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

SEM V

Sr. No	Course code	Course	Teaching Scheme (hrs.)				Continuous Assessment (A) (marks)			Semester End Assessment (B) (marks)					(A+B)	Total Credits
			Th	P	T	Credits	Th	T/W	Total CA (A)	Th	O	P	O&P	Total SEA(B)		
Semester v																
1	DJS22EC501	Analog Communication	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22ET501	Analog Communication Laboratory	-	2	-	1	-	25	25	-	-	-	25	25	50	
2	DJS22EC502	Radio Frequency Circuit Design	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL502	Radio Frequency Circuit Design Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
3	DJS22EC503	Microcontroller & Applications-II	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL503	Microcontroller & Applications-II Laboratory		2	-	1	-	25	25	-	-	-	25	25	50	
4	DJS22EC504	Digital Signal Processing	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL504	Digital Signal Processing Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
5	DJS22EC505	Data Structures & Algorithms	1	-	-	1	-	-	-	-	-	-	-	-	-	2
6	DJS22EL505	Data Structures & Algorithms Laboratory	-	2	-	1	-	25	25	-	-	-	25	25	25	
7	DJS22A3	Environmental Engineering	1	-	-	-	-	-	-	-	-	-	-	-	-	-
8	DJS22ILLL1	Innovative Product Development-III	-	2	-	1	-	25	25	-	-	-	25	25	50	1
		Total	**14**	**12**	**-**	**19**	**140**	**150**	**290**	**260**	**50**	**0**	**100**	**410**	**700**	**19**

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 VI

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 VI																
1	DJS22EC601	Digital Communication	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22ET601	Digital Communication Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
2	DJS22EC602	Radiating Systems	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL602	Radiating Systems Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
3	DJS22EC603	Computer Networks	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL603	Computer Networks Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
4	DJS22EC604	Fundamentals of Digital Image Processing	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL604	Fundamentals of Digital Image Processing Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
5	DJS22EC6011	Basic VLSI	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL6011	Basic VLSI Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC6012	Control Systems	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL6012	Control Systems Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC6013	Neural Network & Fuzzy Logic	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL6013	Neural Network & Fuzzy Logic Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC6014	Operating Systems	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL6014	Operating Systems Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC6015	Big Data Analytics	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL6015	Big Data Analytics Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC6016	Radar Engineering	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL6016	Radar Engineering Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS22EC6017	Linear Algebra	3	-	-	3	35	-	35	65	-	-	-	65	100	4
	DJS22EL6017	Linear Algebra Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
7	DJS22IHL	Professional & Business Communication Laboratory	-	2	-	1	-	25	25	-	-	-	-	-	25	1
8	DJS22ILLL2	Innovative Product Development-IV	-	2	-	1	-	25	25	-	-	-	25	25	50	1
		Total	**15**	**14**	**-**	**22**	**175**	**175**	**350**	**325**	**125**	**0**	**25**	**475**	**825**	**22**

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

Prepared by Checked by Head of the Department Principal

Program: Electronics & Telecommunication Engineering	T.Y B. Tech	Semester: V
Course: Analog Communication (DJS22EC501)		
Course: Analog Communication Laboratory (DJS22EL501)		

Pre-requisite:

1. Electronics Circuit Design (DJS22EC302)
2. Signals & Systems (DJS22EC304)

Objectives:

1. To understand basics of communication systems and effect of noise on communication.
2. To understand various continuous and pulse modulation, demodulation techniques.
3. Get acquainted with various types of multiplexing techniques and their use in communication.

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

1. To compare internal and external noise and its effect on communication system.
2. To examine analog modulation and demodulation techniques along with various analog receivers.
3. To make use of sampling theorem to analog and digital pulse modulation and demodulation techniques.
4. To compare Frequency division and time division multiplexing and de-multiplexing techniques for communication system.

Analog Communication(DJS22EC501)		
Unit	**Description**	**Duration**
1	**Basics of Communication System:** Block diagram, electromagnetic spectrum, signal bandwidth and power, types of communicationchannels, Introduction to time and frequency domain; Types of noise, signal to noise ratio, noise figure and noise temperature.	**04**
2	**Amplitude Modulation and Demodulation:** Introduction, need for modulation. DSBFC: Mathematical analysis, modulation index, bandwidth, voltage distribution and power calculations. Low level and high level modulation, simple diode detector, practical diode detector. DSBSC: Mathematical analysis, modulation index, bandwidth, voltage distribution, power calculations, balanced modulator. SSBSC: Mathematical analysis, voltage distribution and power calculations.	**12**

	SSB generation: Filter method. ISB: Transmitter and receiver block diagram, applications. VSB: Application in television.	
3	**Angle Modulation and Demodulation:** Frequency modulation (FM): Introduction, mathematical analysis, time domain waveform, spectrum of FM wave, modulation index, bandwidth requirement, narrowband FM and wideband FM, Effect of noise, noise triangle, pre-emphasis and de-emphasis, FET reactance modulator, varactor diode modulator, frequency stabilized reactance modulator, indirect method of FM generation. Comparison between FM and PM, FM demodulation: Balance slope detector, Foster-Seely discriminator, ratio detector, amplitude limiting and thresholding.	**10**
4	**Radio Receivers:** Receiver parameters, TRF receiver, problems in TRF receiver, Super - heterodyne receiver, choice of IF, Comparison of FM receiver with AM receiver.	**04**
5	**Pulse Modulation & Demodulation:** Sampling theorem, Nyquist criteria. Sampling techniques, aliasing error and aperture effect PAM, PWM, PPM generation and detection, Quantization and its types, Pulse Code Modulation, delta modulation, adaptive delta modulation, principle, generation and detection. Applications of pulse communication.	**06**
6	**Multiplexing & De-multiplexing:** Frequency Division Multiplexing transmitter & receiver block diagram, Time Division Multiplexing transmitter & receiver block, Examples and applications of FDM and TDM	**04**
	Total	**40**

