



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 VII/VIII

w.e.f. AY 2027-28



Shri Vile Parle Kelavani Mandal's

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Course structure for Honor Degree for Final year Undergraduate Program in Electronics and Telecommunication Engineering : Semester VII

(Academic Year 2027-28)

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	Term Test 1 (TT1)	Term Test 2 (TT2) - b	Assg/CP/GD/Presntation/Quiz) - c	Total (a+b)	Termwork	CA Total (B)		
Honors in Artificial Intelligence and Machine Learning																				
1	DJS23E H1451	Pattern Recognition and Applications	4	—	—	4	2	60	—	--	--	60	15	15	10	40	—	40	100	4
Honors in IoT & NextGen Networks																				
1	DJS23E H2451	5G and Next Generation Technology	4	--	--	4	2	60	--	--	--	60	15	15	10	40	--	40	100	4
Honors in VLSI Design																				
1	DJS23E H3451	VLSI Physical Design	4	--	--	4	2	60	--	--	--	60	15	15	10	40	--	40	100	4
Honors Degree Program in Robotics and Automation																				
1	DJS23E H4451	Industrial Automation Design	4	--	--	4	2	60	--	--	--	60	15	15	10	40	--	40	100	4

Prepared by:			
Name and Signatures:			
Prof. Sheeja Nair		Prof. Amit A. Deshmukh	Dr. Narendra Shekokar
Checked By:		Head of Department	Vice Principal
Name and Signatures:			
Dr. Poonam Kadam			Dr. Hari Vasudevan
			Principal



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Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VIII
Course: Pattern Recognition and Applications	Course Code: DJS23E H1451	

Pre-requisite:

1. Mathematics and Statistics for Artificial Intelligence & Machine Learning (DJS23EH1201)
2. Concepts and Algorithms of Artificial Intelligence & Machine Learning
3. Deep Learning (DJS23ECH1601)

Objectives:

1. To understand the fundamentals of pattern recognition and data representation.
2. To apply feature engineering and machine learning techniques for classification and clustering.
3. To design efficient pattern recognition systems for real-world applications.
4. To analyze and evaluate machine learning models for intelligent systems.

Outcomes: At the end of course, student will be able to:

1. Explain fundamental concepts, paradigms, and techniques used in pattern recognition systems.
2. Apply feature extraction, feature selection, and dimensionality reduction techniques for efficient data representation.
3. Design and implement classification and clustering models for pattern recognition problems.
4. Analyse and evaluate pattern recognition techniques for real-world applications such as vision, text, speech, and healthcare systems.

Pattern Recognition and Applications (DJS23ECH1451)		
Unit	Description	Duration
1	Introduction to Pattern Recognition Introduction to Pattern Recognition, Pattern Recognition Pipeline, Types of Learning (Supervised, Unsupervised, Semi-supervised), Statistical and Structural Pattern Recognition, Applications of Pattern Recognition, Datasets and Data Preprocessing.	06
2	Pattern Representation and Similarity Measures Feature Vectors and Feature Spaces, Structured Pattern Representation (Strings, Trees, Graphs), Distance and Similarity Measures: Euclidean, Manhattan, Mahalanobis, Cosine Similarity, Edit Distance, Data Normalization and Scaling, Curse of Dimensionality.	06
3	Feature Engineering and Dimensionality Reduction Feature Extraction and Feature Selection, Principal Component Analysis (PCA), Fisher's Linear Discriminant (LDA) Wrapper, Filter and Embedded Methods, Introduction to Representation Learning and Embeddings.	06
4	Classification Techniques Bayesian Decision Theory, Naïve Bayes Classifier, k-Nearest Neighbour (k-NN), Decision Trees, Support Vector Machines (SVM), Ensemble Methods: Random Forest and AdaBoost, Introduction to Neural Networks for Pattern Recognition.	08



5	Clustering and Model Evaluation k-Means Clustering, Hierarchical Clustering, DBSCAN, Incremental Clustering, Cluster Validation Metrics, Model Evaluation Techniques: Cross Validation, Accuracy, Precision, Recall, F1-Score, ROC-AUC, Bias-Variance Tradeoff.	08
6	Applications of Pattern Recognition Applications in Computer Vision (Face/Object Recognition), Natural Language Processing (Document Classification, Sentiment Analysis), Speech Recognition, Medical Diagnosis, Industrial Defect Detection, Mini-Project/Case Study.	08
	Total	42

Self -Learning Plan:

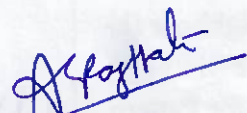
The subject teacher will identify the self-learning topics and ensure that students develop a deeper understanding of their relevance to industry and society. Further, the details of the self-learning activity, assessment methods, and rubrics will be provided in the self-learning plan of the course.

