Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

DJS-23 HONORS DEGREE COURSES

Honors Degree in Artificial Intelligence and Machine Learning

Sem	Subject Name	Credits
III	Mathematics for AIML	**3**
IV	Artificial Intelligence	**3**
V	Machine Learning	**4**
V	Machine Learning Laboratory	**1**
VI	Deep Learning	**3**
VI	Deep Learning Laboratory	**1**
VIII	Pattern Recognition and Application	**3**
	Total	**18**

Honors Degree in IoT and NextGen Networks

Sem	Subject Name	Credits
III	Sensors & Actuators for IoT	**3**
III	Sensors & Actuators for IoT Laboratory	**1**
IV	IoT System Design	**3**
IV	IoT System Design Laboratory	**1**
V	Intelligent IoT	**3**
VI	Industrial IoT	**3**
VI	IoT Applications Laboratory	**1**
VIII	5G Technology	**3**
	Total	**18**

Honors Degree in VLSI Design

Sem	Subject Name	Credits
III	Microelectronics	**3**
IV	Digital System Design using HDL	**3**
V	Digital System Design using HDL Laboratory	**1**
V	Digital VLSI	**3**
V	Digital VLSI Laboratory	**1**
VI	Analog VLSI	**3**
VI	Analog VLSI Laboratory	**1**
VIII	Low Power VLSI	**3**
	Total	**18**

Honors Degree in Robotics and Automation

Sem	Subject Name	Credits
III	Sensors and Instrumentation	**3**
IV	Control Systems	**3**
IV	Control Systems Laboratory	**1**
V	Robotics	**3**
V	Robotics Laboratory	**1**
VI	PLC and Applications	**3**
VI	PLC and Applications Laboratory	**1**
VIII	Industrial Automation Design	**3**
	Total	**18**

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DJS-23 HONORS Syllabus

Semester V

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B. Tech. Program (Electronics & Telecommunication Engineering) (DJS23 Scheme)

HONORS Track: Artificial Intelligence and Machine Learning (Sem V)

Sr. No	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	O	P	O&P	Total SEA(B)		
Semester V																
1	DJS23ECH1501	Machine Learning	4	-	-	4	40	-	40	60	-	-	-	60	100	5
	DJS23ELH1501	Machine Learning Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
		Total	**4**	**2**	**-**	**5**	**40**	**-**	**65**	**60**	**25**	**-**	**-**	**85**	**150**	**5**

HONORS Track: IoT and NextGen Networks (Sem V)

Sr. No	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	O	P	O&P	Total SEA(B)		
Semester V																
1	DJS23ECH2501	Intelligent IoT	3	-	-	3	40	-	40	60	-	-	-	60	100	3
		Total	**3**	**-**	**-**	**3**	**40**	**-**	**40**	**60**	**-**	**-**	**-**	**60**	**100**	**3**

HONORS Track: VLSI Design (Sem V)

Sr. No	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	O	P	O&P	Total SEA(B)		
Semester V																
1	DJS23ECH3501	Digital VLSI	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELH3501	Digital VLSI Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
		Total	**3**	**2**	**-**	**4**	**40**	**-**	**65**	**60**	**25**	**-**	**-**	**85**	**150**	**4**

HONORS Track: Robotics & Automation (Sem V)

Sr. No	**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	O	P	O&P	Total SEA(B)		
Semester V																
1	DJS23ECH4501	Robotics	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELH4501	Robotics Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
		Total	**3**	**2**	**-**	**4**	**40**	**-**	**65**	**60**	**25**	**-**	**-**	**85**	**150**	**4**

Honors in Artificial Intelligence and Machine Learning	
Program: Electronics and Telecommunication Engineering	**Semester: V**
Course: Machine Learning (DJS23ECH1501)	
Course: Machine Learning Laboratory (DJS23ELH1501)	

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 (DJS23ECH1501)		
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.	8
2	**Regression:** Linear Regression, Least Minimum Slope (LMS) algorithm, Gradient Descent, Lasso and Ridge Regression. Polynomial Regression. Logistic Regression, Maximum Likelihood Function	9

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).	8
4	**Classification**: Bayesian Learning, Naïve Bayes, Bayesian Network: Representation in Bayesian, Belief Network, Inference in Bayesian Network, Applications of Bayesian Network. Classification Model Evaluation & Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross Validation, 9 Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost–Benefit and ROC Curves	10
5	**Introduction to Support Vector Machine**: Support Vectors, Kernels: Linear, Polynomial and Radial Basis Function (RBF) Kernel	7
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	**52**

List of Laboratory Experiments: (Minimum 8 using Python)

Machine Learning Laboratory (DJS23ELH1501)	
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.