Analog Communication Laboratory (DJS22EL501)	
Exp.	**Suggested Experiment List**
1.	Study of Amplitude Modulation.
2.	**S**tudy of Double Side Band Suppressed Carrier and Single Side Band Amplitude Modulation.
3.	Simulate of AM system and generate time and frequency domain output.
4.	To study different types of frequency modulators and Demodulators.
5.	Simulate Frequency Modulation system and generate time and frequency domain output.
6.	Implement Pre-emphasis and De-emphasis circuit required for FM and analyze the output.

7.	Study of Natural Sampling and its reconstruction.
8.	Study of Flat top sampling and its reconstruction.
9.	Study of Pulse Amplitude Modulation.
10.	Study of Pulse width Modulation.
11.	Study of Pulse Position Modulation.
12.	Study of PAM-TDM system.
13.	Study of FDM.

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. Kennedy and Devis, "Electronic Communication System", McGraw Hill Education Pvt. Ltd., Fourth Edition, 2017.
2. Wayne Tomasi, "Electronic Communication System", Pearson, Fifth Edition, 2012.

Reference books:

1. Toub Schilling and Shaha, "Principles of Communication Systems", Tata McGraw Hill, Fourth Edition.
2. B. P. Lathi, Zhi Ding, "Modern digital and analog communication system", Oxford University Press, Fourth Edition.
3. Symon Haykin, Michal Moher, "Introduction to Analog and Digital Communication", Wiley, Fourth Edition.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Radio Frequency Circuit Design (DJS22EC502)		
Course: Radio Frequency Circuit Design Laboratory (DJS22EL502)		

Pre-requisite:

1. Electromagnetics Wave Propagation (DJS22EC403)
2. Electrical Network Analysis and Synthesis (DJS22EL305)
3. Engineering Mathematics-III (DJS22EC301)

Objectives:

1. To develop the model for inductor, capacitor and resistor at high frequency.
2. To analyze transmission line using Smith Chart
3. To study application of smith chart for impedance matching
4. To synthesize filter for given specifications

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

1. Analyze the single and Multi-port network using parameters.
2. Apply their knowledge in analyzing inductor, capacitor and resistor at high frequency.
3. Calculate parameters of transmission line analytically and using Smith Chart.
4. Design matching network using Impedance matching techniques.
5. Design the filters for given specifications using insertion loss and image parameter method.

Radio Frequency Circuit Design (DJS22EC502)		
Unit	**Description**	**Duration**
1	**Single- and Multiport Networks:** **Basic Definitions** Interconnecting Networks, Series Connection of Networks, Parallel Connection of Networks, Cascading Networks. **The Scattering Matrix** Reciprocal Networks and Lossless Networks, A Shift in Reference Planes, Power Waves and Generalized Scattering Parameters, Practical Measurements of S-Parameters. **The Transmission (ABCD) Matrix**, Relation to Impedance Matrix and Scattering Matrix, Equivalent Circuits for Two-Port Networks	**08**
2	**Importance of Radio Frequency Design:** **RF behaviour of Passive Components** High-Frequency Resistors, High-Frequency Capacitors, High-Frequency Inductors. **Chip Components and circuit Board Considerations** Chip Resistors, Chip Capacitors, Surface-Mounted Inductors. **SMD Assembly Process** Solders for SMD Applications, Fluxing and Cleaning, Types of Flux- Organic Soluble Fluxes, R Flux, RMS Flux, RA Flux, Water Soluble Fluxes and Types Flux Selection,	**08**

	Solder Applications, Curing solder Paste, The Reflow Process, Assembly Methods, Adhesive Applications and Curing, Solder Creams.	
3	**Smith Chart:** **From Reflection Coefficient to Load Impedance** Reflection coefficient in Phasor Form, Normalized Impedance Equation, Parametric Reflection Coefficient Equation, Graphical Representation **Impedance Transformation** Impedance Transformation for General Load, Standing Wave Ratio, Special Transformation Conditions **Admittance Transformation** Parametric Admittance Equation, Additional Graphical Displays **Z-Y Smith Chart** **Parallel and Series Connection of Lumped Elements and their analysis using Smith Chart** Parallel Connection of R and L, Parallel Connection of R and C, Series Connection of R and L, Series Connection of R and C, T and π Network.	**10**
4	**Impedance Matching and Tuning:** **Matching with Lumped Elements (L Networks)** Analytic Solutions, Smith Chart Solutions **Impedance Transformers** Single-Section Quarter-Wave Transformer, Multi-section Quarter-Wave Transformer, Transformers with Uniformly distributed section reflection coefficient, Binomial Multi-section Matching Transformer, Chebyshev Multi-section Matching Transformer**.**	**06**
5	**RF Filter Design:** **Basic Resonator and Filter configurations** Filter Types and Parameters, Low-Pass Filter, High-Pass Filter, Bandpass and Bandstop Filters, Insertion Loss **Special Filter Realizations using Insertion Loss Method** Butterworth-Type Filters, Chebyshev-Type Filters, Denormalization of Standard Low-Pass Design **Filter Implementation** Unit Elements, Kuroda's Identities, Microstrip Filter Design **Filter Design by the Image Parameter Method** Image Impedances and Transfer Functions for Two-Port Networks, Constant-k Filter sections, m-derived Filter Sections, Composite Filters	**08**
	Total	**40**

Radio Frequency Circuit Design Laboratory (DJS22EL502)	
Exp.	**Suggested Experiment List**
1	Characterization of resistor at high frequency
2	Characterization of capacitor at high frequency
3	Characterization of inductor at high frequency
4	Analysis of Parallel and Series Connection of Lumped Elements and verification using Smith chart
5	Filter Design by the Image Parameter Method

6	Filter Design by the Insertion Loss Method
7	Matching of Lumped Elements
8	Design of quarter wave transformer
9	Design of Binomial Multi-Section Matching Transformer
10	Numerical from previous years GATE Examination paper.