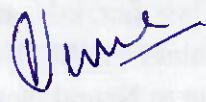
Books Recommended:*Textbooks:*

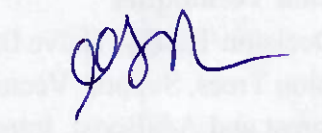
1. C. M. Bishop, "*Pattern Recognition and Machine Learning*", Springer, 2006.
2. R. O. Duda, P. E. Hart, and D. G. Stork, "*Pattern Classification*", John Wiley & Sons, 2004.

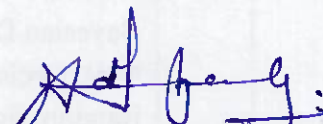
Reference Books/ Courses:

1. T. M. Cover and P. E. Hart, "*Nearest Neighbor Pattern Classification*", IEEE Transactions on Information Theory, Vol. 13, pp. 21-27, 1967.
2. Pattern Recognition and Application, IIT Kharagpur, Prof. Prabir Kumar Biswas <https://nptel.ac.in/courses/117105101> (NPTEL Course).
3. Pattern Recognition, IISc Bangalore, Prof. M. Narasimha Murty, Prof. V. Susheela Devi, <https://nptel.ac.in/courses/106108057> (NPTEL Course).


Prepared by


Checked by


Head of the Department


Principal



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Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course: 5G Technology and Machine Learning	Course Code: DJS23E.H2451	

Pre-requisite:

1. Analog & Digital Communication (DJS23ECPC503)
2. Mobile Communication Systems (DJS23ECPC701)

Objectives:

1. Learn the basics of 5G and beyond wireless communication.
2. Study 5G network architecture and Heterogeneous Network and Small cells
3. Provide understanding of the key technologies and enablers of 5G and beyond communication systems.
4. Learn 5G technology like massive MIMO, mmWave etc.

Outcomes: At the end of course, student will be able to:

1. Distinguish between the major cellular communication standards (1G/2G/3G/4G/5G systems) and the architecture of wireless communications networks.
2. Apply the 5G techniques e.g., massive MIMO, mmWave, etc. for the design of communication systems.
3. Analyse various modulation and multiplexing techniques e.g., OFDM, NOMA, etc.
4. Describe applications of cognitive radio in 5G Wireless Communication

5G Technology and Machine Learning (DJS23ECH2451)

Unit	Description	Duration
1	Basics of 5G Technology: Introduction to 5G Technology, Features, Requirements, Applications, 5G Services, Introduction to 5G. Digital modulations (OFDM, generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), 5G Internet, Internet of Things and Context-Awareness, Software Defined Networking, Network Function Virtualisation (NFV).	08
2	5G Access network: 5G Network Architecture, Cloud RAN(C-RAN), Definitions of Heterogeneous Networks, Radio Resource and Interference Management for Heterogeneous Networks, Traffic offloading scenarios for heterogeneous networks, mobility management and handover. Small cell deployments: different types, Deployment scenarios, performance and analysis, Energy efficient mechanism with BS sleep mode in green small cell networks, Game theory and learning techniques for self-organization in small cell networks, 3GPP RAN standards for small cell.	08
3	mmWave & NOMA: mmWave: Millimeter bands, radio-wave propagation Physical layer design and algorithms, mmWave MIMO challenges, channel modelling, channel	10



	estimation and Beam-forming. Types of transceivers, Merits and Demerits, Applications. Physical or Radio layer Technologies - Massive MIMO (Sub 6Ghz) -mm wave MIMO (above 6 GHz). Non orthogonal Multiple Access (NOMA), Different Types: power domain NOMA and code domain NOMA, Difference between Orthogonal multiple access and NOMA, Filter Bank multi carrier -Full duplex Radio Techniques, Precoding	
4	Cognitive Radio and Machine learning: Introduction, Overview of Cognitive Radio Technology in 5G Wireless, Spectrum Optimisation using Cognitive Radio, Cognitive Radio and Carrier Aggregation. Machine and Reinforcement Learning for Resource Allocation in Cognitive Radio Networks: Use of Q Learning for Cross-layer Resource Allocation, Deep Q-Learning and Resource Allocation, Cooperative Learning and Resource Allocation, Decentralized Resource Minimization.	08
5	Use cases for 5G: 5G NR, Carrier Aggregation in 5G, Open RAN, Use cases of 5G:eMBB, URLLC and mMTC, Advance applications: Robotic surgery, driverless car and Industrial IoT (IIoT), Tactile Internet, 5G-IoT applications, AR/VR in 5G.	04
6	6G Network Introduction: Introduction to 6G: Use-cases, Performance requirements, Roadmap; 6G spectrum: sub 6 GHz, millimeter waves, THz; 6G cell-free networks;	04
	Total	42

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. Aditya K. Jagannatham, "*Principles of Modern Wireless Communication Systems Theory and Practice*", McGraw Hill Education, 2017.
2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "*Millimeter Wave Wireless Communication*", Prentice Hall, 2014.

