B. Tech. Program (Electronics & Telecommunication Engineering)

Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and detailed syllabus (DJS22)

Final Year B. Tech.

In

(Semester VII)

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)

B. Tech. Program (Electronics & Telecommunication Engineering) (DJS22 Scheme)

SEM VII

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 VII																
1	DJS22EC701	Microwave Engineering	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL701	Microwave Engineering Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
2	DJS22EC702	Mobile Communication System	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL702	Mobile Communication System Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
3	DJS22EC703	Internet of Things	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL703	Internet of Things Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
4	DJS22EC7011	Artificial Intelligence & Machine Learning	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL7011	Artificial Intelligence & Machine Learning Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC7012	Robotics	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL7012	Robotics Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC7013	Power Electronics	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL7013	Power Electronics Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC7014	Data Compression & Encryption	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL7014	Data Compression & Encryption Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC7015	Speech Processing	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL7015	Speech Processing Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC7016	Embedded Systems	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL7016	Embedded Systems Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC7017	Advanced VLSI	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL7017	Advanced VLSI Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
5	DJS22ILO7011	Product Lifecycle Management	3	--	--	3	35	--	35	65	--	-	--	65	100	3
	DJS22ILO7012	Management Information System	3	--	--	3	35	--	35	65	--	-	--	65	100	3
	DJS22ILO7013	Operations Research	3	--	--	3	35	--	35	65	--	-	--	65	100	3
	DJS22ILO7014	Cyber Security and Laws	3	--	--	3	35	--	35	65	--	-	--	65	100	3
	DJS22ILO7015	Personal Finance Management	3	--	--	3	35	--	35	65	--	-	--	65	100	3

	DJS22ILO7016	Energy Audit and Management	3	--	--	3	35	--	35	65	--	-	--	65	100	3
	DJS22ILO7017	Disaster Management and Mitigation Measures	3	--	--	3	35	--	35	65	--	-	--	65	100	3
	DJS22ILO7018	Science of Well-being	3	--	--	3	35	--	35	65	--	-	--	65	100	3
	DJS22ILO7019	Research Methodology	3	--	--	3	35	--	35	65	--	-	--	65	100	3
	DJS22ILO7020	Public Systems and Policies	3	--	--	3	35	--	35	65	--	-	--	65	100	3
6	DJS22EL704	Industrial Automation Laboratory	-	2	-	1	-	25	25	-	-	-	-	-	25	1
7	DJS22ECP701	Project Stage I	-	4	-	2	-	50	50	-	-	-	50	50	100	2
		Total	**15**	**14**	**0**	**22**	**175**	**175**	**350**	**325**	**100**	**0**	**50**	**475**	**825**	**22**

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Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (hrs.)
Theory	a. One Term test (based on 40 % syllabus)	20	1
	b. Second Term test (next 40 % syllabus) / presentation / assignment / course project / group discussion / any other.	15	1
	Total marks (a + b)	35	--
Audit course	Performance in the assignments / quiz / power point presentation / poster presentation / group project / any other tool.	--	As applicable
Laboratory	Performance in the laboratory and documentation.	25	
Tutorial	Performance in each tutorial & / assignment.	25	
Laboratory &Tutorial	Performance in the laboratory and tutorial.	50	

The final certification and acceptance of term work will be subject to satisfactory performance upon fulfilling minimum passing criteria in the term work / completion of audit course.

Semester End Assessment (B):

Course	Assessment Tools	Marks	Time (hrs.)
Theory / * Computer based	Written paper based on the entire syllabus.	65	2
	* Computer based assessment in the college premises.		
Oral	Questions based on the entire syllabus.	25	As applicable
Practical	Performance of the practical assigned during the examination and the output / results obtained.	25	2
Oral & Practical	Project based courses - Performance of the practical assigned during the examination and the output / results obtained. Based on the practical performed during the examination and on the entire syllabus.	As per the scheme	2

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DJS-22

Syllabus

Semester VII

ACADEMIC YEAR: 2025-26

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course: Microwave Engineering	Course Code: DJS22EC701	
Course: Microwave Engineering Laboratory	Course Code: DJS22EL701	

Pre-requisite:

1. Applied Physics (DJS22FECEP102)
2. Electromagnetic Wave Propagation (DJS22EC403)
3. Analog Communication (DJS22EC501)
4. Radio Frequency Circuit Design (DJS22EC502)
5. Radiating Systems (DJS22EC602)

Objectives:

1. To understand the basics of Microwave Communication Systems.
2. To understand various Microwave Devices and Measuring Techniques.

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

1. Analyze propagation through guiding media using Wave equation and design various Impedance Matching Techniques.
2. Analyze functioning of different Microwave components.
3. Analyze Microwave Tubes and derive expressions of necessary performance parameters for them.
4. Understand measurement techniques to measure various circuit parameters at microwave frequency and carry out experimental verification for the same.

Microwave Engineering (DJS22EC701)		
Unit	**Description**	**Duration**
1	**Basics of Microwave Communication Systems** Microwave Frequency Bands in Radio Spectrum, Characteristics, Advantages and Applications of Microwaves. **Review of Low frequency parameters:** Impedance, Admittance, Hybrid and ABCD parameters, Different types of interconnections of Two port networks. High Frequency parameters, Formulation of S- parameters, Properties of S- parameters.	**02**
2	**Waveguides and Impedance matching Network and Passive Devices** Rectangular waveguides: Construction, Working and Mode analysis and Applications. **Circular and Ridge Waveguide:** Construction and Applications, Design of Impedance matching network using distributed parameters.	**10**

3	**Passive and Semiconductor Microwave Devices** Tees, Hybrid ring, Directional couplers, Phase shifters, Terminations, Attenuators and Ferrite devices such as Isolators, Gyrators, and Circulators. Diodes: Varactor, PIN, Tunnel, Point Contact, Schottky Barrier, Gunn, IMPATT. **Transistors:** BJT, Hetro junction BJT, MESFET, and HEMT **Application of Tunnel, Gunn and IMPATT diode as a Microwave Oscillator** construction, working, equivalent circuit and performance characteristics	**12**
4	**Microwave Generation and Amplification** Two Cavity Klystron, Multi-Cavity Klystron and Reflex Klystron, Helix Travelling Wave Tube and Cross Field Amplifier, Backward Wave Oscillator, Cylindrical Magnetron and Gyrotron.	**10**
5	**Microwave Measurements** VSWR, Frequency, Power, Impedance, Attenuation, Dielectric Constant.	**03**
6	**Microwave Application and Modern Trends in Microwave Engineering** Effects of Microwave radiation on human body, Microwave hazards. Medical (Microwave Imagining, Microwave Diathermy) and Civil applications (Microwave heating, Instrumentation landing Systems, Radar Navigation Systems) of microwaves.	**03**
	Total	**40**

