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**

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

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 VIII																
1	DJS22EC801	Optical Communication	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL801	Optical Communication Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
2	DJS22EC802	Wireless Network	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL802	Wireless Network Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
3	DJS22EC8011	5G Technology	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL8011	5G Technology Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC8012	Computer Vision	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL8012	Computer Vision Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC8013	Satellite Communication	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL8013	Satellite Communication Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC8014	Internet Engineering & Network Security	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL8014	Internet Engineering & Network Security Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC8015	Machine Learning for Signal Processing	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL8015	Machine Learning for Signal Processing Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC8016	Advanced Digital Signal Processing	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL8016	Advanced Digital Signal Processing Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC8017	Microwave Amplifier & Oscillator Design	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL8017	Microwave Amplifier & Oscillator Design Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
4	DJS22ILO8021	Project Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8022	Entrepreneurship Development and Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8023	Corporate Social Responsibility	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8024	Human Resource Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8025	Corporate Finance Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8026	Logistics and Supply Chain Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8027	IPR and Patenting	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8028	Digital Marketing Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8029	Environmental Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3

	DJS22ILO8030	Labor and Corporate Law	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8021	Project Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8022	Entrepreneurship Development and Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8023	Corporate Social Responsibility	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8024	Human Resource Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3
	DJS22ILO8025	Corporate Finance Management	3	--	-	3	35	--	35	65	--	--	--	65	100	3
5	DJS22ECP801	Project Stage – II	-	10	-	5	-	100	100	-	-	-	100	100	200	5
		Total	**12**	**16**	**0**	**20**	**140**	**175**	**315**	**260**	**175**	**0**	**0**	**435**	**750**	**20**

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.

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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.

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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 Saloman, "*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.

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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.

Prepared by Checked by Head of the Department Principal

DJS-22

Syllabus

Semester VIII

ACADEMIC YEAR: 2025-26

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VIII
Course: Optical Communication	Course Code: DJS22EC801	
Course: Optical Communication Laboratory	Course Code: DJS22EL801	

Pre-requisite:

1. Applied Physics (DJS22FECEP)
2. Electromagnetic Wave Propagation (DJS22EC403)
3. Analog Communication (DJS22EC501)

Objectives:

1. To understand and analyze Optical fiber structures wave guide, fabrication and signal degradation in fiber.
2. To understand and analyze the characteristics of optical sources and detectors.
3. To design optimal optical links by using Link budget and rise time budget and understand basic concepts of optical networks.

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

1. Explain different signed number representation and signed binary arithmetic.
2. Minimize logic expressions using various reduction techniques.
3. Design combinational logic circuits using logic gates and implement the circuit by carrying out required investigations and debugging techniques.
4. Design flip-flops using logic gates and use them to realize different sequential circuits and implement the circuit by carrying out required investigations and debugging techniques.
5. Classify different programmable logic devices and design combinational circuits using PLD.

Optical Communication (DJS22EC801)		
Unit	**Description**	**Duration**
1	**Optical Fiber Fundamentals:** Motivations for light wave communications, General Optical system block diagram, advantages, disadvantages and applications of optical fiber communication, Loss and bandwidth window optical fiber waveguides, Ray theory, Electromagnetic waves, Modes in a planar waveguide, Phase and group velocity, Types and classification of optical fibers.	**08**
2	**Transmission Characteristics of Optical Fiber:** Attenuation, absorption, linear and nonlinear scattering losses, bending losses, dispersion, Chromatic dispersion, Intermodal dispersion, over all dispersion in single mode and multimode fibers, dispersion shifted and dispersion flattened fibers, OTDR. Non-linear effects, scattering effects, Kerr effects, soliton.	**10**

3	**Optical Sources and Detectors:** Working principle and characteristics of sources (LED, LASER), Tunable lasers, Quantum well lasers, Charge capture in Quantum well lasers, Multi Quantum well Laser diodes, Surface Emitting Lasers: Vertical cavity Surface Emitting Lasers. Working principle and characteristics of detectors (PIN, APD), Material requirement for RCEPD, Resonant cavity enhancement (RCE) Photo Detector, receiver structure, bit error rate of optical receivers and receiver performance.	**08**
4	**Optical Communication Components:** Fiber joints, fiber connectors, splices Couplers, Isolators, multiplexers, filters, fiber gratings, Fabry Perot filters, switches and wavelength converters, Optical amplifiers, basic applications and types (EDFA and SOA).	**06**
5	**Optical Networks and Free Space:** Optics Point-to-Point Links, System Considerations, Link Power Budget, Rise time budget, SONET/SDH optical networks, WDM and DWDM optical networks. Introduction to FSO, Applications, Comparison with microwave systems, coherent optical space communication, Drawback and problems of realization, system description and design.	**08**
	Total	**40**

Optical Communication Laboratory (DJS22EL801)	
Exp.	**Suggested Experiment List**
1	Calculation of Numerical aperture
2	Calculation of dispersion for given fiber
3	Calculation of link Loss for given link
4	Performance analysis of Single mode fiber.
5	Analog communication link.
6	Digital communication link.
7	Performance Analysis of Optical Link with Different Sources
8	Performance Analysis of Optical Link with Different Detectors
9	Performance Analysis of Optical Amplifier
10	Calculation of link Loss for given link with nonlinearities.
11	Experiments using MATLAB.
12	Calculation of bit error rate.