Minimum eight tutorials based on syllabus will be conducted.

Books Recommended:

Text books:

1. Ludwig, Reinhold & Bretchko, Pavel, "RF circuit design: Theory and Applications", Prentice-Hall, Second Edition, 2011.
2. Pozar, David M, "Microwave Engineering", Hoboken, NJ: Wiley Publication, 2012.
3. Traister, John, "Design guidelines for surface mount technology", Elsevier, 2012.

Reference Books:

1. Guillermo Gonzalez, "Microwave transistor amplifiers: Analysis and design", Prentice-Hall, Second Edition, 1996.
2. Matthew M. Radmanesh, "Radio Frequency and Microwave Electronics Illustrated", Prentice Hall PTR, 2001.

Prepared by Checked by Head of the Department Principal

Program: Third Year Electronic and Telecommunication Engineering	T.Y B. Tech	Semester: V
Course: Microcontroller & Applications-II (DJS22EC503)		
Course: Microcontroller & Applications-II Laboratory (DJS22EL503)		

Pre-requisite: Knowledge of

1. Digital System Design (DJS22EC303)
2. Microcontroller & Applications – I (DJS22EC404)

Objectives:

1. To develop background knowledge and core expertise in advanced microcontroller.
2. To understand peripheral devices and their interfacing to advanced microcontroller.
3. To develop programming skill for microcontroller and their applications in Assembly and Embedded C language.

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

1. Identify different functionalities and architecture of ARM 7 Processor.
2. Identify different hardware components and use relevant software for programming of LPC2148 microcontroller-based development system.
3. Write assembly language programing and Embedded C programming for LPC2148 microcontroller-based systems.
4. Interface different input/output devices with LPC2148 microcontroller for various applications

Microcontroller & Applications-II (DJS22EC503)		
Unit	**Description**	**Duration**
1	**ARM7 Architecture:** Features of ARM core architecture, Data Flow Model, Pipeline, Registers, operating modes.	**05**
2	**Introduction to ARM Programming:** Introduction to THUMB, Differences between ARM and THUMB, Register usage in Thumb, ARM Thumb Interworking. General Structure of ARM assembly module, Assembler directives- Simple ALP programs on Arithmetic & logical operations, Factorial, string operation, sorting, searching, and Scan.	**10**
3	**LPC2148 ARM CPU:** Salient features, Pin diagram, block diagram, memory mapping. Functional features of Interrupt controller, RTC, USB, UART, I2C, SPI, SSP controllers, watch dog timers and other system control unit	**10**

4	**LPC2148 Peripherals:** Registers, GPIOs, PLL-Features, PLL structure, Timers-Features, applications, Architecture of timer module, register description, Simple C programs for application using -GPIO, PLL, Timer.	**08**
5	**LPC2148 based Applications:** Design of system using GPIO's Blink a group of 8 LEDs with a delay, Stepper motor control, DC motor control, LCD interface, ADC, DAC, UART	**07**
	Total	**40**

Microcontroller & Applications-II Laboratory (DJS22EL503)	
Exp.	**Suggested Experiment List**
1	To study ARM (LPC2148) Embedded Trainer kit and its software tools.
2	Write a program to generate LED sequence using ARM 7(LPC2148).
3	To display message on multiplexed four common anode7-segment display.
4	To read DIP switch status and display its position on 7-segment.
5	To display message on Alphanumeric LCD.
6	To verify LDR operation using on-chip ADC of LPC2148.
7	Waveforms generation using DAC.
8	To display room temperature on LCD using LM35 sensor.
9	Write a program to control DC motor speed using PWM.
10	Write a program for Interfacing keyboard and LCD.
11	Write a program for Interfacing EPROM and EEPROM.
12	Write a program for Interfacing stepper motor.
13	Write a program to transmit and receive data serially using UART.
14	Implementing ZIGBEE protocol with ARM.

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. Andrew N. Sloss, "ARM System Developers Guide", Elsevier, First Edition, 2008.
2. Lyla Das, "Embedded Systems: An Integrated Approach", Pearson Publication, First Edition, 2012.

Reference Books:

1. William Hohl, “ARM Assembly Language – Fundamentals and Techniques”, CRC Press, First Edition, 2009.
2. Steve Furber, “Arm System On Chip Architecture”, Pearson Publication, First Edition, 2012.
3. J.R. Gibson, “ARM Assembly Language: An Introduction”, Cengage Learning, First Edition, 2010.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	**T. Y. B. Tech**	**Semester: V**
Course: Digital Signal Processing (DJS22EC504)		
Course: Digital Signal Processing Laboratory (DJS22EL504)		

Pre-requisite: Signals and Systems (DJS22EC304)

Objectives:

1. To develop a thorough understanding of DFT and FFT and their applications.
2. To apply the design techniques and performance analysis of digital filters
3. To understand the effects of Poles and Zeros in the frequency response of digital filters.