Microwave Engineering Laboratory (DJS22EL701)	
Exp.	**Suggested Experiment List**
1	Study of Microwave Components.
2	Measurement of Microwave frequency using Microwave Bench Setup.
3	Measurement of Attenuation using Microwave Bench Set-up.
4	Study of Various Modes of Reflex Klystron
5	Compare Analytical and Graphical Method of Impedance Matching for Single Stub.
6	Study of Microwave Hazards.
7	Measurement of Wavelength, VSWR and Unknown load using Microwave Bench Set-up.
8	Measurement of S-parameters for various microwave components.
9	Design and Simulation of Branch line coupler.
10	Mode Pattern Analysis for Rectangle Waveguide

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:

TextBooks:

1. Samuel Liao, *"Microwave Devices and Circuits",* 3rd Edition, Prentice Hall,1999.
2. M. Kulkarni, *"Microwave and Radar Engineering",* 3rd Edition, Umesh Publication, 2023.

Reference Books:

1. D. M. Pozar, "*Microwave Engineering*", Wiley Publications, 4th Edition, 2012.
2. Annapurna Das, Sisir K. Das, "*Microwave engineering*", Tata McGraw Hill, 5th Edition, 2021.
3. Peter A. Rizzi, "*Microwave Engineering: Passive Circuits*" Prentice Hall, 2nd Edition, 1998.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course: Mobile Communication System	Course Code:DJS22EC702	
Course: Mobile Communication System Laboratory	Course Code:DJS22EL702	

Pre-requisite:

1. Analog Communication (DJS22EC501)
2. Digital Communication (DJS22EC601)
3. Computer Networks (DJS22EC603)

Objectives:

1. To understand the cellular fundamentals and different types of radio propagation models.
2. To study the system architecture of 2G, 2.5 G, 3G and 4 G standards and beyond.

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

1. Classify different types of propagation models
2. Explain the cellular fundamentals and estimate the coverage and capacity of cellular systems.
3. Illustrate the fundamentals and system architecture of GSM, 2.5G, IS-95 and UMTS.
4. Elaborate on the concepts and principles 4G network deployment and optimization.
5. Discuss the emerging technologies for upcoming mobile communication systems.

Mobile Communication System (DJS22EC702)		
Unit	**Description**	**Duration**
1	**Mobile Radio Propagation:** Large scale fading: Free space propagation model, the three basic propagation mechanisms, reflection, ground reflection (two-ray) model, Small scale fading: Small scale multipath propagation, types of small-scale fading, Rayleigh and Rician distributions.	**06**
2	**Fundamentals of Mobile Communication:** The Cellular Concept System Design Fundamentals: Frequency Reuse, Handoff, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems Features of conventional multiple access techniques: Frequency division multiple access (FDMA), Time division multiple access (TDMA), OFDM.	**06**
3	**Digital Telephony System (2G and 3G Systems):** GSM: GSM Network architecture, GSM channels, frame structure for GSM, GSM speech coding, authentication and security in GSM, GSM call procedures, GSM hand-off procedures, GSM evolution: GPRS and EDGE- architecture, radio specifications, IS-95: Architecture of CDMA	**10**

	system, CDMA air interface, power control in CDMA system, rake receiver. UMTS: Objectives, evolution path to 3G, network architecture, W-CDMA air interface, attributes of W-CDMA system, Cdma2000 cellular technologies: Forward and Reverse Channels.	
4	**Advanced Techniques for 4G Deployment:** LTE network Architecture, Physical layer: Frames, slots, and symbols, modulation, coding. Multi-antenna Techniques: Smart antennas, multiple input multiple output systems. Cognitive radio: Architecture, spectrum sensing. Relaying multi-hop and cooperative communications: Principles of relaying, fundamentals. SDR: Architecture, limitations, advantages, disadvantages.	**08**
5	**4G Network Planning and Optimization**: Network Elements in a LTE Radio Network, User Equipment (UE), Base Station (eNodeB), Key Phenomena in LTE, Interference in LTE, Scheduling, Quality of Service, Radio Network Planning Process, Pre-Planning Phase, Detailed Network Planning, LTE Radio Network Optimisation, Initial Tuning, Cluster Tuning, Market Level/Network Tuning, Self- organizing, Networks, Key Performance Indicators, LTE Advanced, Carrier Aggregation, MIMO, Coordinated Multi-point Transmission and Reception (CoMP), Relay Nodes	**06**
6	**Road map towards 5G:** Introduction 5G enabling technologies, Introduction to Femtocell, Femtocell Attributes, Femtocell Standards, Concept of Femtocells, Types of Femtocells Applications of Femtocells.	**04**
	Total	**40**

Course: Mobile Communication System Laboratory (DJS22EL702)	
Exp.	**Suggested Experiment List**
1	Study of frequency reuse using Matlab/Scilab
2	To study performance evaluation of handover for absolute signal strength measurement
3	Tutorial based on fundamentals of frequency reuse and capacity of cellular communication system.
4	Implementation of adaptive modulation for wireless environment.
5	Study of Rayleigh and Rician fading distribution using Simulink and computation of link budget using Okumura model.

6	Tutorial based on emerging technologies of 4G.
7	Tutorial based on 3GPP LTE.
8	Scilab Based GSM, CDMA Implementations
9	Verify use of Orthogonal Walsh codes in CDMA environment
10	Tutorial based on Propagation Models

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. Theodore S. Rappaport, "*Wireless communications principles and practice*", Pearson Publication, 2nd edition,2010.
2. T L Singal, "*Wireless Communications*", Mc Graw Hill Education, 1st edition, 2010.
3. Andreas F. Molisch, "*Wireless Communication*", Wiley India Pvt Ltd, 2nd edition, 2013.

