopping application. Case studies on Smart product management, Smart Environment, Smart Agriculture.	09
6	Security challenges in Intelligent IoT: IoT security and privacy, Security threats in the IoT, Misbehavior in M2M Communication-Problem Scenario, System Model, Quantities Results	05
	Total	40



Self -Learning Plan:

The subject teacher will identify the self-learning topics and ensure that students develop a deeper understanding of their relevance to industry and society. Further, the details of the self-learning activity, assessment methods, and rubrics will be provided in the self-learning plan of the course.

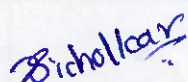
Books Recommended:

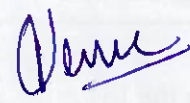
Text books:

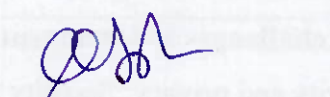
1. Sudip Mishra, Chandra Roy, and Anandarup Mukharjee, *Introduction to Industrial Internet of Things and Industry 4.0*, First edition published 2021, CRC press.
2. Sudip Misra, Subhadeep Sarkar Subarna Chatterjee Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of Things. 2019 by Taylor & Francis Group.
3. Srinivasa K G, "*Internet of Things*", CENGAGE Learning India, 2017

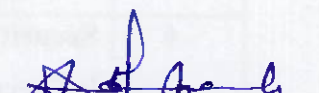
Reference Books:

1. Mishra, Umesh K. and Singh, Jaspreet, *Semiconductor Device Physics and Design*, Springer, 2014.
2. Intelligent Connectivity: AI, IoT, and 5G (IEEE Press), Abdulrahman Yarali Wiley-IEEE Press, 2021.
3. Vijay Madiseti, Arshdeep Bahga, "*Internet of Things (A Hands-on-Approach)*", 2015.
4. Perry Lea, "*Internet of Things for Architects*", 1st Edition, Packt publication, 2018.


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Honors in VLSI Design	
Program: Electronics and Telecommunication Engineering	Semester: V
Course: Digital VLSI (DJS23EH3301)	
Course: Digital VLSI Laboratory (DJS23EH3301L)	

Pre-requisite:

1. Basic Electrical Engineering & Digital Electronics (DJS22FECBE).
2. Digital System Design (DJS23EPC203)
3. Microelectronics (DJS23EH3201)
4. Digital System Design Using HDL (DJS23EH3251)

Objectives:

1. To provide understanding for construction of CMOS circuits using different design styles.
2. To provide Understanding of CMOS technology-specific layout rules.

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

1. Apply CMOS technology-specific layout rules.
2. Analyze the characteristics of MOS Inverters.
3. Design static CMOS combinational and sequential logic at the transistor level.
4. Design functional units including adders, multipliers, ROMs, SRAMs.
5. Analyze and evaluate delays in IC.

Digital VLSI (DJS23EH3301)		
Unit	Description	Duration
1	Technology Trend: Design Methodology: Semi-custom Full custom design, VLSI Design Flow. Layout: Stick diagram for different gates, Lambda based design rules (CMOS), Eulers Path, Layout of logic circuits.	08
2	CMOS Inverter Circuit Analysis: Types of MOS inverters: Active and passive load and their comparison. Circuit Analysis of MOS Inverters: Static Analysis of resistive and CMOS inverter: Calculation of all critical voltages and noise margins, Design of symmetric CMOS inverter. Dynamic Analysis of CMOS inverter: Calculation of rise time, fall time and propagation delay.	10
3	MOS Circuit Design Styles: Design styles: Static CMOS, Dynamic CMOS, Domino logic, NORA logic, Pass transistor logic, Transmission gate, Pseudo NMOS, C2MOS. Combinational Logic Circuit Design: Analysis and design of 2-I/P NAND, NOR, Realization of Multiplexer (up to 4:1 Mux), Decoder. Sequential Circuit Design: Setup and hold time measurement, Realization of SR Latch, JK FF, D FF.	10



4	Design of Arithmetic Building Blocks and Memory Subsystems: Data path Design: Full adder, Ripple carry adder, CLA adder, Carry Skip Adder, Carry Save Adder and carry select adder, Array Multiplier. Memory and Storage circuits: ROM array, 6T SRAM, operation, design strategy, sense amplifier, DRAM Operation of 1T, 3T, operation modes, refresh operation, Input-Output circuits.	07
5	Interconnect and Gate Delays: Logical effort and Parasitic delay: Introduction to Delay in CMOS, CMOS Inverter RC approximated delay, Elmore Delay, Gate sizing, Asymmetric gate, Skewed gates, Logical effort and Parasitic delay for different gates, complex Boolean function using equivalent CMOS inverter for simultaneous switching. Interconnects: RC delay, Elmore delay.	07
Total		42

Digital VLSI Laboratory (DJS23EH3301L)

Exp.	Suggested Experiment List
1	I-V Curves of NMOS and PMOS Transistors
2	DC Characteristics of CMOS Inverters (VTC, Noise Margin)
3	Dynamic Characteristics of CMOS Inverters (Propagation Delay, Power Dissipation)
4	Multiplexer Design using different design styles
5	Schematic entry and simulation of CMOS 2- input NAND and NOR gates
6	CMOS Full adder design
7	Decoder design
8	CMOS Inverter Layout and post simulation
9	CMOS 2- input NAND and NOR gates Layout
10	Flip flop Design and Simulation

Minimum eight experiments from the above suggested list or any other experiment based on syllabus to be included, which would help the learner to apply the concept learnt.