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. John M. Senior, "*Optical Fiber Communications*", Pearson Education, 3rd Edition, 1998.
2. Gerd Keiser, "*Optical Fiber Communication*", Tata McGraw Hill,4th Edition, 2003.
3. JH Franz, VK Jain, Optical Communications Components and systems, Narosa, 2nd Edition, 2013.

Reference Books:

1. Harold Kolimbiris, "*Fiber optics communications*", Pearson Education, 3rd Edition, 2007.
2. Rajiv Ramaswami and Kumar N. Sivarajan, "*Optical Networks: A Practical Perspective*", Elsevier India Pvt. Ltd, 3rd Edition, 2009.
3. Ghatak and K.Thyagrajan, "*An introduction to fiber optics*", Cambridge Univ Press. 4. Joseph C Palais, Fiber Optic Communication, 4th Edition, Pearson Education, 2010.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VIII
Course: Wireless Network	Course Code: DJS22EC802	
Course: Wireless Network Laboratory	Course Code: DJS22EL802	

Pre-requisite:

1. Analog Communication (DJS22EC501)
2. Digital Communication (DJS22EC601)
3. Computer Networks (DJS22EC603)
4. Mobile Communication (DJS22EC702)

Objectives:

1. To understand architecture concept of wireless transmission and spectrum requirement.
2. To understand the concepts of WPAN, WLAN and WSN.
3. To understand type 1 and type 2 applications of WSN.

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

1. Differentiate wireless network standards and frequency bands used for various wireless technologies.
2. Compare various personal area networks and understand their applications.
3. Compare IEEE 802.11 standards and understand their features.
4. Identify category 1 and category 2 applications of WSN and the required middleware.

Wireless Network (DJS22EC802)		
Unit	**Description**	**Duration**
1	**Basics of Wireless Networks:** Introduction to Wireless Network, Classifications of wireless networks, Wireless Standards, Spectrum requirement for various wireless systems.	**04**
2	**Wireless Personal Area Networks:** WPAN: Bluetooth (802.15.1): Radio Specifications, Protocol Stack, Link Types, Security, Topologies, Zigbee (802.15.4): Radio Specifications, Components, Topologies, Protocol Stack, Applications. RFID: Radio Specifications, Architecture & Types, Near Field Communication & UWB (802.15.3 a): Introduction and working.	**10**
3	**Wireless Local Area Network and Wireless Metropolitan and Wide Area Networks:** Introduction and features of IEEE802.11a, b, I, g and n Equipment, Topologies, Technologies, Applications, IEEE802.11 WLAN Joining an existing Basic Service Set, Security and Power Management, Radio Link and Coverage Planning for IEEE 802.11 WLAN. **Case Study:** Campus Wi-Fi installation.	**08**
4	**Wireless Sensor Network:** Background of sensor network technology, sensor network architectural elements, historical survey of sensor networks, Technologies for wireless sensor network, sensor node technology, hardware and software, sensor taxonomy, operating environment, wireless network trends, transmission technology	**08**

5	**Applications of Wireless Sensor Network:** Applications of wireless sensor network, range of applications, examples of category 1 and 2. **Case Study:** Any one application of sensor network Wireless Body Area Network: Properties, Network Architecture, Network Components, Applications.	**06**
6	**Middleware for Wireless Sensor Networks:** Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware	**04**
	Total	**40**

Course: Wireless Network Laboratory (DJS22EL802)	
Exp.	**Suggested Experiment List**
1	Tutorial based on introduction to Wireless Networks.
2	Study, discussion and installation of network simulation tool such as NS2/ NS3.
3	To design a Wireless nodes using TCL Script/ Packet tracer/ Contiki Cooja.
4	To create energy nodes and observe energy dissipation using TCL Script/ Packet tracer/ Contiki Cooja.
5	To deploy sensor nodes with reference to their communication range using NS2/NS3.
6	Analysis of Wi-Fi network.
7	Implementation of data transfer using Bluetooth.
8	Implementation of data transfer using Zigbee.
9	Implementation of data transfer using RFID.
10	Case study home automation system using IoT.

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. Vijay K. Garg, "*Wireless Communication and Networking"*, Morgan, Kaufmann Series in Networking, Elsevier, 1st Edition, 2007.
2. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "*Wireless Sensor Networks: Technology, Protocols, and Applications"*, John Wiley &Sons, 1st Edition, 2007.
3. Sunil Kumar, S. Manvi, and Mahabaleshwar S. Kakkasageri, "*Wireless and Mobile Networks Concepts and Protocol",* Wiley Publication, *2nd* Edition, 2010.
4. Raj Kamal, "*Internet of Things Architecture & Design Principles"*, McGraw Hill, 4th Edition, 2017.

Reference Books:

1. Upena Dalal, "*Wireless and Mobile Communications*", Oxford University Press, 1st Edition, 2015.
2. Theodore S. Rappaport, "*Wireless communications principles and practice*", 2nd Edition, Pearson Publication, 2010.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VIII
Course: 5G Technology	Course Code: DJS22EC8011	
Course: 5G Technology Laboratory	Course Code: DJS22EL8011	

Pre-requisite:

1. Analog Communication (DJS22EC501)
2. Digital Communication (DJS22EC601)
3. Computer Networks (DJS22EC603)
4. Mobile Communication (DJS22EC702)

Objectives:

1. To learn the Basics of 5G and Beyond Wireless communication.
2. To provide basic understanding of the key technologies and modulation techniques of 5G.
3. To study architecture of 5G.
4. To develop the concepts of spectrum requirements, MIMO, antennas for 5G.