Reference Books:

1. Upena Dalal, "*Wireless and Mobile Communications*", Oxford University Press, 1st edition, 2015.
2. Vijay K. Garg, "*Wireless Communication and Networking"*, Morgan, Kaufmann Series in Networking, Elsevier, 1st edition, 2007.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course : Internet of Things	Course Code: DJS22EC703	
Course : Internet of Things Laboratory	Course Code: DJS22EL703	

Pre-requisite:

1. Digital Communications (DJS22EC601)
2. Computer Networks (DJS22EC603)

Objectives:

1. To introduce the concept of network connected IOT devices.
2. To introduce methods to generate and acquire analog and digital sensor data.
3. To introduce various data communications and role of layers.
4. To introduce methods for data storage and retrieval.
5. To outline the formal procedure for connecting to data networks for data transfer.

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

1. Summarize the concepts, features and functions of network connected embedded devices.
2. Adopt a suitable communication model for a given IOT application
3. Identify and summarize different components and resources required for IOT applications.
4. Adopt a suitable data model for a given IOT application
4. Analyze the data generated or received in system through Data Analytics tools.

Internet of Things (DJS22EC703)		
Unit	**Description**	**Duration**
1	**IOT Introduction**: Concepts and Definitions of the Internet of Things (IoT), Requirements, Functionalists, and structure of IOT, IoT enabling technologies, IoT Architecture, The major component of IOT (Hardware & Software), IoT communication models and networking protocols, Role of wired and wireless communication, IoT services and applications, IoT Standards, Examples of IoT.	**08**
2	**IOT Data Acquisition & Platforms:** Micro Controllers (Arduino uno/mega2560, Rasberry-Pi, ARM Cortex M), Real-time systems, and embedded software, OS and Drivers (End Device Program), Hardware & Software Requirements.	**10**
3	**IOT Data Communication**: Data transfer data by Wireless / Wired connectivity, Ipv4/Ipv6, Ethernet/GigE, MIPI, M-PHY, UniPro, SPMI, BIF, SuperSpeed USB Inter-Chip (SSIC), Mobile	**10**

	PCIe (M-PCIe) and SPI, GSM , 2g ,3g ,4g & 5g, IEEE 802.15.4, IEEE 802.15.4e, 802.11ah, Relay Access Point (AP), Grouping of station, Target Wake Time (TWT)	
4	**IOT Data Storage & Retrieval**: Overview and Role of Storage in Cloud / Server /Inhouse Storage, Databases Connectivity with IOT and uses, Case Study over Mysql / NoSql / NewSql, Case Study over Cloud Services and Administration, Case Study of Big Data & Hadoop Platforms.	**08**
5	**IOT Data Analytics & Visualization:** Analysis of data using the Python language libraries (modules), Visualization and interpretation of Data, Data Cleaning in IoT.	**04**
	Total	**40**

Internet of Things Laboratory (DJS22EL703)	
Exp.	**Suggested Experiment List**
1	Basic Embedded operations – I/O toggling, Interrupt handling, Timer operations, periodic event generations, ADC operations, Serial data transfer – numbers and string transmissions.
2	Data Generation – ADC conversion of analog sensors including temperature using NTC, their calibrations and data transfer to PC terminal.
3	Data Generation – Reading digital sensors and data transfer to PC terminal.
4	State machine design – Data flow planning, design and deployment of communication model through coding.
5	Communication across network – TCP method.
6	Communication across network – UDP Method.
7	Actuations across network - Trigger of relays and solenoids, DC motor.
8	Actuations across network - Demonstration of the DC motor speed control.
9	Data Display across network – Display data on LCD 16X2 Display and OLED module.
10	IOT Product Development & Testing with Project.

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:

Textbooks:

1. Raj Kamal, "*Internet of Things Architecture and Design Principles"*, Tata McGraw Hill, 2017.
2. Colin Dow*, "Internet of Things Programming Projects: Build modern IoT solutions with the Raspberry Pi 3 and Python"*, Packt Publishing, 2018.
3. Anand Tamboli, "*Build Your Own IoT Platform: Develop a Fully Flexible and Scalable Internet of Things Platform in 24 Hours"*, Apress, 2019.

Reference Books:

1. Kamal, R.,"*Internet of Things – Architecture and Design Principles*", 1st Edition, Mcgraw Hill,2017.
2. Simone Cirani, "*Internet of Things- Architectures, Protocols and Standards*", WILEY, 2018.
3. Alessandro Bassi, "*Enabling Things to Talk- Designing IoT solutions with the IoT Architectural Reference Model*", Springer, 2013.
4. Constandinos X. Mavro Moustakis, George Mastorakis, Jordi Mongay Batalla, "*Internet of Things (IoT) in 5G Mobile Technologies"*, Springer International Publication, 2016.
5. Fadi Al-Turjman, "*Artificial Intelligence in IoT"*, 1st Edition, Springer International Publishing.
6. Shampa Sen, Leonid Datta, Sayak Mitra, "*Machine Learning and IoT: A Biological Perspective"*, CRC Press, 2019.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech.	Semester: VII
Course: Artificial Intelligence and Machine Learning	Course Code: DJS22EC7011	
Course: Artificial Intelligence and Machine Learning Laboratory	Course Code: DJS22EL7011	

Pre-requisite:

1. Engineering Mathematics - IV (DJS22EC401)

Objectives:

1. To teach the basics of Artificial Intelligence and Optimization Algorithms.
2. To deliver the fundamental concepts and techniques of Machine Learning.
3. To make students familiar with regression, classification and clustering methods.

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

1. Recall the concepts introduced in Artificial Intelligence (AI), machine learning and neural network fundamentals.
2. Understand searching, optimization algorithms, basics of knowledge representation and reasoning in AI, supervised and unsupervised Machine learning techniques.
3. Apply different search and optimization algorithms, logic rules, machine learning techniques, including supervised and unsupervised learning, to solve various problems.
4. Analyze various search and optimization algorithms, performance of different machine learning techniques identifying their strengths, weaknesses.