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

1. Implement DFT and FFT algorithms in finding the response of the system.
2. Design different types of IIR filters.
3. Design different types of FIR filters.
4. Determine effects of Poles and Zeros in the frequency response of digital filters.

Digital Signal Processing (DJS22EC504)		
Unit	**Description**	**Duration**
1	**Discrete Fourier Transform & Fast Fourier Transform:** Definition and Properties of DFT, IDFT, Circular convolution of sequences using DFT and IDFT. Filtering of long data sequences: Overlap-Save and Overlap-Add Method for computation of DFT. Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT, composite Radix FFT N=2.3, N=3.2.	**10**
2	**IIR Digital Filters:** Types of IIR Filters (Low Pass, High Pass, Band Pass, Band Stop), Analog filter approximations: Butterworth, Chebyshev I. Mapping of S-plane to Z-plane, impulse invariance method, bilinear transformation method, Design of IIR digital filters (Butterworth and Chebyshev-I) from Analog filters with numerical examples. Effect of Poles and Zeros on the Frequency Response of IIR filters. Position of Poles and Zeros of Low Pass, High Pass, Band Pass, Band Stop, All Pass filters.	**10**
3	**FIR Digital Filters:** Characteristics of FIR digital filters, Minimum Phase, Maximum Phase, Mixed Phase and Linear Phase (Type 1 to Type 4) FIR Filters. Design of FIR filters using Window techniques (Rectangular, Hamming, Hanning, Blackman), Design of FIR filters using Frequency Sampling technique, Comparison of IIR and FIR filters.	**08**
4	**Poles, Zeros and Filters:** Effects of poles and zeros in the frequency response of IIR filters (LP, HP, BP, BR/Notch, All Pass filters). Placement of zeros and design of filters in Type1 to Type 4 Linear Phase FIR filters.	**06**

	Finite Word Length effects in Digital Filters: Quantization, truncation and rounding, Error due to truncation and rounding.	
5	**DSP Processors:** Introduction to General Purpose and Special Purpose DSP processors, fixed point and floating-point DSP processor, Computer architecture for signal processing, Harvard Architecture, Pipelining, multiplier and accumulator (MAC), Special Instructions, Special purpose DSP hardware, Architecture of TMS320CX fixed and floating DSP processors.	**06**
	Total	**40**

Digital Signal Processing Laboratory (DJS22EL504)	
Exp.	**Suggested Experiment List**
1	Plot of Discrete Time Signals.
2	Frequency response of LTI systems by DTFT.
3	To perform Discrete Fourier Transform.
4	To implement Circular Convolution of two discrete time sequences.
5	To perform OverlapAdd method of DFT for long data sequence.
6	To implement the algorithm of DIT-Fast Fourier Transform.
7	To plot the FFT of Sinusoids with noise.
8	Magnitude and phase response of FIR filter.
9	Design an Analog Butterworth filter with given specifications.
10	Design a Digital IIR Butterworth filter with given specifications.
11	Design an FIR filter by window method.
12	Removal of Noise by a designed filter.
13	Perform basic signal processing operations with DSP processor TMS 320C6713.
14	Generation of Sine Wave with Key Pressing in DSP processor TMS 320C6713.
15	Capturing a real time signal by the Processor and display on a DSO.
16	Implementation of Real time Low Pass filtering by DSP Processor.

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. Proakis J., Manolakis D., "*Digital Signal Processing*", Pearson Education, Fourth Edition, 2007.
2. B. Venkata Ramani and M. Bhaskar, "*Digital Signal Processors, Architecture, Programming and Applications*", Tata McGraw Hill, Second Edition, 2004.

Reference Books:

1. Oppenheim A., Schafer R., Buck J., "*Discrete Time Signal Processing*", Pearson Education, Third Edition, 2021.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", McGraw Hill Education, Fourth Edition, 2013.
3. Tarun Kumar Rawat, "*Digital Signal Processing"*, Oxford University Press, First Edition, 2015.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Data Structures & Algorithms (DJS22EC505)		
Course: Data Structures & Algorithms Laboratory (DJS22EL505)		

Pre-requisite:

1. Structured programming using C (DJS22FEC12)

Objectives:

1. Understand and remember algorithms and its analysis procedure.
2. Introduce the concept of data structures through ADT including List, Stack, Queues.
3. To design and implement various data structure algorithms.

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

1. Design and implement various data structures such as arrays, linked lists, stacks, queues and trees.
2. Understand the operations of data structures.
3. Determine and analyze the complexity of given Algorithms.

Detailed Syllabus: Data Structures & Algorithms (DJS22EC505)		
Unit	**Description**	**Duration**
1	**Introduction to Data structures and Algorithms:** Introduction to Data structures, Types of Data structures: Linear and nonlinear data structures, Arrays, Stacks, Queue, Linked list and Tree, Recursion.	**02**
2	**Stack and Queue data structure:** Introduction to Stack, Operations on Stack Introduction to Queue, Queue as ADT, Operations on Queue, Linear representation of queue, Circular Queue.	**04**
3	**Linked List data structure:** Introduction to Linked List, Singly Linked list, Doubly Linked list, Operations on linked list, Linked representation of stack, Linked representation of Queue.	**04**
4	**Tree:** Introduction to Trees, Definitions & Tree terminologies, Binary tree representation, Operations on binary tree, Traversal of binary trees, Binary search tree.	**04**
	Total	**14**

Data Structures & Algorithms Laboratory (DJS22EL505)	
Exp.	**Suggested Experiment List**
1	To implement stack.
2	To implement parenthesis checking using stack.
3	Implementation of Infix to Postfix conversion.