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

1. Understand the basics of 5G and beyond communication.
2. Characterize and analyze various modulation and multiplexing techniques used in 5G.
3. Elaborate system architecture of 5G technology.
4. Illustrate spectrum requirement, antenna design and radio propagation for 5G technology.
5. Design security architecture of 5G.

5G Technology (DJS22EC8011)		
Unit	**Description**	**Duration**
1	**Basics of Wireless Networks:** Introduction – Historical trend of wireless communication – Evolution of LTE Technology to Beyond 4G.Internet of Things and context – Awareness – Network Reconfiguration and Virtualization support – Mobility – quality of Service Control – Emerging approach for resource over provisioning the 5G radio-access technologies-OFDMA, NOMA, SCMA, IDMA.	**08**
2	**Architecture of the Core Network:** The Evolved Packet Core - Release 8 Architecture. Control and User Plane Separation The 5G Core Network- Representation Using Reference Points, Representation Using Service-based Interfaces, Data Transport, Roaming Architectures, Data Storage Architectures, Non-3GPP Access to the 5G Core. Network Areas, Slices and Identities-Signalling Protocol	**08**
3	**Architecture of the Radio Access Network:** The Evolved UMTS Terrestrial Radio Access Network – 3GPP Architecture, Carrier Aggregation, Dual Connectivity the Next-generation Node B - High Level Architecture, Internal Architecture, and Deployment Options. Network	**08**

	Areas and Identities - Tracking Areas, RAN Areas, Cell Identities. Signaling Protocols - Signaling Protocol Architecture, Signaling Radio Bearers	
4	**MIMO systems and Communication Devices:** Introduction, MIMO in LTE, Theoretical background, Single user MIMO, Multi-user MIMO, Capacity of massive MIMO: a summary, Fundamentals of baseband and RF implementations in massive MIMO. Device To Device D2D Communication – D2D: from 4G to 5G – Radio resource management for mobile brand D2D	**08**
5	**Spectrum, Antennas and Radio Propagation:** Spectrum - Spectrum landscape and requirements, Spectrum Allocations for 5G, Bandwidth requirements, Spectrum access modes and sharing scenarios, Spectrum technologies- Spectrum toolbox, Main technology component. Antennas - Antennas and Propagation, Antenna Gain Radio Propagation - Radio Propagation Issues for Millimetre Waves, Diffraction and Reflection, 08 Penetration Losses, Foliage Losses, Atmospheric Losses, Multipath, Fading and Coherence.	**08**
	Total	**40**

Wireless Network Laboratory (DJS22EL8011)	
Exp.	**Suggested Experiment List**
1	To find Antenna diversity in 5G
2	SU Massive MIMO
3	Spatial Diversity, Spatial Multiplexing
4	Simulate 5G New Radio PHY in MATLAB
5	Write program in MATLAB for 5G New Radio Polar Coding
6	Write program in MATLAB for LDPC Processing for DL-SCH and UL-SCH
7	Write program in MATLAB for Transmission over MIMO Channel Model with Delay Profile TDL
8	NR Intercell Interference Modelling
9	Simulate 5G New Radio PHY in MATLAB
10	Channel Estimation

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. Christopher Cox, Chris Cox, "*An Introduction to 5G: The New Radio, 5G Network and Beyond*", John Wiley & Sons Ltd,1st Ednition,2020.
2. Afif Osseiran, Jose F. Monserrat, Patrick Marsch, "*5G Mobile and Wireless Communications Technology"*, Cambridge University Press,1st Edition,2016.

Reference Books:

1. Raj Kamal, "*Internet of Things Architecture and Design Principles*", McGraw Hill Education private Limited, 2017.
2. Jonathan Rodriguez, "*Fundamentals of 5G Mobile Networks"*, Wiley publication, 2015.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VIII
Course: Computer Vision	Course Code: DJS22EC8012	
Course: Computer Vision	Course Code: DJS22EL8012	

Pre-requisite:

1. Fundamentals of Digital Image Processing (DJS22EC604)

Objectives:

1. Review of image acquisition, enhancement, filtering, and transformations in spatial and frequency domains.
2. Develop an understanding of feature extraction methods (e.g., edges, corners, SIFT, HOG) and their applications in image analysis and pattern recognition.
3. Learn algorithms for object detection, segmentation, and classification using traditional methods and machine learning approaches.
4. Understand 3D reconstruction, stereo vision, and depth estimation techniques used for scene understanding.
5. Explore methods for motion detection, tracking, and optical flow estimation in videos and dynamic environments.

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

1. Explain the principles of image preprocessing, feature extraction, and object recognition Techniques.
2. Extract and utilize advanced features (e.g., SIFT, SURF, or learned embedding) for specific tasks like tissue differentiation in medical images or lane detection in autonomous driving.
3. Understand 3D reconstruction, stereo vision, and depth estimation techniques used for scene understanding.
4. Develop solutions for tracking moving objects using motion analysis techniques like optical flow.