Artificial Intelligence and Machine Learning(DJS22EC7011)		
Unit	**Description**	**Duration**
1	**Introduction to Artificial Intelligence (AI)** Introduction and Definition of Artificial Intelligence. **Intelligent Agents:** Agents and Environments, Concept of Rationality, Nature of Environments, Structure of Agents.	**04**
2	**Problem Solving by Searching** Problem Solving Agent, Formulating Problems, Example Problems. **Uninformed Search Methods:** Depth Limited Search, Depth First Iterative Deepening (DFID). **Informed (Heuristic) Search Methods**: Greedy best-first search**,** A* Search. **Optimization Problems**: Hill climbing Search, Simulated annealing, Genetic algorithm, Ant colony optimization **Case study**: Travelling salesman problem.	**08**

3	**Knowledge representation and Reasoning** Knowledge based agents, Knowledge representation using logic, Propositional logic, Properties of propositional logic statements, Semantics of propositional logic, Resolution algorithm, Inference in Semantics of propositional logic, Resolution algorithm, **case study**: Wumpus world. Introduction to knowledge representation in FOL.	**08**
4	**Introduction to Machine Learning** Machine Learning basics, Types of Machine Learning. **Introduction to Artificial Neural Network** Fundamental concept, Biological Neuron, Artificial Neural Networks, NN architecture, Activation functions.	**05**
5	**Supervised Learning** Linear Regression Case study: Predicting house prices with Linear Regression, Linear Regression with one variable, Cost function, Gradient descent. Classifying with k-Nearest Neighbors, Splitting datasets one feature at a time: decision trees, Classifying with probability theory: Naïve Bayes, Logistic regression, Support Vector Machines.	**10**
6	**Unsupervised Learning** Grouping unlabeled items using k-means clustering. **Dimensionality Reduction** Principal Component Analysis (PCA).	**05**
	Total	**40**

Artificial Intelligence and Machine Learning Laboratory(DJS22EL7011)	
Exp.	**Suggested Experiment List**
1	Find a goal by Breadth First Search (BFS) algorithm.
2	Find a goal by Depth First Search (DFS) algorithm.
3	Find a goal by Deepening Depth First Search (DFID) algorithm.
4	Predicting house prices by Linear Regression.
5	K Nearest neighbour (KNN) classification of Iris dataset
6	Decision Tree classification with Tennis Dataset
7	Generate Confusion Matrix for Naïve Bayes Classifier.
8	Clustering data by K means clustering algorithm.
9	Find the minimum of a polynomial by Gradient Descent Method.
10	To implement Support Vector Machines.

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:

Textbooks:

1. Stuart J. Russell and Peter Norvig, "*Artificial Intelligence*", A Modern Approach, Pearson Education,3rd edition,1997.
2. Tom M. Mitchell, "Machine Learning", McGraw Hill Education,1st edition, 2017.

Reference Books:

1. Deepak Khemani, "*A First Course in Artificial Intelligence*", McGraw Hill (India) Pvt. Ltd,1st edition, 2013.
2. Kevin P. Murphy, "*Machine Learning*", A Probabilistic Perspective, MIT Press, 2012, 1st edition.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course: Robotics	Course Code: DJS22EC7012	
Course: Robotics Laboratory	Course Code: DJS22EL7012	

Pre-requisite:

1. Engineering Mathematics III (DJS22EC303)
2. Microcontroller & Applications-I (DJS22EC404)
3. Microcontroller & Applications-II (DJS22EC503)

Objectives:

1. To understand the functional elements of Robotics.
2. To impart the knowledge on direct and inverse Kinematics.
3. To cover various path planning methodologies for robotic navigation and task execution.
4. To introduce the dynamics of robotic manipulators and the control mechanisms.
5. To develop understanding of localization, navigation strategies, and planning techniques.

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

1. Understand basic concept of robotics.
2. Understand the principle of direct and inverse Kinematics in robotic operation.
3. Describe the various path planning techniques, dynamics and control in robotic applications.
4. Write program to use the robot for the various applications.

Robotics (DJS22EC7012)		
Unit	**Description**	**Duration**
1	**Basic Concepts:** Brief History, Types of Robot–Technology-Robot classifications and specifications, Design and Control issues, Various manipulators, Sensors, Work cell, Programming languages.	**04**
2	**Direct and Inverse Kinematics:** Mathematical representation of Robots, Homogeneous transformation Various joints, Degrees of freedom representation using the Denavit Hattenberg parameters, Direct kinematics-Inverse kinematics, Solvability – Solution methods-Closed form solution, SCARA robots..	**08**
3	**Path Planning:** Joint space technique, Use of p-degree polynomial, Cubic polynomial, Cartesian space technique, Parametric descriptions, Straight line and circular paths, Position and orientation planning.	**08**

4	**Dynamics and Control:** Lagrangian mechanics, 2DOF Manipulator, Lagrange Euler formulation, Dynamic model, Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.	**07**
5	**Service Robotics:** Need for service robots, Challenges of Localization, Map Representation, Probabilistic Map based Localization, Monte Carlo localization, Landmark based navigation, Globally unique localization, Globally unique localization, Route based localization, Path planning overview, Cell decomposition path planning, Potential field path planning, Obstacle avoidance .	**07**
6	**Applications: Ariel robots, Collision avoidance,** Robots for agriculture, mining, exploration, underwater, civilian andmilitary applications, nuclear applications, Space applications, Humanoids.	**06**
	Total	**40**

Robotics -Laboratory (DJS22EL7012)	
Exp.	**Suggested Experiment List**
1	Robot Classification and Specifications
2	Composite Rotation Transformation Matrix
3	Composite Homogenous Transformation Matrix
4	Evaluate Denavit-Hartenberg representation of three axis planar robot with ARM matrix computation
5	Joint Space Path Planning Using Cubic Polynomial Interpolation in MATLAB
6	Comparing Joint Space and Cartesian Space Path Planning Techniques in MATLAB
7	Dynamic Response Analysis of a 2DOF Manipulator Under PID Control in MATLAB
8	Simulating Path Planning and Obstacle Avoidance
9	Perform experiment no 1 (Movemaster) and 2 (Forward Kinematics of PUMA 560) available at the link: https://mr-iitkgp.vlabs.ac.in/
10	Programming a 6-DoF Articulated Robot for Automated Loading and Unloading Operations