Reference Books:

1. R. Vannithamby and S. Talwar, "*Towards 5G: Applications, Requirements and Candidate Technologies*", John Wiley & Sons, West Sussex, 2017.



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2. Theodore S. Rappaport, "*Wireless communications principles and practice*", 2nd Edition, 2010, Pearson Publication.
3. Manish, M., Devendra, G., Pattanayak, P., Ha, N., "*5G and Beyond Wireless Systems PHYLayer Perspective*", Series in Wireless Technology Springer, 2021.
4. Sassan Ahmadi, "*5G NR: Architecture, Technology, Implementation, and Operation of 3GPP New Radio Standards*", Academic Press, 2019.

Bechholkar

Prepared by

Chune

Checked by

gosh

Head of the Department

Adhikari

Principal

**Honors in VLSI Design**

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course: VLSI Physical Design	Course Code: DJS23E. H3451	

Pre-requisite:

1. Digital VLSI (DJS23EH3301)
2. Analog VLSI (DJS23EH3601)

Objectives:

1. To understand power dissipation mechanisms in CMOS VLSI systems.
2. To learn the complete VLSI physical design flow from partitioning to GDSII generation.
3. To study power optimization techniques at logic, circuit, gate, and architectural levels.
4. To understand timing analysis and power estimation.
5. To understand sign-off techniques in VLSI design.

Outcomes: At the end of course, student will be able to:

1. Describe VLSI physical design flow and power dissipation mechanisms in CMOS circuits.
2. Apply floor planning, placement, routing and power optimization techniques for VLSI systems.
3. Analyse low-power CMOS design techniques and clock network optimization methods.
4. Perform timing analysis and estimate power consumption.
5. Design and optimize low-power VLSI systems and carry out sign-off verification for GDSII generation.

VLSI Physical Design (DJS23ECH3451)

Unit	Description	Duration
1	Introduction to VLSI Physical Design and Floor planning: Introduction to VLSI design flow and Physical Design flow, Electronic Design Automation (EDA) tools and methodologies, Netlist generation and system partitioning, Floor planning concepts and floor planning algorithms, Pin assignment techniques, Power planning and physical design optimization.	05
2	Placement, Clock Tree Synthesis and Routing: Introduction to placement and placement methodologies, Placement optimization techniques, Clock network concepts and Clock Tree Synthesis (CTS), Clock routing techniques, Routing concepts and stages of routing: Global routing, Track assignment and Detailed routing, Power and ground routing, DRC, LVS and routing violation fixes, Post-route optimization techniques.	07
3	Timing Analysis, Physical Synthesis and Sign-off Flow: Introduction to timing closure and timing analysis, Static Timing Analysis (STA): concepts and methodology, Setup time, Hold time, Timing constraints and SDC concepts, Timing corners and timing report analysis, Physical synthesis and timing-driven optimization, Interconnect modeling	12



	and compact layout, Testing concepts, fault modeling and fault simulation, Sign-off verification and GDSII generation flow.	
4	CMOS Power Dissipation and Power Optimization Techniques: Hierarchy of power limits and sources of power dissipation, Physics of power dissipation in CMOS devices, Dynamic, static and short-circuit power dissipation, Logic level power optimization, Circuit level and gate level power optimization, Architectural level low-power techniques, Low-power subsystem design of adders and multipliers.	09
5	Low Power CMOS Design and Power Estimation: Low-power design techniques for combinational and sequential circuits, Low-power memory design techniques, Low-power clock design techniques, Adiabatic and designs with partially reversible logic, Power estimation methods at circuit, gate, architecture and behavioral levels, probabilistic techniques for signal activity estimation, estimating average power in combinational circuits, estimating average power in sequential circuits.	09
Total		42

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. Sneh Saurabh, "Introduction to VLSI Design Flow", Cambridge University Press, 1st Edition, 2023.
2. Kaushik Roy and Sharat C. Prasad, "Low Power CMOS VLSI Circuit Design", Kluwer Academic Publishers, 1st Edition.
3. Neil H. E. Weste and David Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education, 4th Edition.
4. Naveed A. Sherwani, "Algorithms for VLSI Physical Design Automation", Springer, 3rd Edition.