Self -Learning Plan:

The subject teacher will identify the self-learning topics and ensure that students develop a deeper understanding of their relevance to industry and society. Further, the details of the self-learning activity, assessment methods, and rubrics will be provided in the self-learning plan of the course.



Books Recommended:

Textbooks:

1. Sung Mo Kang, Yusuf Leblebici, *CMOS Digital Integrated Circuits*, 4th Edition, Tata McGraw Hill, 2019.
2. Rabaey J M, Chandrakasan A and Nikolic B, *Digital Integrated Circuits: A design perspective*, 2nd Edition, Pearson Education, 2016.

Reference Books:

1. Sedra Smith, *Microelectronic Circuits*, 5th Edition. Oxford university press, 2011.
2. Uyemura J P, *CMOS Logic Circuit Design*, 2nd Edition, Springer Books, 2005.
3. D. Neamen, D. Biswas, *Semiconductor Physics and Devices*, 4th Edition, McGraw-Hill Education, 2017.
4. N. Weste and D. Harris, *CMOS VLSI Design. A Circuits and Systems Perspective*, 4th Edition, Pearson Education India, 2015.

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**Honors Degree in Robotics & Automation****Program: Electronics and Telecommunication Engineering****Semester: V****Course: Robotics (DJS23EH4301)****Course: Robotics Laboratory (DJS23EH4301L)****Objectives:**

1. To equip learners with a foundational and applied understanding of robotic systems, including their kinematics, workspace analysis, and path planning.
2. To introduce learners to emerging areas in robotics such as swarm intelligence and simultaneous localization and mapping (SLAM).

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

1. Explain the classification, components, joint types, and specifications of robots along with their industrial and practical applications. (Bloom's Level: Understand)
2. Apply forward and inverse kinematics using transformation matrices and Denavit-Hartenberg representation for planar and SCARA robots. (Bloom's Level: Apply)
3. Analyze workspace, trajectory paths, and motion control techniques to implement pick-and-place and continuous path operations. (Bloom's Level: Analyze)
4. Evaluate advanced robotic concepts including swarm intelligence and SLAM, and their role in intelligent automation and navigation. (Bloom's Level: Evaluate)

Robotics (DJS23EH4301)

Unit	Description	Duration
1	Fundamentals of Robotics: Robot Classification, Robot Components, Robot Specification, Joints, Coordinates, Coordinate frames, Workspace, Applications.	06
2	Kinematics of Robots: Homogeneous coordinates and transformation matrices, Kinematic parameters, 2 Denavit-Hartenberg representation of forward kinematics – Mircobot Alpha II, The Arm Equation, Forward and inverse kinematic solutions of Planar & SCARA robot.	12
3	Workspace Analysis: Workspace analysis, Work envelope of a planar robot, SCARA robot, Workspace fixtures, Pick and Place Operation.	06
4	Continuous Path Motion: Path and Trajectory, Continuous Path Control of four axis SCARA robot, Interpolated Motion, Linear Interpolation with Parabolic Blends.	08
5	Advanced Robotics: Introduction to Swarm Intelligence, Ant Foraging Behaviour, Combinatorial Optimisation and Routing in Communications Network, Introduction to Simultaneous Localisation and Mapping (SLAM), SLAM Process - Odometry, Laser Scan, Extended Kalman Filtering.	10
	Total	42

**Robotics Laboratory (DJS23EH4301L)**

Exp.	Suggested Experiment List
1	Research Paper Review
2	Implementing algorithm for fundamental rotation transformation matrix and its interpretation
3	Composite – rotation and translation, transformation matrix implementation and interpretation.
4	Forward kinematics – DH representation of representative robot/s, and interpretation of the arm equation.
5	Forward kinematics – DH representation of representative robot/s, and interpretation of the arm equation.
6	Inverse kinematics – Significance and solution of ARM matrix for representative robot/s.
7	Inverse kinematics – Significance and solution of ARM matrix for representative robot/s.
8	SLAM process – odometry data.
9	SLAM process – lidar data.
10	Implementing Swarm Intelligence algorithm – Ant Colony Optimisation.
11	Implementing Swarm Intelligence algorithm – Particle Swarm Optimisation.

Batch wise laboratory work of minimum eight 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.

Self-Learning Plan:

The subject teacher will identify the self-learning topics and ensure that students develop a deeper understanding of their relevance to industry and society. Further, the details of the self-learning activity, assessment methods, and rubrics will be provided in the self-learning plan of the course.

Books Recommended:*Textbooks:*

1. Robert Shilling, "*Fundamentals of Robotics - Analysis and control*", Prentice Hall of India, 2009.
2. Bonabeau E., Dorigo M. and Theraulaz G. "*Swarm Intelligence: from Natural to Artificial Systems*", Oxford University Press, Oxford, 1999.
3. S. Riisgaard, and M. Blas. "*SLAM for Dummies: A Tutorial Approach to Simultaneous Localization and Mapping*", 2005.

Reference Books:

1. Saeed Benjamin Niku, "*Introduction to Robotics – Analysis, Control, Applications*", Wiley India Pvt. Ltd., 2nd Edition, 2011.
2. John J. Craig, "*Introduction to Robotics – Mechanics & Control*", 3rd Edition, Pearson Education, India, 2009.
3. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, "*Robot Modeling & Control*", Wiley India Pvt. Ltd., 2006.

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