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:

Textbooks:

1. R. K. Mittal and I. J. Nagrath, "*Robotics and Control*", Tata McGraw Hill, 4th Edition, 2005.

2. John J. Craig, "*Introduction to Robotics Mechanics and Control*", Pearson Education, 3rd Edition, 2009.

Reference Books:

1. Ashitava Ghoshal, "*Robotics-Fundamental Concepts and Analysis*", Oxford University Press, 6th Edition, 2010.
2. Edwin Wise, "*Applied Robotics*", Cengage Learning, 1st Edition, 2003.
3. K. K. Appu Kuttan, "*Robotics*", I K International, 1st Edition, 2007.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course: Power Electronics	Course Code: DJS22EC7013	
Course: Power Electronics Laboratory	Course Code: DJS22EL7013	

Pre-requisite:

1. Engineering Mathematics III (DJS22EC303)
2. Electronic Devices and Circuits (DJS23ECPC302), ((DJS22EC302))

Objectives:

1. To develop the understanding of fundamental principles of power electronics.
2. To disseminate various power electronic semiconductor devices and their characteristics.
3. To develop the concept of power electronic converters and their topologies.

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

1. Describe the features and characteristics of power semiconductor devices.
2. Analyze and design triggering, commutation and protection circuits.
3. Illustrate, analyze and design AC-DC converters.
4. Illustrate, analyze and design DC-DC converters.
5. Illustrate, analyze and design DC-AC converters.
6. Illustrate, analyze and design AC-AC converters.

Power Electronics (DJS22EC7013)		
Unit	**Description**	**Duration**
1	**Power Semiconductor Devices:** Principle of operation, constructional features and characteristics of: SCR, TRIAC, DIAC, GTO, MOSFET and IGBT.	**04**
2	**Triggering, Commutation and Protection:** Basic Gate Drive circuits for SCR, TRIAC, MOSFET and IGBT, Methods of commutation of SCR, Methods of protection of SCR.	**06**
3	**AC-DC Converters:** Uncontrolled half and full wave rectifiers with R and RL load, SCR controlled half and full wave rectifier with R and RL load. Power factor of the controlled rectifier. Effect of source and load inductances.	**06**
4	**DC-DC Converters:** Buck, Boost and Buck-Boost converters, Flyback and Cúk converter, DC-DC converters with R and RL load.	**08**
5	**DC-AC Converters:** Principle of operation and performance parameters, Voltage control of single phase inverters	**08**
6	**AC-AC Converters:** Principle of on-off and phase angle control; performance parameters, Single phase full-wave AC-AC converter with R and RL load	**08**
	Total	**40**

Power Electronics Laboratory (DJS22EL7013)	
Sr. No.	**Experiment Title**
1	To study V-I characteristics of SCR, DIAC and TRIC
2	To study V-I characteristics of IGBT.
3.	To study different triggering circuits for SCR R Triggering circuit RC triggering circuit
4	To study class B commutation circuit of SCR.
5	To study Half wave controlled rectifiers using SCR.
6	To study AC phase control circuit using DIAC and TRIAC.
7	To study totem pole gate triggering circuit for MOSFET.
8	To study uncontrolled and controlled rectifiers.
9	To Study a controlled rectifier with (i) Source Inductance (ii) Freewheeling diode.
10	To study buck and boost converters.
11	To study flyback converters.
12	To study single phase DC to AC converters.
13	To study AC to AC converters.

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:

Textbooks:

1. N. Mohan, T. M. Undeland, W. P. Robbins, "*Power Electronics: Converters Application and Design"*, John Wiley & Sons, 2nd edition, 2003.
2. M. H. Rashid, "*Power Electronics: Circuits, Devices, and Applications"*, Pearson Education India, 4th edition,2014.
3. P.S. Bhimbra, "Power Electronics", Khanna Publishers, 5th edition, 2012.

Reference Books:

1. P.C. Sen, *Modern Power Electronics*, Wheeler publications, 1st edition, 2005.
2. Ramamurthy, *Thyristor & Their Applications*, East-West Press, 2nd edition,1998.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course: Data Compression and Encryption	Course Code: DJS22EC7014	
Course: Data Compression and Encryption Laboratory	Course Code: DJS22EC7014	

Pre-requisite:

1. Engineering Mathematics – III (DJS22EC301)
2. Signals and Systems(DJS22EC304)

Objectives:

1. To introduce different lossy and lossless compression for text audio, image and video.
2. To introduce the concept of Symmetric and Asymmetric key cryptography and its applications in security protocols.

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

1. Describe various lossy and lossless techniques.
2. Apply various compression techniques for compression of text, image, audio and video.
3. Describe the range of different cryptosystems and various network security related protocols.
4. Analyze how the basic design criteria for various cryptosystems like confusion, diffusion and number theory are used in cryptographic techniques.

Data Compression & Encryption (DJS22EC7014)		
Unit	**Description**	**Duration**
1	**Text compression:** Introduction to data compression, Comparison of lossy and lossless compression, Modelling and Coding, Compression Parameters. Huffman Coding, Adaptive Huffman Coding, Arithmetic coding. Dictionary based compression: Static and Dynamic Dictionary, LZ77, LZ78, LZW.	**10**
2	**Image Compression:** Differential lossless compression DPCM, JPEG-LS, DCT, JPEG, JPEG 2000.	**06**
3	**Audio and Video Compression:** Digital Audio, μ law and A law companding, MPEG-1 Audio layer (MP3 audio format). Digital Video, MPEG-2, H.261 encoder and decoder.	**04**
4	**Symmetric key cryptography & Key management:** **Introduction**: Security Goals, Security techniques – Cryptography and Steganography, Cryptographic attacks.	**08**

	Symmetric Key Cryptography: Substitution cypher, Transposition Cypher, Stream and Block cypher, DES, Double DES, Triple DES, AES. Key management, Diffie- Hellman Key Exchange.	
5	**Asymmetric key cryptography and Message Integrity:** Prime numbers, Fermat's and Euler's theorem, Chinese Remainder theorem. Principles of Public Key cryptosystem, RSA. Message Integrity: Message authentication and Hash functions, SHA, HMAC, Digital Signature Standard.	**08**
6	**Network Security:** Email, PGP, S/MIME, Intrusion detection system. Web security considerations, SSL, TLS, Secure Electronic transaction. Kerberos, X.509 authentication service, Public Key Infrastructure.	**04**
	Total	**40**