Computer Vision (DJS22EC8012)		
Unit	**Description**	**Duration**
1	**Fundamentals of Image Formation, Transformation:** Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Histogram Processing.	**06**
2	**Feature Extraction and Matching:** Canny edge detector, Harris corner detector. Hessian, LOG, DOG, HOG, Line detectors (Hough Transform) **Descriptors and Key points**: SIFT, SURF.	**10**
3	**Camera Calibration, Depth from Stereo:** Use stereo image pairs to estimate depth using disparity maps. **3D Reconstruction:** Reconstruct a 3D scene from multiple 2D images using Structure from Motion (SfM)	**06**
4	**Introduction to Machine Learning for Image Classification**: Object Detection, Semantic Segmentation. Convolutional Neural Networks (CNNs)	**10**

	Build and train a simple CNN for image classification using frameworks like TensorFlow or PyTorch. Object Segmentation with Deep Learning Implement semantic segmentation using UNet or Mask R-CNN. **Transfer Learning:** Fine-tune a pre-trained model (e.g., ResNet or MobileNet) for a custom dataset.	
5	**Optical Flow** Horn and Shunck method: algorithm using discrete formulation, steps of Jacobi's method for matrix inversion, Lucas-Kanade algorithm for optical flow, Comparison of Horn-Shunck and Lucas-Kanade algorithms. Applications of optical flow.	**08**
	Total	**40**

Computer Vision Laboratory (DJS22EL8012)	
Exp.	**Suggested Experiment List**
1	Apply spatial filters (e.g., Gaussian, Median, and Laplacian filters) for smoothing and edge enhancement.
2	Apply corner detection algorithms (e.g., Harris Corner Detection) to find interest points in images.
3	Extract keypoints using SIFT, SURF, or ORB.
4	Perform global, adaptive, and Otsu thresholding on sample images. or Implement region growing or Watershed algorithm for image segmentation.
5	Implement HOG with SVM for any classification problem
6	Experiment with YOLO or SSD for real-time object detection.
7	Optical Flow: Implement optical flow methods (e.g., Lucas-Kanade or Farneback) to detect motion in video sequences.
8	Apply object tracking algorithms such as Mean-shift, Camshift, or KLT tracker.
9	Use stereo image pairs to estimate depth using disparity maps.
10	Build and train a simple CNN for image classification using frameworks like TensorFlow or PyTorch.
11	Segment medical images (e.g., X-rays or MRIs) to detect abnormalities like tumors or lesions.
12	Implement semantic segmentation using UNet or Mask R-CNN.

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. Richard Szeliski, "*Computer Vision: Algorithms and Applications"*, Springer, 2nd Edition, 2022.

2. Rafael C. Gonzalez and Richard E. Woods, "*Digital Image Processing"*, 4th Edition Pearson, 2021.
3. David A. Forsyth and Jean Ponce, "*Computer Vision – A Modern Approach"*, PHI Learning, 2nd Edition, 2009.

Reference Books:

1. Gary Bradski and Adrian Kaehler, "*Learning OpenCV"*, O'Reilly Media, 2nd Edition, Inc,2008.
2. Adrian Rosebrock, "*Deep Learning for Computer Vision with Python"*, 1st Edition, 2017.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VIII
Course: Satellite Communication	Course Code: DJS22EC8013	
Course: Satellite Communication- Laboratory	Course Code: DJS22EL8013	

Pre-requisite:

1. Electromagnetic Wave Propagation (DJS22EC403)
2. Analog Communication (DJS22EC501)
3. Digital Communication (DJS22EC601)

Objectives:

1. To understand the basics of satellite communications and different satellite communication orbits.
2. Provide an in-depth understanding of satellite communication system operation, launching techniques, satellite link design and earth station technology.
3. To explain the tools necessary for the calculation of basic parameters in a satellite communication system.
4. Review the state of the art in new research areas such as satellite networking, satellite personal communications, mobile satellite communication, Laser satellite

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

1. Explain basics of satellite communication, space segment and earth segment.
2. Understand different satellite orbits and orbital parameters.
3. Design and analyze link budget of satellite signal for proper communication.
4. Understand various applications of satellite communications.

Satellite Communication (DJS22EC8013)		
Unit	**Description**	**Duration**
1	**Overview of Satellite Systems, Orbits and Launching:** Frequency allocation for satellite communication, Polar orbiting satellites, Kepler's Laws, orbital parameters, orbital perturbations, effects of a non-spherical earth, atmospheric drag. Wave Propagation & Polarization, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Antenna Polarization, Polarization of Satellite signals. Sub-satellite Point, predicting satellite position, antenna look angels, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage. Selection of launching site, launch window, launch vehicles; satellite launch vehicle (SLV), augmented satellite launch vehicle (ASLV), polar SLV, geostationary satellite launch vehicle (GSLV).	**08**
2	**Space Segment:** Satellite subsystems: Transponder sub-system, Antenna subsystem, AOC Sub-system, TT&C Sub-system, power sub-system, Thermal sub-system, reliability and quality Assurance. Satellite stabilization, stabilization techniques.	**08**

3	**Earth station:** Design consideration, General configuration- Block diagram, receive only type earth, transmit-receive type earth station, Antenna system, Feed system, Tracking system, LNA, HPA.	**06**
4	**Satellite Link:** Isotropic radiated power, transmission losses, free-space transmission, feeder losses, antenna misalignment losses, fixed atmospheric and ionosphere losses, link power budget, System noise, antenna noise, amplifier noise temperature, amplifiers in cascade, noise factor, noise temperature of absorptive networks, overall system noise temperature, carrier to noise ratio, Uplink: Saturation flux density, input back off, earth station HPA, Downlink: Output back off, satellite TWTA output, Effects of rain, uplink rain-fade margin, downlink rain-fade margin, combined uplink and downlink C/N ratio, inter-modulation noise	**10**
5	**The Space Segment Access and Utilization:** Space segment access methods, pre-assigned FDMA, demand assigned FDMA, SPADE system, Code Division Multiple Access: Direct-sequence spread spectrum– acquisition and tracking, TDMA: Reference Burst; Preamble and Postamble, carrier recovery, frame efficiency, channel capacity, preassigned TDMA, demand assigned TDMA, Satellite Applications : VSAT systems: Advantages, configurations, frequency bands, Television broadcast systems, DAB , Laser Satellite Communication: Link analysis, optical satellite link transmitter, optical satellite link receiver, satellite beam acquisition, tracking & positioning, deep space optical communication link.	**08**
	Total	**40**