4	To implement Implementation of prefix and postfix evaluation using menu driven approach.
5	To implement Linear queue.
6	To implement Circular queue.
7	To implement different operations on linked list –copy, concatenate, split, reverse, count no. of nodes.
8	To implement various operations on doubly linked list
9	To implement Stack using Linked List
10	To implement Queue using Linked List
11	To create a binary tree and traverse it in Inorder, preorder and Postorder
12	To implement binary search tree

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

Books Recommended:

Text books:

1. Tenenbaum, Langsam, Augenstein, "Data structures using C", Pearson Education, First Edition, 2019.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", W. H. Freeman and Company, Second Edition, 2008.
3. Reema Thareja, "Data Structures using C", Oxford, Second Edition, 2017.

Reference Books:

1. Mark A. Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, Fourth Edition, 2014.
2. M. T. Goodritch, R. Tamassia, D. Mount, "Data Structures and Algorithms in C++", Wiley, Second Edition, 2011.
3. Kruse, Leung, Tondo, "Data Structures and Program Design in C", Pearson Education, Second Edition, 2013.
4. Seymour Lipschutz, "Data Structures", Schaum's Outline Series, Tata McGraw-Hill, First Edition, 2014.

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Innovative Product Development-III (DJS22ILLL1)		

Pre requisite:

1. Electronics Circuit Design (DJS22EC302)
2. Digital System Design (DJS22EC303)
3. Integrated Circuits (DJS22EC402)
4. Python Programming Laboratory(DJS22EL306)

Objectives:

1. To determine the goals, resource requirements of project and produce them in the form of documentation.
2. To learn effective utilization of time and project management skills.
3. To address the real-world projects, to connect theory with practice as per recent industrial trends.
4. To integrate knowledge and skills from various areas through more complex and multidisciplinary projects.

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

1. Define problem statement, formulation and solution by reviewing relevant literature
2. Identify alternate approaches to complete a project
3. Apply project management skills by interacting and dividing project work among team members
4. Develop technical, communication, and presentation skills

Syllabus: Domain knowledge (any beyond) needed from the following areas for the effective implementation of the project:

Microcontroller and Embedded Systems, Signal Processing, Microwave and Antennas, Networking and Internet of Things, Data science and Big data, Communication, Web and Application development, Robotics, AI and Machine learning, etc.
The above areas can be updated based on the technological innovations and development needed for specific project.

Guidelines: The main purpose of this course is to improve the students' documentation and technical skills to find the cost effective solution of a problem. Guidelines are as follows:

1. The project work is to be carried out by a group of 4/5/6 students (2/3 second year and 2/3 third year students)
2. Each group is allotted a final year student as mentor and a faculty member as guide.
3. Project topics will be floated in various domains. Each group submits three project topic preferences, out of which one topic is allotted in discussion with faculty guide and faculty coordinators.
4. Each group will identify the hardware and software requirement for their problem statement.
5. Each group will be reviewed twice in a semester and marks will be allotted based on the rubrics mentioned in the evaluation scheme.
6. In the first review of the semester, each group is expected to complete the literature survey, budget plan and documentation based on project methodology.
7. In the second review of the semester, each group is expected to implement 30% of project.

8. Subsequent reviews will be carried out in sixth semester.

Evaluation Scheme:
Semester End Examination (A):

Laboratory:
Oral examination should be conducted by Internal and External examiners. Students have to give presentation and demonstration based on their project.

Continuous Assessment (B):
Laboratory: (Term work)
Each group will be reviewed twice in a semester by faculty guide and faculty coordinators based on the following criteria:

1. Objective and expected outcome
2. Long term social impact
3. Innovative ideas and motivation
4. Documentation
5. Simulation effectiveness
6. Literature survey and comparative research methodology
7. Project Progress/Implementation
8. Overall Presentation and team work

Each review consists of 25 marks. Average of the marks scored in both the reviews will be considered for final grading. The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Prepared by Checked by Head of the Department Principal

Program: Third Year Electronic and Telecommunication Engineering	T.Y B.Tech	Semester:VI
Course: Digital Communication (DJS22EC601)		
Course: Digital Communication Laboratory (DJS22EL601)		

Pre-requisite:

1. Signal and System (DJS22EC304)
2. Engineering Mathematics –IV (DJS22EC401)
3. Analog Communication (DJS22EC501)

Objectives:

1. To learn about theoretical bounds on the rates of digital communication system and represent a digital signal using several modulation methods
2. To draw signal space diagrams, compute spectra of modulated signals and apply redundancy for reliable communication.

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

1. Apply the basics of information theory and coding techniques to determine the minimum number of bits per symbol required to represent the source and the maximum rate at which a reliable communication can take place over the channel.
2. Describe and determine the performance of different waveform techniques for the generation of digital representation of signals.
3. Determine methods to mitigate inter symbol interference in baseband transmission system.
4. Describe and determine the performance of different error control coding schemes for the reliable transmission of digital representation of signals and information over the channel of Communication systems.