Data Compression and Encryption Laboratory (DJS22EL7014)	
Exp.	**Suggested Experiment List**
1	To find compression ratio after compression of various file formats.
2	To implement Huffman coding.
3	To implement Arithmetic coding.
4	To implement μ law and A law companding for Audio compression.
5	To implement DCT for image compression.
6	To implement Substitution cypher for text/ image.
7	To implement Transposition cypher for text/ image.
8	To implement square and multiply algorithm.
9	To implement Fermat's theorem.
10	To implement RSA.
11	To implement Diffie-Hellman Key exchange mechanism.
12	To implement PGP.
13	Case study on specific topics.
14	To study X.509 certificate format by downloading few samples from internet.

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. Khalid Sayood , "*Introduction to Data Compression*", Elsevier, 5th Edition, 2017.
2. William Stallings, "*Cryptography and Network Security Principles and Practices*", Pearson Education, 5th Edition, 2020.

Reference Books:

1. David Salomon, "*Data Compression: The Complete Reference*",4th Edition, Springer, 2007.
2. Mark Nelson, Jean- Loup Gailly, "*The Data Compression Book*", 2nd Edition, BPB Publications,2014.
3. Atul Kahate, "*Cryptography and Network Security*", McGraw-Hill ,4th Edition, 2019.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course: Speech Processing	Course Code: DJS22EC7015	
Course: Speech Processing Laboratory	Course Code: DJS22EL7015	

Pre-requisite:

1. Digital Signal Processing (DJS22EC504)

Objectives:

1. To acquire the fundamentals of the digital signal processing that allows them to assimilate the concepts related to the speech processing.
2. To introduce the fundamentals of speech signal processing.
3. To present basic principles of speech analysis.
4. To give an overview of speech processing applications including speech enhancement, speech recognition and speaker recognition.

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

1. understand the mechanism of human speech production and digital models of speech signals.
2. apply standard digital signal processing tools to analyze speech signals in terms of their Time and frequency domain representations.
3. understand Linear Predictive analysis of speech signal and different pitch period estimation methods.
4. understand the Homomorphic processing of speech signal and applications of speech processing, including speech enhancement.
5. understand the applications of speech processing including speaker recognition and speech recognition.

Speech Processing (DJS22EC7015)		
Unit	**Description**	**Duration**
1	**Introduction to Speech Processing**, Fundamentals of Digital Speech Processing, The Mechanism of speech production, Acoustic phonetics: vowels, diphthongs, semivowels, nasals, fricatives, stops and affricates, Applications of Speech Signal Processing, Digital Models for Speech Signals: Vocal Tract, Radiation, Excitation, The complete Model.	**04**
2	**Speech Analysis**: Short-Time Speech Analysis : Windowing , Spectra of Windows , Time-Domain Parameters: signal analysis in Time Domain, Short-Time average magnitude, Short-Time Average zero-crossing rate (ZCR) and Short-Time auto correlation function Short-Time Average Magnitude Difference Function, Frequency Domain (Spectral) Parameters : Short-Time Fourier Transform Analysis, Spectral Displays,	**12**

	Formant Estimation and Tracking.	
3	**Speech Analysis**, Linear predictive coding (LPC) of Speech: Introduction, Basic principles of Linear Predictive Analysis, Solution of the LPC Equation: Cholesky Decomposition Solution for covariance method, Durbin's Recursive Solution for the Autocorrelation Equations, Frequency domain interpretation of mean squared prediction error, Applications of LPC parameters: pitch detection using LPC parameters and Formant analysis using LPC parameters. Pitch Period Estimation using Parallel Processing Approach, Pitch Period Estimation using Autocorrelation Function.	**12**
4	**Frequency Analysis**, Homomorphic Speech processing: Homomorphic Speech processing: Introduction, Homomorphic systems for Convolution, The complex cepstrum of speech, The Homomorphic Vocoder. Speech enhancement: Introduction, Background, Nature of interfering sounds, speech enhancement techniques: spectral subtraction, Multi-Microphone Adaptive Noise Cancellation.	**12**
5	**Speech Recognition**: Basic pattern recognition approaches, Preprocessing, Parametric Representation, speech recognition systems: Isolated Digit Recognition system and continuous Digit Recognition system. Speaker Recognition: Verification vs recognition, Speaker Recognition Systems: speaker verification system and speaker identification system.	**03**
	Total	**40**

Speech Processing Laboratory (DJS22EL7015)	
Exp.	**Suggested Experiment List**
1	To study the effects of sampling (aliasing) and quantization on speech signals by playing them at different sampling rates and bits per sample (upto 16 bps).
2	To study the time-varying nature of the speech signal in the time domain
3	To study the varying nature of the speech signal in the frequency domain
4	Short-Time Spectrum Analysis of Speech
5	Spectrographic analysis of speech
6	Cepstral analysis of speech
7	Linear prediction analysis of speech
8	Formant synthesis
9	Analysis by synthesis of speech
10	Dynamic Time Warping for Automatic Speech recognition
11	Audio segmentation
12	Audio Source separation

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:

Textbooks:

1. Douglas O'Shaughnessy, "*Speech Communications: Human & Machine"*, University Press,2nd edition, 1999.
2. Rabiner and Schafer, "*Digital Processing of Speech Signals"*, Prentice Hall, 3rd edition, 1978.