Books Recommended:

Text books:

1. Tom Mitchell, *Machine Learning* McGraw Hill, 2017
2. Peter Harrington, *Machine Learning In Action*, DreamTech Press, 2012.
3. Ethem Alpaydın, *Introduction to Machine Learning*, MIT Press, 2014.

Reference Books:

1. Han Kamber, *Data Mining Concepts & Techniques*, Morgann Kaufmann Publishers, 2011
2. Stephen Marsland, *Machine Learning An Algorithmic Perspective* CRC Press, 2015
3. Kevin P. Murphy, *Machine Learning — A Probabilistic Perspective*‖, 2012
4. Andreas C. Müller and Sarah Guido- *Introduction to Machine Learning with Python*: A Guide for Data Scientists, O'reilly,201

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Honors in IoT and NextGen Networks	
Program: Electronics and Telecommunication Engineering	**Semester: V**
Course: Intelligent IoT (DJS23ECH2501)	

Pre-requisite:

1. Sensors & Actuators for IoT (DJS23ECH2301).
2. IoT System Design (DJS23ECH2401)

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.

Intelligent IoT (DJS23ECH2501)		
Unit	**Description**	**Duration**
1	**Introduction to Intelligent IoT**-Definition, characteristics of Intelligent IoT, Prerequisites of Intelligent IoT-Basics of CPS. CPS and Intelligent IoT, M2M vs IoT,Role of ML in Intelligent IoT.	04
2	**IoT Data acquisition and Pre-processing techniques** -Sensor network data collection, Data Preprocessing for AI and 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, Machine Learning, 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: Cost Considerations for IoT Analytics, Introduction to Edged AI.	08
4	**IoT and AI Integration** –Graphic Processing Unit, Tensor Processing Unit, case study on Google's TPU and the Edge TPU. TensorFlow Lite, ONNX Runtime, and Edge TPU for deployment of AI models.	08
5	**Used 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**

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 Leaning 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 Madisetti, Arshdeep Bahga, *"Internet of Things (A Hands-on-Approach)",* 2015.

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Honors in VLSI Design	
Program: Electronics and Telecommunication Engineering	**Semester: V**
Course: Digital VLSI (DJS23ECH3501)	
Course: Digital VLSI Laboratory (DJS23ELH3501)	

Pre-requisite:

1. Basic Electrical Engineering & Digital Electronics (DJS22FECBE).
2. Digital System Design (DJS23ECPC303)
3. Microelectronics (DJS23ECH3301)
4. Digital System Design Using HDL (DJS23ECH3401)

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. Understand 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 Interconnect and Gate Delays in IC.

Digital VLSI (DJS23ECH3501)		
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.	6
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.	10

	Sequential Circuit Design: Setup and hold time measurement, Realization of SR Latch, JK FF, D FF.	
4	**Design of Arithmetic Building Blocks and Subsystem:** **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.	7
5	**Interconnect and Gate Delays:** **Logical effort and Parasitic 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.	7
	Total	**40**

Digital VLSI Laboratory (DJS23ELH3501)	
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.

Books Recommended:

Text books:

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: (DJS23ECH4501)	

Objectives:

To equip learners with a foundational and applied understanding of robotic systems, their kinematics, workspace analysis, path planning, and emerging areas such as swarm intelligence and 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 (DJS23ECH4501)		
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.	04
4	**Continuous Path Motion:** Path and Trajectory, Continuous Path Control of four axis SCARA robot, Interpolated Motion, Linear Interpolation with Parabolic Blends.	07
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	**39**

Robotics Laboratory (DJS23ELH4501)	
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.
11	Implementing Swarm Intelligence algorithm.

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.

Books Recommended:

Text books:

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., Second Edition, 2011.
2. John J. Craig, "*Introduction to Robotics – Mechanics & Control*", Third 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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