Digital Communication (DJS22EC601)		
Unit	**Description**	**Duration**
1	**Information theory and source coding:** Block diagram and sub-system description of a digital communication system, measure of information and properties, entropy and it's properties, Source Coding, Shannon's Source Coding Theorem, Shannon-Fano Source Coding, Huffman Source Coding , Differential Entropy, joint and conditional entropy, mutual information and channel capacity, channel coding theorem, channel capacity theorem.	**09**
2	**Baseband Modulation and Transmission:** Discrete PAM signals and it's power spectra, Inter-symbol interference, correlative coding, equalizers, and eye pattern.	**06**

3	**Band pass Modulation and Demodulation:** Band pass digital transmitter and receiver model, digital modulation schemes Generation, detection, signal space diagram, spectrum, bandwidth efficiency, and probability of error analysis of: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK)Modulations, Binary Phase Shift Keying (BPSK) Modulation, Quaternary Phase Shift Keying (QPSK), Quadrature Amplitude Modulation (QAM), Comparison between bandwidth and bit rate, applications of digital modulation schemes	**12**
4	**Error Control Systems:** Types of error control, error control codes **Linear Block Codes:** vector spaces, vector sub spaces, generator matrix, systematic linear block codes, parity check matrix, syndrome testing, error correction, and decoder implementation **Cyclic codes:** Algebraic structure of cyclic codes, binary cyclic code properties, encoding in systematic form, circuits for dividing polynomials, systematic encoding with shift register and error detection **Convolution Codes:** Time domain and transform domain approach, graphical representation, code tree, trellis, state diagram, decoding methods, maximum likelihood decoding, and free distance.	**13**
	Total	**40**

Digital Communication Laboratory (DJS22EL601)	
Exp.	**Suggested Experiment List**
1	Entropy and Mutual Information
2	Source Coding Algorithms (Huffman coding)
3	Linear block codes (Error detection and correction)
4	Cyclic codes (comparison of performance of coded and uncoded system)
5	Convolutional Encoding.
6	ASK, FSK And PSK
7	Generation and Detection of Binary Amplitude Shift Keying (BASK)
8	Generation of Binary FSK signal modulation (FSK)
9	Observing Eye pattern

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. Haykin Simon, “Digital Communication Systems,” John Wiley and Sons, New Delhi, Fourth Edition, 2014.
2. H. Taub, D. Schlling, and G. Saha, “Principles of Communication Systems,” Tata Mc-Graw Hill, New Delhi, Third Edition, 2012.

Reference Books:

1. Sklar B, and Ray P. K., “Digital Communication: Fundamentals and applications,” Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009.
2. T L Singal, “Analog and Digital Communication,” Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
3. P Ramakrishna Rao, “Digital Communication,” Tata Mc-Graw Hill, New Delhi, First Edition, 2011.
4. M F Mesiya, “Contempory Communication systems”, Mc-Graw Hill, Singapore, First Edition, 2013.
5. Lathi B P, and Ding Z., “Modern Digital and Analog Communication Systems,” Oxford University Press, Fourth Edition, 2009

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Radiating Systems (DJS22EC602)		
Course: Radiating Systems Laboratory (DJS22EL602)		

Pre-requisite:

1. Radio Frequency Circuit Design (DJS22EC502)

Objectives:

1. To learn fundamental parameters of Antenna.
2. To learn about linear wire antenna elements and Antenna arrays.
3. To learn about Special types of Antennas.
4. To learn measurement procedures of Antenna parameters.

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

1. Explain and measure basic antenna parameters like radiation pattern, input impedance, gain and polarization.
2. Derive the field equations for the basic radiating elements like linear wire antenna and loop antenna.
3. Design of uniform linear and planar antenna arrays using isotropic and directional Sources.
4. Design regular shape microstrip antennas and aperture antennas.

Radiating Systems (DJS22EC602)		
Unit	**Description**	**Duration**
1	**Antenna Fundamentals:** Review of Maxwells equations and vector potential wave equation. Antenna Parameters: Near field and far field radiation, dual equations for electric and magnetic current sources, radiation Mechanism, basic antenna parameters, Radiation pattern, radiation power density, radiation intensity, beam width, directivity, Antenna efficiency, Gain, beam efficiency, bandwidth, polarization, input impedance, antenna vector effective length and equivalent areas, antenna radiation efficiency, FRIIS transmission equation. **Measurement of Antenna parameters:** Input Impedance, Radiation Pattern, Gain (Two and Three antenna, method), Polarization.	**10**
2	**Wire Elements: Dipoles, Monopoles, Loops and Helical:** Infinitesimal dipole, radiation fields, radiation resistance, radiation sphere, near field, far field directivity, small dipole, finite length dipole, half wave length dipole, linear elements near or on infinite perfect conductors, Monopole antenna, Folded dipole. Design of dipole and monopole antenna. **Loop Antenna:** Small circular loop, comparison of small loop with short dipole, Ferrite loop, Radiation patterns, its parameters, and their applications.	**09**

	Helical Antennas: Input impedance matching, Axial mode and normal mode propagation, Circular polarization using Helical Antenna.	
3	**Arrays:** Linear arrays, Array of two isotropic point sources, linear arrays of N elements, principle of pattern multiplication applicable to non-isotropic sources, Phase scanning arrays, Broadside and End-fire Array, Increased Directivity end fire array, Calculations of Directivity, Beam width, Maxima and null directions for N-element Array, basics of planar arrays. Design of Yagi antenna and Log Periodic antenna.	**09**
4	**Microstrip Antenna:** Microstrip antenna (MSA): Introduction, Feeding Techniques, Regular Shape MSAs (Rectangular, Circular, Equilateral Triangular), Design of Regular shape MSAs.	**06**
5	**Aperture Antennas:** Horn Antennas: E-Plane Sectoral Horn, H-Plane Sectoral Horn, Pyramidal Horn, Conical Horn. Reflector Antennas: Introduction, Plane Reflector, Corner Reflector, Parabolic Reflector, Design considerations.	**06**
	Total	**40**

Radiating Systems Laboratory (DJS22EL602)	
Exp.	**Suggested Experiment List**
1	Study of antenna types.
2	Plot radiation pattern of dipole and monopole using antenna trainer kit/ simulation software.
3	Plot radiation pattern of dipole for varying length using simulation software.
4	Design of RMSA using simulation software.
5	Design of CMSA using simulation software.
6	Design of ETMSA using simulation software.
7	Plot radiation patterns of microstrip antenna using antenna trainer kit.
8	Design of broad side-end fire array.
9	Study of pattern multiplication.
10	Design of phase scanning array.
11	Gain measurement using three antenna method.
12	Radiation pattern measurement.