Reference Books:

1. Thomas F. Quatieri, "*Discrete-Time Speech Signal Processing: Principles and Practice"*, Prentice Hall, 3rd Edition, 2001.
2. Nelson Morgan and Ben Gold, "*Speech and Audio Signal Processing: Processing and Perception of Speech and Music"*, John Wiley & Sons,2nd Edition, 2011.
3. J. L. Flanagan, "*Speech Analysis Synthesis and Perception"*, Springer-Verlag, 2nd Edition, 1972.
4. Gold & Morgan, *Speech and Audio Signal Processing*, Wiley and Sons,2nd Edition, 1999.
5. Dr. Shaila D. Apte, *Speech and Audio Processing*, Wiley Precise Textbook,1st Edition, 2015.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course : Embedded Systems	Course Code: DJS22EC7016	
Course : Embedded Systems Laboratory	Course Code: DJS22EL7016	

Pre-requisite:

1. Digital System Design (DJS22EC303)
2. Microcontroller & Applications-I (DJS22EC404)
3. Microcontroller & Applications-II (DJS22EC503)

Objectives:

1. To develop background knowledge of Embedded Systems.
2. To understand Embedded Systems communication techniques.
3. To write programs for Embedded Systems based applications.

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

1. Understand Embedded Systems design metrics and development life cycle.
2. Describe various processor design techniques and architectures through relevant examples.
3. Recognize and differentiate between communication types, buses, and protocols in Embedded Systems
4. Illustrate the concepts and essential components of a Real Time Operating System.

Embedded Systems (DJS22EC7016)		
Unit	**Description**	**Duration**
1	**Embedded System Overview:** Definition of embedded system, Embedded System vs General computing system, Classification, Major application areas, Characteristics and quality attributes (Design Metric) of embedded system, Real time system's requirements, real time issues, interrupt latency, Embedded product development life cycle.	**06**
2	**Processor:** Overview of Custom single purpose processors, General purpose processors, Standard single purpose processors, RISC and CISC architectures, GCD example.	**09**
3	**Communication:** CAN bus, I2C, MOD bus, SPI, Examples on Parallel communication, Serial communication, Wireless communication.	**09**
4	**Real Time Operating Systems (RTOS):** Operating system basics, Types of OS, Tasks, process, Threads, Multiprocessing and, Multitasking, Task scheduling, Task communications, Task synchronization, Device drivers, RTOS selection criterion, RTOS examples.	**10**

5	**Design examples:** Requirements and specifications, Digital Camera, Automatic Chocolate Vending Machine, Adaptive Cruise Control in car.	**06**
	Total	**40**

Embedded Systems-Laboratory (DJS22EL7016)	
Exp.	**Suggested Experiment List**
1	Interfacing of I2C, CAN, SPI with ARM controller
2	Speed Control of DC Motor using ARM controller
3	Interface humidity sensor to ARM controller and display it on LCD
4	Interface temperature sensor to ARM controller and display it on LCD
5	Simulation of multitasking using RTOS
6	Simulation of mutex using RTOS
7	Simulation of mailboxes using RTOS
8	Inter process communication using semaphore in RTOS
9	Simulation of message queues using RTOS
10	Mini Project

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:

Textbooks:

1. Frank Vahid and Tony Givargis, "*Embedded System Design: A Unified Hardware/Software Introduction*", Wiley Publication, 3rd Edition, 2006.
2. Raj Kamal, "*Embedded Systems: Architecture, Programming and Design*", Tata McGraw-Hill, 1st Edition, 2003.
3. P. E. Allen and D. R. Holberg, "*CMOS Analog Circuit Design*", Oxford University Press, 3rd Edition, 2012.

Reference Books:

1. David Simon, "*An Embedded Software Primer*", Pearson Publication, 1st Edition, 2009.
2. K. V. Shibu, "*Introduction to Embedded Systems*", McGraw Hill, 2nd Edition, 2017.

3. K.V.K. Prasad, "*Embedded Systems/Real-Time Systems: Concepts, Design and Programming*", Dreamtech, 1st Edition, 2003.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech.	Semester: VII
Course : Analog VLSI Design	Course Code: DJS22EC7017	
Course : Analog VLSI Design Laboratory	Course Code: DJS22EL7017	

Pre-requisite:

1. Electronic Circuit Design (DJS22EC302)
2. Integrated Circuits (DJS22EC402)
3. Basic VLSI (DJS22EC6011)

Objectives:

1. To highlight the circuit design issues in the context of Analog VLSI technology
2. To provide the understanding of different design styles.
3. To provide an exposure to drawing layout of circuits.

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

1. Describe MOSFET operation and analyze small signal MOS models
2. Design single stage amplifier based on MOSFET.
3. Design differential amplifier based on MOSFET.
4. Design the MOSFET-based operational amplifier.
5. Describe the techniques of layout for analog circuits.

Analog VLSI Design (DJS22EC7017)		
Unit	**Description**	**Duration**
1	**CMOS Analog building blocks** **MOS Models**: Necessity of CMOS Analog Design, Review of Characteristics of MOS Device, MOS Small Signal Model, MOS SPICE Models. **Passive and Active Current Mirrors**: Basic Current Mirrors, Cascode Current Mirrors and Active Current Mirrors. **Band Gap References**: General Considerations, Supply-Independent Biasing, Temperature-Independent References, PTAT Current Generation and Constant-Gm Biasing.	**10**
2	**Single Stage Amplifiers** **Configurations**: Basic concepts, Common-Source stage, Source follower, Common-Gate stage, Cascade stage.	**10**

	Frequency Response and Noise: General Considerations, Common-Source stage, Source followers, Common-Gate stage, Cascode stage and Noise in Single Stage Amplifier.	
3	**Differential Amplifiers** **Configurations**: Single-Ended and Differential Operation, Basic Differential Pair, Common-Mode Response, Differential Pair with MOS Loads, Gilbert Cell. **Frequency response and noise in differential Amplifiers:** Differential pair with Passive Loads, Differential Pair with Active Loads.	**08**
4	**MOS Operational Amplifiers** **Op-amp Design**: General Considerations, Performance parameters, One-stage op-amps, Two-stage op-amps, Gain Boosting, Common-Mode Feedback, Input Range Limitations, Slew Rate, Power Supply Rejection, Noise in op-amps. **Stability and Frequency Compensation:** General Considerations, Multi pole systems, Phase margin, Frequency compensation.	**08**
5	**Analog Layout and other concepts** **Analog Layout Techniques:** Antenna Effect, Resistor Matching, Capacitor Matching, Active Device Design, Current Mirror Matching, Floor Planning, Shielding and Guard Rings.	**04**
	Total	**40**

Analog VLSI Design-Laboratory (DJS22EL7017)	
Exp.	**Suggested Experiment List**
1	To study trans-conductance plots of MOSFET device (voltage bias, current bias and technology bias).
2	To design basic amplifier using MOSFETs
3	To design cascode amplifier
4	To design basic current sink
5	To design current sink by using negative feedback resistor
6	To design cascode current sink.
7	To design of positive feedback boot strap current sink
8	To design of regulated cascode current sink
9	To design of simple current mirror
10	To design Wilson current mirror

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:

Textbooks:

1. B. Razavi, "*Design of Analog CMOS Integrated Circuits*", Tata McGraw Hill, 2nd Edition, 2017.
2. R. Jacob Baker, Harry W. Li, David E. Boyce, "*CMOS Circuit Design, Layout, and Stimulation*", Wiley, 3rd Edition, 2010.
3. P. E. Allen and D. R. Holberg, "*CMOS Analog Circuit Design*", Oxford University Press, 3rd Edition, 2012.