Industrial Automation- Laboratory (DJS22EL704)	
Exp.	**Suggested Experiments List**
1	To study Active and Passive satellite.
2	To study transmission and reception of 1 KHz tone signal through satellite link.
3	To study transmission of video and audio signal over satellite link.
4	To design link budget for satellite system.
5	To find look angles and limits of visibility for the satellite.
6	To design satellite antennas and measure the gain of the antennas.
7	To find satellite system temperature and measure the light intensity for solar panel.
8	To find the power and efficiency of the solar panel used in satellite.
9	To find the time delay for transmission and reception of satellite data between earth
10	To study effect of multipath fading, path loss and propagation delay on satellite signal.

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. Dennis Roddy, "*Satellite Communications*", Mc. Graw-Hill International, 4th Edition, 2009.
2. M. Richharia, "*Satellite Communication Systems Design Principles*", Macmillan Press Ltd, 2nd Edition, 2003.
3. R. N. Mutangi, "*Satellite Communication*", Oxford university press, 1st Edition, 2016.
4. Gerard Maral and Michel Bousquet, "*Satellite Communication Systems*", Wiley Publication, 4th Edition, 2018.

Reference Books:

1. Gerard Maral, "*VSAT Networks*", John Willy & Sons, 2nd Edition, 2004.
2. Timothy Pratt, Charles Bostian, and Jeremy Allmuti," *Satellite Communications*", John Willy & Sons (Asia) Pvt. Ltd, 2nd Edition, 2017
3. Wilbur L. Pritchard, Henri G. Suyderehoud, and Robert A. Nelson, "*Satellite Communication Systems Engineering*", Pearson Publication, 2nd Edition, 2007.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VIII
Course: Internet Engineering & Network Security	Course Code: DJS22EC8014	
Course: Internet Engineering & Network Security Laboratory	Course Code: DJS22EL8014	

Pre-requisite:

1. Computer Networks (DJS22EC603)

Objectives:

1. To understand Internet protocol, standards, services and administration.
2. To discuss voice over IP as a real-time interactive audio/video service.
3. To introduce various techniques to implement security mechanisms for network and cyber security.
4. To discuss security implications on Organizations with the help of Risk Management and Incident preparation.

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

1. Configure various application layer protocols.
2. Analyze services of network layer provided by advanced protocols.
3. Compare and analyze various audio and video digitization and compression mechanism and explain voice over IP in the context of real-time interactive audio/video service.
4. Understand network security fundamentals, analyze IP security mechanisms (IPsec), and evaluate web security protocols to ensure secure data transmission.
5. Understand firewall systems, intrusion detection, biometric security, and operational security centres, while understanding security solutions for modern networks, including cloud, Wi-Fi, and mobile environments."

Internet Engineering & Network Security (DJS22EC8014)		
Unit	**Description**	**Duration**
1	**Introduction to Application layer protocols:** What is the Internet, ,Evolution of the Internet, Review of TCP/IP layer functions, Application Layer protocols: HTTP, DHCP, DNS, FTP, TFTP, SMTP, MIME, IMAP, POP3, TELNET, SSH.	**08**
2	**Network Layer:** IPv6, Packet format, Transition from IPv4 to IPv6, ICMP(v4 and v6) Review of IP addresses, Special addresses, NAT, CIDR: Address aggregation	**04**
3	**Multimedia Communication:** Digitizing audio and video, Audio Compression, video compression, streaming stored audio / video Characteristics of real time interactive audio/video, RTP, RTP Packet format, UDP Port, RTCP,RTCP messages VOIP:SIP,H.323, Flow characteristics, Flow classes, techniques to improve QoS, Resource reservation, admission control.	**08**
4	**Security in Networks:** Introduction to Information Security, Network Security Domains, Attacks and their classification, Security services and	**10**

	mechanisms Network security basics, Overview of IP Security (IPsec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange, Web Security Requirements, Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Electronic Transaction (SET).	
5	**Firewalls and IDS:** Designing and Configuring Firewall Systems, Firewall Components, Firewalls – Types, Comparison of Firewall Types, Firewall Configurations, Installing and Configuring FW, Proxy Server ,Honey pot, Digital Immune System.	**05**
6	**System security and case study:** Signature verification, Finger print recognition, Voice recognition, Iris Recognition system, Security Operations Centre (SOC), Network Operations Centre (NOC), Network Security Audit, Cloud Security, Wi-Fi Security, Mobile and Cellular Security.	**05**
	Total	**40**

Internet Engineering & Network Security Laboratory (DJS22EL8014)	
Exp.	**Suggested Experiment List**
1	Configure DNS Server using open source tool.
2	Configure DHCP Server using open source tool.
3	Configure services of TFTP server using Cisco Packet tracer.
4	Configuration of VOIP using Cisco packet tracer.
5	Configure Vlan and VOIP across networks
6	Explore and analyze network vulnerabilities using open source tools.
7	Deploy and monitor an Intrusion Detection System.
8	1. Download and install Wireshark and capture ICMP, TCP, and http packets in promiscuous mode. 2. Explore how the packets can be traced based on different filters.
9	Detect ARP spoofing using nmap and/or open source tool ARPWATCH and Wireshark. Use Arping tool to generate gratuitous arps and monitor using Wireshark.
10	Configure and analyze the behavior of different types of firewalls.