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. C. A. Balanis, “Antenna Theory Analysis and Design”, John Wiley & Sons, Third Edition, 2016.
2. G. Kumar, K. P. Ray, “Broadband Microstrip Antenna”, Artech House, First Edition, 2002.

Reference Books:

1. R. E. Collin, “Antennas and Radio Wave Propagation”, International Student Edition, McGraw Hill, Fourth Edition, 1985.

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Computer Networks (DJS22EC603)		
Course: Computer Networks Laboratory (DJS22EL603)		

Pre-requisite: Knowledge of

1. Analog Communication (DJS22EC501)

Objectives:

1. To Learn various hardware network components.
2. To understand network reference models and process involved in data communication.
3. To understand the protocols working at different layers.
4. To design and configure a network for an organization.

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

1. Compare OSI layered architecture with TCP/IP protocol suite and differentiate functions of each layer.
2. Define characteristics of physical media and differentiate among multiplexing techniques.
3. Understand responsibilities of the data link layer and explain the datalink layer protocols.
4. Design network and subnetwork and list the commands required to carry out investigations and troubleshooting.
5. Distinguish transport layer protocols based on application.

Detailed Syllabus: Computer Networks (DJS22EC603)		
Unit	**Description**	**Duration**
1	**Introduction to Computer Network:** Reference Models, OSI model, overview of TCP/IP, layer functions, services, peer to peer protocols, sockets and ports, Data encapsulation, Networking devices: Repeater, hub, bridge, switch and routers, Network topology.	**06**
2	**Introduction to Physical Layer Services:** Introduction to physical media, Guided transmission media: Coaxial cable, RJ 45, Optical fiber, twisted pair, bit transmission, frequency division multiplexing. Time division multiplexing.	**04**
3	**Data Link Layer:** Data link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols: Stop and Wait protocol, Go-back-n protocol, Selective-repeat protocol, Data Link Protocols: HDLC: High-Level Data LinkControl, Channel Allocation Problem, Multiple Access Protocols.	**10**

4	**Network Layer:** Network functions for the Network Layer Functions, Routing Algorithms: Distance vector and Link state routing, shortest path first algorithm: Dijikstra and Bellman Ford algorithm, Quality of Service. Network Layer In The Internet: The IP Protocol, IPv4 header, IP Addressing classfull and classless, CIDR notation, Subnetting, supernetting, Internet Control Protocols, The Interior Gateway Routing Protocol: RIP, OSPF, and The Exterior Gateway Routing Protocol: BGP.	**10**
5	**Transport Layer:** The Transport Service, Elements of Transport Protocols, The Internet Transport Protocol: TCP and UDP, The Internet Transport Protocol: TCP:-Introduction to TCP, The TCP, Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release, Modelling TCP Connection Management, TCP Transmission Policy, TCP Congestion Control, TCP Timer Management.	**10**
	Total	**40**

Computer Networks Laboratory (DJS22EL603)	
Exp.	**Suggested Experiment List**
1	To implement different networking command using Cisco packet tracer.
2	To study various hardware and software network components.
3	To configure the Web (HTTP and DNS), FTP and SMTP server using Cisco packet tracer
4	To configure RIP protocol in a network using Cisco packet tracer.
5	To configure OSPF protocol in a network using Cisco packet tracer.
6	To establish TELNET session using Cisco packet tracer.
7	To design Firewall using standard and extended ACL's.
8	To study VLSM using Cisco packet tracer
9	To implement Dijikstras algorithm
10	To implement Bellman Ford algorithm
11	To analyze network traffic: HTTP, TCP, UDP using Wireshark

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. A. S. Tanenbaum, “Computer Network”, Prentice Hall, Fourth Edition, 2017.
2. Behrouz A. Forouzan, “Data Communication and Networking with TCP/IP Protocol Suite”, Tata McGraw-Hill, Sixth Edition 2022.

Reference Books:

1. Kurose, Ross, “Computer Networking”, Pearson, Seventh Edition, 2017.
2. D. E. Comer, “Computer Networks and Internets”, Pearson, Sixth Edition, 2014.
3. Behrouz A. Forouzan, “TCP/IP Protocol Suite”, Tata McGraw-Hill, Fourth Edition, 2017.

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Fundamentals of Digital Image Processing (DJ19ECC603)		
Course: Fundamentals of Digital Image Processing Laboratory (DJ19ECL603)		

Pre-requisite: Knowledge of

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

Objectives:

1. To cover the fundamentals, mathematical models and transformation techniques in digital image processing.
2. To develop time and frequency domain techniques for image enhancement.