Reference Books:

1. Mohammed Ismail and Terri Faiz, "*Analog VLSI Signal and Information Process"*, McGraw-Hill Book company,1994.
2. John P. Uyemura,"*CMOS Logic Circuit Design* ", Springer US, 2001.
3. Gray, Meyer, Lewis, Hurst, "*Analysis and design of Analog Integrated Circuits*", Willey, 6th Edition, 2024.

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Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course: Industrial Automation Laboratory	Course Code: DJS22EL704	

Pre-requisite:

1. Basic Electrical and Electronics (DJ19FEC105)
2. Digital System Design (DJS22EC303) (DJS23ECPC303)
3. Control Systems (DJ19ECEC5011) (DJS22EC6012)
4. Microprocessor and Microcontroller (DJ19ECC501)

Objectives:

1. To learn Industrial automation and various systems.
2. To learn Industrial automation techniques.
3. To identify the differences between PLCs, SCADA, DCS.
4. To provide the skills to install and trouble shoot Automation systems.
5. To provide working experience in various programming techniques.

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

1. Identify different components of an automation system.
2. Interface the given I/O device with appropriate PLC module.
3. Prepare PLC ladder program for the given application
4. Prepare a simple SCADA application.
5. Use Internet of Things for industrial automation

Industrial Automation- Laboratory (DJS22EL704)		
Unit	**Description**	**Duration**
1	**Introduction:** Need and benefits of Industrial Automation, Basic components of automation system, Types of automation, Fixed, Programmable, Flexible, Different systems used for Automation i.e. PLC, HMI, SCADA, DCS, Drives.	**08**
2	**Programmable Logic Controller (PLC):** Introduction, Block diagram, memory organization, IO modules (discrete and Analog), I/O modules selection criteria, Fixed and Modular PLC, PLC selection, PLC Installation, Advantage, Application.	**10**
3	**PLC Programming:** I/O addressing, Programming instructions (Relay, Timer, Counter, Delay, Logical, Data Handling, Comparison), Functional Block Diagram (FBD), Ladder Programming.	**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 object, 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.	**06**
	Total	**40**

Industrial Automation- Laboratory (DJS22EL704)	
Exp.	**Suggested Experiments List**
1	Develop/Execute ladder diagram using timer, counter, logical and arithmetic instructions.
2	Use PLC to control the devices, lamp, motor switches, sensors.
3	Measure Temperature of the given liquid using RTD or Thermocouple and PLC.
4	Design ladder diagram for Blink LEDs.
5	Design ladder diagram for sequential control of DC motor.
6	Develop and test ladder program for pulse counting using switch/ proximity sensor.
7	Use various functions of SCADA simulation editors to develop simple project.
8	Develop SCADA mimic diagram for water tank level control.
9	Industrial PC based control system.
10	Identify various automation systems available in different appliances/devices/machines in day-to-day use.
11	Identify various parts and front panel status indications of the given PLC.

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:

Textbooks:

1. Petruzella F. D, "*Programmable Logic Controller*", Tata McgGaw Hill, 4th Edition, 2021.
2. Mitra Madhuchandra, Sengupta, "*Programmable logic controller and industrial automation*", Penram International publication, 5th Edition, 2008.

3. Bhoyar S A, "*Supervisory control & Data acquisition*", ISA publication, 4th Edition, 2016.

Reference Books:

1. S.K. Singh, "*Industrial Instrumentation and Control*", 2nd Edition, Tata McGraw Hill, 2021.
2. Richard L. Shell, "*Handbook of Industrial Automation*", 1st Edition, CRC Press, 2000.
3. Bailey, David, "*Practical SCADA for Industry*", 1st Edition, Newness international publication, 2003.
4. Stenerson John, "*Industrial Automation & Process Control*", 1st Edition, Pearson publication, 2002.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VII
Course: Project Stage I	Course Code: DJS22ECP701	

Objectives:

1. Demonstrate the skills and knowledge students have acquired through their coursework
2. Help students gain confidence and experience working in a group on a project
3. Prepare students for the job market after graduation
4. Help students develop intellectual qualities like creative thinking, analytical abilities, teamwork, and communication skills
5. Help students discover their areas of interest

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

1. Apply the technical knowledge gained from previous courses, identify problems and design solutions to solve real-life problems.
2. Apply project management skills (scheduling work, procuring parts, documenting technical and non-technical details and working within the confined deadline).
3. Create technical reports, research articles and present the same to the evaluation authorities.

Project Stage I (DJS22ECP701)

In final year group of maximum three students will be completing a comprehensive project work based on the courses studied. The project work may be internally assigned or may be externally assigned by the research institutes, industry etc. Each group will be assigned one faculty as a supervisor. This project work in final year may be extension of the Innovative Product Development (DJ STRIKE) Project work done in pre-final year.

The main intention of Project work is to enable students to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem. The Project work may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be

- Learning additional skills
- Development of ability to define, design, analysis and implementation of the problem and lead to its accomplishment with proper planning
- Learn the behavioural science by working in a group
- The project area may be selected in which the student intends to do further education and/or may be either intend to have employment or self-employment
- The topic of project should be different and / or may be advancement in the same topic of Innovative Product Development (DJ STRIKE) project

The students may use this opportunity to learn different computational techniques as well as some model development. This they can achieve by making proper selection of Project work.

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