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. B. Forouzan, "*TCP/IP Protocol Suite"*, McGraw Hill Publication, 4th Edition, 2009.

2. B. Forouzan, "*Cryptography and Network Security"*, McGraw Hill Publications, 2nd Edition ,2010.

3. Nina Godbole, "*Cyber Security",* John Wiley Publications, 1st Edition 2011.

Reference Books:

1. Leon Garcia, "*Communication Networks"*, McGraw-Hill Publication, 2nd Edition, 2004.
2. Kurose and Ross, "*Computer Networking",* Pearson Publication, 5th Edition, 2012.
3. Pfleeger and Pfleeger, "*Security in Computing"*, Pearson Publications, 5th Edition, 2011.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech.	Semester: VIII
Course: Machine Learning for Signal Processing	Course Code: DJS22EC8015	
Course: Machine Learning for Signal Processing Laboratory	Course Code: DJS22EL8015	

Pre-requisite:

1. Engineering Mathematics - IV (DJS22EC401).
2. Digital Signal Processing (DJS22EC504)

Objectives:

1. Introduce students to the fundamentals of machine learning (ML) techniques useful for various signal processing applications.
2. To discuss various mathematical methods and algorithms involved in ML for Signal Processing.

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

1. Recall key concepts in linear algebra, probability theory and fundamentals relevant to machine learning for Signal Processing
2. Understand the theoretical foundations of linear, non-linear models, and the principles behind probabilistic and advanced Signal Processing models.
3. Apply various machine learning and Signal Processing algorithms and techniques, in problem solving.
4. Analyze the performance and suitability of different learning techniques for specific tasks such as time series analysis, speech recognition, and image processing.

Machine Learning for Signal Processing (DJS22EC8015)		
Unit	**Description**	**Duration**
1	**Linear Algebra:** Vectors, Matrices and Tensors, Linear Dependence and Span, Norms, Eigen decomposition, Singular Value Decomposition. **Probability Theory:** The Chain Rule of Conditional Probabilities, Independence and Conditional Independence, Expectation, Variance and Covariance, Bayes' Rule.	**05**
2	**Linear Models for Regression:** Polynomial Curve fitting, Maximum likelihood and least squares, Geometry of least squares, Sequential learning, Regularized least squares, Multiple outputs.	**05**
3	**Linear Models for Classification:** Two class Classification, Multiclass Classification, Least Squares for Classification, Problems with Least Squares Loss, Perceptron Algorithm.	**06**
4	**Non-Linear Models-Neural Networks:** Non-Linear Regression, Parameter Optimization, Gradient descent Optimization, Evaluation of error-function derivatives, A simple example, Efficiency of backpropagation. **Regularization for Neural Networks:** Data set Augmentation, Early Stopping, Bagging, Dropout.	**08**

5	**Probabilistic models and Expectation Maximization Algorithm:** k- means clustering, Gaussian Mixture Model, Maximum likelihood for Gaussian Mixtures, EM for Gaussian Mixtures.	**08**
6	**Machine Learning for Audio Classification:** Time Series Analysis, LSTMs and CNNs. **Machine Learning for Speech Recognition:** Hidden Markov Models, Finite State Transducers and Dynamic Programming. **Machine Learning for Image Processing:** Transfer Learning, Attention models, Attribute-based learning.	**08**
	Total	**40**

Machine Learning for Signal Processing Laboratory (DJS22EL8015)	
Exp.	**Suggested Experiment List**
1	To Implement Correlation and Covariance Of Given Dataset.
2	Image Compression and Reconstruction by SVD Decomposition
3	To Implement Principal Component Analysis In Python
4	Polynomial Regression: To generate a dataset and fit a Polynomial through it.
5	Reducing Overfitting by Ridge and Lasso Regression of A Given Data.
6	Backpropagation Implementation in Simple Neural Network with one hidden layer.
7	Implementation of Dropout Using Convolutional Neural Network
8	Implementation Of Data Augmentation In Python.
9	Perform Image Segmentation with Gaussian Mixture Model.
10	Implementation of Speech Recognition by Dynamic Programming.
11	Audio Noise Classification from Urban Sound database using Time Series Analysis and CNNs and compare their performance
12	Implementation of processing audio data in Python - Mel Spectrograms and how to generate them.

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. Christopher M. Bishop, *"Pattern Recognition and Machine Learning",* Springer, 1st Edition, 2006.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, *"Deep Learning",* The MIT Press, 1st Edition, 2006.

Reference Books:

1. Christopher M. Bishop, *Neural Networks for Pattern Recognition,* Clarendon Press, Oxford, 1995.
2. Tom M. Mitchell, *Machine Learning,* McGraw-Hill, 1st Edition, 1997.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VIII
Course: Advanced Digital Signal Processing	Course Code: DJS22EC8016	
Course: Advanced Digital Signal Processing Laboratory	Course Code: DJS22EL8016	

Pre-requisite:

1. Engineering Mathematics – III (DJS22EC301 & DJS22EL301)
2. Engineering Mathematics – IV (DJS22EC401 & DJS22EL401)
3. Signals & Systems (DJS22EC304 & DJS22EL304)
4. Digital Signal Processing (DJS22EC504 & DJS22EL504)

Objectives:

1. To understand the effect of hardware limitations on performance of digital filters.
2. To understand the concept of multirate signal processing.
3. To understand linear prediction and optimum linear filtering.
4. To understand Adaptive Filtering and Wavelet.