Reference Books/Online Courses:

1. Neil H. E. Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", Pearson Education.
2. Sadiq M. Sait and Habib Youssef, "VLSI Physical Design Automation: Theory and Practice", World Scientific Publishing.
3. Jan M. Rabaey, "Digital Integrated Circuits: A Design Perspective", Pearson Education.
4. Douglas Pucknell and Kamran Eshraghian, "Basic VLSI Design", Prentice Hall.
5. nptel.ac.in/courses/106105161 (Prof. Indranil Sengupta, IIT Kharagpur).
6. nptel.ac.in/courses/108107380 (Prof. Bishnu Prasad Das, IIT Roorkee)
7. nptel.ac.in/courses/106105034 (Prof. Ajit Pal, IIT Kharagpur)

Prepared by

Checked by

Head of the Department

Principal

**Honors in Robotics & Automation****Program: Electronics and Telecommunication Engineering****B. Tech****Semester: VII****Course: Industrial Automation Design****Course Code: DJS23ECH451****Pre-requisite:**

1. Sensors and Instrumentation (DJS23EH4201)
2. Basics of Control Systems (DJS23EH4251)
3. PLC and Applications (DJS23ECH4601)

Objectives:

1. To learn basic functions & working of pneumatic, hydraulic & electrical components used in process control.
2. To understand principles of process parameter conversion & transmission in various forms.
3. To study various types of controllers used in process control & their tuning for different applications.
4. To be aware of recent advances & technological developments in industrial instrumentation & process control.

Outcomes: At the end of course, students will be able to:

1. Select the proper components for pneumatic & hydraulic systems.
2. Choose the transmitter / controller for given process application.
3. Analyze the controller parameters for discrete or continuous type.
4. Prepare a simple SCADA application.

Industrial Automation Design (DJS23ECH451)

Unit	Description	Duration
1	Actuators & Process Control Valves: Electrical actuators: Relays, solenoids & electrical motors (DC, AC & stepper motor). Pneumatic actuators: Basic pneumatic system, pneumatic compressors (piston, vane, screw) flapper nozzle, single & double acting cylinder, rotary actuator, filter-regulator-lubricator (FRL). Hydraulic actuator: Hydraulic pumps, control valve types (globe, ball, needle, butterfly, gate, diaphragm & pinch), cavitation & flashing with their remedies, pressure drop across valve & leakage, valve noise, flow characteristics on load changes, control valves parameters, control valves sizing, valve calibration, digital control valves, selecting control valves & applications.	09
2	Design of Signal Conditioning Circuits: Principles of analog & digital signal conditioning: Signal level & bias change, linearization, conversion, filtering & impedance matching, concept of loading, comparators & converters. Design of operational amplifier: Based circuits in instrumentation, analysis of voltage divider circuits, bridge circuits, RC filters, inverting & non-	09



	inverting amplifier, instrumentation amplifier, V to I & I to V converter, integrator, differentiator & linearization (with numerical examples). Transmitters: Introduction to telemetry & its basic block diagram, 2 wire, 3 wire & 4 wire transmitters, 4 mA to 20 mA current transmitters, electronic transmitters for temperature, level, pressure & flow, current to pressure (I to P) & pressure to current (P to I) converters.	
3	Process Controller Principles: Discontinuous controller: Two position mode, multi-position mode & floating mode Continuous controller – single mode (P, I & D) & composite mode (PD, PI & PID), split range, auto select, ratio & cascaded controllers, selection criterion of controller for a process mode. Tuning of PID controller: Process loop tuning, open loop transient response method, Ziegler – Nichols tuning method, frequency response methods (numerical examples on PID tuning).	08
4	Supervisory Control and Data Acquisition System (SCADA): Introduction, Architecture/Block diagram, editors of SCADA, Interface SCADA with PLC, create SCADA screen for simple objects, Application of SCADA like Traffic light control, water distribution, Industrial PCs, Mini Rugged PCs, Industrial Open Frame Panel PCs.	08
5	Distributed Control System (DCS): Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Advantages of DCS.	08
Total		42

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. Curtis D. Johnson, "Process Control Instrumentation Technology", PHI, 7th Edition.
2. S. K. Singh, "Industrial Instrumentation & Control", McGraw Hill, 3rd Edition.
3. Bhoyar S A, "Supervisory control & Data acquisition", ISA publication, 4th Edition, 2016.

Reference Books:

1. B.C. Nakra & K. K. Chaudhary, "Instrumentation Measurement & Analysis", McGraw Hill, 3rd Edition.
2. Andrew Parr, "Pneumatics & Hydraulics", Jaico Publishing Co., 2nd Edition.
3. B. G. Liptak, "Handbook of Process Control & Instrumentation", CRC Press, 4th Edition.
4. Bailey, David, "Practical SCADA for Industry", 1st Edition, Newness international publication, 2003.

Prepared by

Checked by

Head of the Department

Principal