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

1. Analyze the effect of hardware limitations on performance of digital filters.
2. Implement multistage sampling rate conversion.
3. Analyze linear prediction methods and optimum linear filters.
4. Implement adaptive filters for given applications.
5. Analyze wavelet theory for various applications.

Advanced Digital Signal Processing (DJS22EC8016)		
Unit	**Description**	**Duration**
1	**System realization forms:** Direct form I, Direct form II, Cascade form and Parallel form realization, Frequency sampling realization, Lattice realization for FIR & IIR filters and Lattice-ladder realization structure.	**06**
2	**Multirate DSP and Filter Banks:** Introduction and concept of Multirate Processing, Block Diagram of Decimator and Interpolator, Decimation and Interpolation by Integer Numbers, Multistage Approach to Sampling rate converters, Sample rate conversion using Polyphase filter structure, Type I and Type II Polyphase Decomposition.	**08**
3	**Linear Prediction and Optimum Linear Filters**: Representation of Stationary Random Process, Forward and Backward Linear Prediction, Solution of Normal Equation (Levinson-Durbin and Schur Algorithm), AR Lattice and ARMA Lattice Ladder Filters, Weiner Filters for Filtering and Prediction, Discrete Kalman Filter.	**09**
4	**Adaptive Filters:** Applications of Adaptive Filters: System Identification, Adaptive Channel Equalization, Echo Cancellation, Adaptive Noise Cancellation, Suppression of Narrowband Interference in Wideband Signals, Adaptive Arrays, Adaptive Algorithms: LMS Algorithm, RLS Algorithm, Lattice-ladder Algorithm.	**09**

5	**Wavelet Transform:** Introduction to Time Frequency Analysis, Short Time Fourier Transform, Continuous Wavelet Transform, Discrete Wavelet Transform, Multiresolution Analysis, Application.	**08**
	Total	**40**

Advanced Digital Signal Processing Laboratory (DJS22EL8016)	
Exp.	**Suggested Experiment List**
1	Realization of filter using DF-I, DF-II forms in Simulink
2	Realization of filter using series, parallel forms in Simulink
3	Lattice-ladder structure realization
4	To perform up sampling & down sampling
5	To design FIR Weiner filter for noise cancellation
6	To demonstrate LMS algorithm for noise cancellations
7	To demonstrate RLS algorithm to calculate it‘s error function
8	To study different types of wavelet functions
9	To demonstrate application of Wavelet Transform for denoising
10	To implement discrete Kalman filter prediction & correction steps

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. Monson H. Hayes, "*Statistical Digital Signal Processing and Modeling*," John Wiley & Sons, 2nd Edition, 2008
2. John G. Proakis, Dimitris G. Monolakis, "*Digital Signal Processing*," Pearson Education, 4th Edition, 2014.
3. Emmanuel C. Ifeachor, Barrie W. Jervis, "*Digital Signal Processing- A Practical Approach*," Pearson Education, 2nd Edition, 2002

Reference Books:

1. Simon Haykin, "*Adaptive Filter Theory*," Pearson Education, 5th Edition, 2014.
2. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, "*Digital Signal Processing*," McGraw-Hill Education, 2nd Edition, 2010.
3. Tarun Kumar Rawat, "*Digital Signal Processing*," Oxford University Press, 1st Edition, 2015.

4. Simon Haykin, "*Adaptive Filter Theory*," Pearson Education, 5th Edition, 2014.
5. P. P. Vaidyanathan, "*Multirate Systems and Filter Banks*", Pearson Education, 2nd Edition, 2008.
6. Raghuveer M. Rao and Ajit S. Bopardikar, "*Wavelet Transforms- Introduction to Theory and Applications*," Pearson Education Asia, 1st Edition, 2nd Impression, 2008

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Program: Electronics and Telecommunication Engineering	B. Tech	Semester: VIII
Course: Microwave System Design	Course Code: DJS22EC8017	
Course: Microwave System Design-Laboratory	Course Code: DJS22EL8017	

Pre-requisite:

1. Electromagnetic Wave Propagation (DJS22EC403)
2. Analog Communication (DJS22EC501)
3. Radio Frequency Circuit Design (DJS22EC502)
4. Radiating Systems (DJS22EC602)
5. Microwave Engineering (DJS22EC701)

Objectives:

1. To understand basics of microstrip lines and coupled lines
2. To understand the concept of Microwave Amplifier design.
3. To understand the concept of Microwave Oscillator design.
4. To understand design and operation of printed microwave circuits and related concepts.

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

1. Understand design concepts of microstrip lines.
2. Design microwave amplifier and analyze its functioning.
3. Design and analyze microwave oscillator and understand design concepts of mixers.
4. Describe various microwave system components like power dividers, directional couplers and attenuators.
5. Understand concepts of EMI and EMC techniques for microwave system.

Microwave System Design (DJS22EC8017)		
Unit	**Description**	**Duration**
1	**Microstrip Lines and Coupled Line Propagation** **Microstrip Lines**: Planar wave guides, Microstrip field configurations, Microstrip transitions and microstrip measurements, non-TEM propagation, line impedance. **Microstrip Discontinuities**: Microstrip open circuits and gaps, micro strip corners, step change in width, microstrip-T junction, bends and microstrip cross junctions. **Co-planar Lines**: Co-planar waveguides, co-planar strips and co-planar transitions. **Coupled Microstrip Lines**: Analysis of coupled lines, wave equations for coupled lines, propagation models and coupled line parameters.	**10**

2	**Microwave Amplifier Design** **Introduction:** Definitions of Two-Port Power gains, derivation of power gains, stability circles, Test for unconditional stability. **Single-Stage Transistor Amplifier Design**: Maximum gain amplifier design (Conjugate Matching), constant-gain circles, Specific gain amplifier design and Low noise amplifier design. **Broadband Transistor Amplifier Design**: Balanced amplifier, Distributed amplifiers, differential amplifiers. **Power Amplifiers:** Characteristics of power amplifiers, Design of class A power amplifiers.	**10**
3	**Oscillators and Mixers** **Oscillator Design**: One-port and two-port microwave oscillator design, dielectric resonator oscillator design. **Oscillator Phase Noise:** Analysis of phase noise in oscillators. **Mixers:** Characteristics, Various types of Mixers: Single ended diode mixers, FET mixers, Balanced mixers, Image reject mixers and other types of mixers	**08**
4	**Power Dividers, Directional Couplers, Attenuators** **Power Dividers**: Two-way, Three-way and Four-way Equal Power Dividers, Unequal, Broadband and Compact Power Dividers. **Directional Couplers**: Coupled Line Directional Couplers, Branch Line Couplers, and Rat Race Coupler. **Attenuators**: Fixed and Variable Attenuators.	**06**
5	**Microwave Systems and EMI, EMC Techniques** **Microwave Systems**: RF Harvesting System, High Power Microwave System, Microwave Imaging System. **EMI Sources**: Natural sources of EMI, EMI from Circuits, apparatus and open site test area. Radiated and conducted EMI measurements. **EMC Techniques**: Grounding, shielding, bonding, shielding and EMI filters, cables, connectors, components and EMC Standards.	**06**
	Total	**40**

Microwave System Design Laboratory (DJS22EL8017)	
Exp.	**Suggested Experiment List**
1	Parametric analysis of Microstrip Line.
2	Parametric analysis of Coplanar Waveguide.
3	Parametric study of microstrip corners, step change width of microstrip line.
4	Design and simulation of single stage maximum gain amplifier design.
5	Design and simulation of specified gain amplifier design.

6	Design and simulation of low noise amplifier design.
7	Design and simulation of one port oscillator design.
8	Design and simulation of two-way and four-way power divider
9	Case Study on sources of EMI in practical applications of microwave circuits.
10	Case Study on EMC techniques useful in practical applications of microwave circuits.

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 learnt concepts.

Books Recommended:

Textbooks:

1. K.C. Gupta et.al., "*Micorstrip Lines and Sotlines*" Artech House, 2nd Edition, 1996.
2. D. Pozar, "*Microwave Engineering*", Wiley Publication, 4th Edition, 2015.
3. R. Ludwig R. & G. Bogdanov, "*RF Circuit Design*", Pearson Education Inc. 2nd Edition, 2009.
4. W. Prasad Kodali, "*Engineering Electromagnetic Compatibility: Principles, Measurements, Technologies, and Computer Models*", Wiley-IEEE Press, 2nd Edition,2001.

Reference books:

1. G. Gonzalez, "*Microwave Transistor Amplifiers Analysis and Design* "Prentice Hall, 2nd Edition, 1997.
2. M. L. Sisodia & G. S. Raghuvanshi, "*Microwave Circuits and Passive Devices*", John Wiley & Sons, 3rd Edition, 1987.
3. Clayton R. Paul, "*Electromagnetic Compatibility"*, John Wiley & Sons, 2nd Edition, 2006.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	B. Tech.	Semester: VIII
Course: Project Stage - II	Course Code: DJS22ECP801	

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. Demonstrate technical skills required in an electronics industry for designing, building, testing electronic circuitry using modern software and hardware tools.
3. Apply project management skills (scheduling work, procuring parts, documenting technical and non-technical details and working within the confined deadline).
4. Develop and demonstrate troubleshooting ability in electronic circuits and systems (including software and hardware part of the systems)
5. Create technical reports, research articles and present the same to the evaluation authorities.

Project Stage - II (DJS22ECP801)

The final year students have already under gone project assignment in their seventh semester and in this semester the students are expected to continue the project work of stage I.

Evaluation Scheme:

Semester End Examination (A):

Oral & Practical:

An approved external examiner and internal examiner appointed by the head of the institute together will assess during oral examination. The oral examination is a presentation by the group members on the project along with a demonstration of the work done. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained. The evaluation of the dissertation is done independently by each examiner.

Continuous Assessment (B):

Termwork:

The college should keep proper assessment record of the progress of project and at the end of the semester it should be assessed for awarding termwork marks. The termwork should be examined by approved internal faculty appointed by the head of the institute on the basis of following:

- Scope and objective of the project work.
- Extensive Literature survey.
- Progress of the work (Continuous assessment)
- Design, implementation, and analysis of the project work.
- Results, conclusions and future scope.
- Report in prescribed format.

The final certification and acceptance of term work will be subject to satisfactory performance of project work and upon fulfilling minimum passing criteria in the term work. The Internal Guide follows evaluation rubrics, which is set by the Department.

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