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

1. Understand and analyze concept of sampling, quantization and various color models in image processing
2. Implement various image enhancement algorithms in spatial domain
3. Apply different image Transforms in applications
4. Apply various filters for image restoration
5. Recognize different shapes using various representation/segmentation techniques and classify the object using different classification methods

Fundamentals of Digital Image Processing (DJ19ECC603)		
Unit	**Description**	**Duration**
1	**Digital Image Fundamentals:** Steps in Digital Image Processing, Components, Image Sampling and Quantization **Color Image Processing:** Color Fundamentals Color models	**04**
2	**Image Enhancement (point processing):** Image Negative, Thresholding, Gray level slicing with and without background, power law and log transform, Contrast Stretching, Histogram equalization and Histogram Specification **Image Enhancement in Spatial Domain (Neighborhood processing):** Basics of Spatial Filtering, Generating Spatial Filter Masks–Smoothing and Sharpening Spatial Filtering **Image Transforms:** 1-D DFT, 2-D Discrete Fourier Transform and Its Inverse, Some Properties of 2D DFT, Walsh -Hadamard, Discrete Cosine Transform, Haar Transform, Slant Transform **Image Enhancement in Frequency Domain**: The Basics of Filtering in the Frequency Domain, Smoothing and Sharpening frequency domain filters	**12**

3	**Morphology:** Erosion and Dilation, Opening and Closing, The Hit or-Miss Transformation. **Restoration**: Noise models – Mean Filters – Order Statistics – Adaptive filters –wiener filter	**06**
4	**Point, Line, and Edge Detection:** Detection of Isolated Points, Line detection, edge models, basic and advance edge detection, Edge linking and boundary detection, Canny's edge detection algorithm **Thresholding:** Foundation, Role of illumination, Basic Global thresholding, Otsu's method **Region Based segmentation:** Region Growing, Region Splitting and merging, Relationships between pixels, Hough transform **Region Identification:** chain code, simple geometric border representation, Fourier Transform of boundaries, Boundary description using segment sequences	**12**
5	**Object Recognition:** Knowledge representation, Classification Principles, Classifier setting, Classifier Learning, Support vector machine, Kernels, cluster analysis, K means Clustering	**08**

Fundamentals of Digital Image Processing Laboratory (DJ19ECL603)	
Exp.	**Suggested Experiment List**
1	To perform basic Image Processing, Geometric, Arithmetic and Logical operations on images.
2	To perform Spatial Domain Image Enhancement using different Point Processing techniques
3	To perform Spatial Domain Image Enhancement using different Neighborhood Processing techniques
4	To perform Histogram equalization
5	Application of Harr transform in image processing
6	To perform frequency domain Image Enhancement techniques
7	To perform region-based segmentation
8	To perform morphological operations on Image
9	To perform edge detection using basic and advanced techniques
10	To perform Image restoration using various filters

11	To perform classification using Support Vector Machine
12	To perform clustering using K-means algorithm

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. Gonzales and Woods, “Digital Image Processing”, Pearson Education, Third Edition, 2002.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis, and Machine Vision”, Cengage Engineering, Third Edition, 2013.

Reference books:

1. Anil K.Jain, “Fundamentals of Image Processing”, Prentice Hall of India, First Edition, 1989.
2. W. Pratt, “Digital Image Processing”, Wiley Publication, Third Edition, 2002.

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Basic VLSI (DJS22EC6011)		
Course: Basic VLSI Laboratory (DJS22EL6011)		

Pre-requisite:

1. Electronics Circuit Design (DJS22EC302)
2. Digital System Design (DJS22EC303)
3. Integrated Circuits (DJS22EC402)

Objectives:

1. To highlight the circuit design issues in the context of VLSI technology.
2. To provide understanding of VLSI circuit design using different design styles.
3. To provide introduction to HDL programming.

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

1. Understand transistor scaling and VLSI circuit performance.
2. Realize logic circuits using different design styles.
3. Understand operation of memory, storage circuits and data path elements.
4. Design digital circuits using HDL language.

Basic VLSI (DJS22EC6011)		
Unit	**Description**	**Duration**
1	**MOSFET Scaling:** Types of scaling, short channel effects. **Layout:** Lambda based design rules(CMOS), MOSFET capacitances.	**06**
2	**CMOS INVERTER Circuit Analysis:** Static and dynamic analysis (Noise, propagation delay and power dissipation) of resistive load and CMOS inverter. Comparison of all types of MOS inverters. Design of CMOS inverters and its layout. **Design styles:** Static CMOS, Dynamic CMOS, pass transistor logic, transmission gate, Pseudo NMOS, Domino logic, C^2MOS, NORA logic, NP Domino logic ,Realization of Multiplexer (up to 4:1 Mux) , Encoder, Decoder, SR Latch, JK FF, D FF, 1 Bit Shift Register design in different design styles and their layouts	**14**
3	**Memory and Storage circuits:** ROM array, SRAM (operation, design strategy, leakage currents, read /write circuits), layout of SRAM. DRAM (Operation of 1T, 3T, operation modes, refresh operation, Input-Output circuits), layout of DRAM.	**08**

4	**Data path design:** Full adder, Ripple carry adder, CLA adder, Carry Skip Adder, Carry Save Adder and carry select adder, Array Multiplier, Barrel shifter	**08**
5	**Design methods:** Semi-custom Full custom design PLA PAL PROM FPGA PLD. Introduction to Verilog Programming.	**04**
	Total	**40**

Basic VLSI Laboratory (DJS22EL6011)	
Exp.	**Suggested Experiment List**
1	To study MOS characterization using simulation software
2	Static analysis of CMOS Inverter
3	Dynamic analysis of CMOS Inverter
4	Multiplexer design using pass transistor and transmission gate logic style
5	1-bit CMOS Adder design using static CMOS logic style
6	1-bit CMOS mirror Adder design
7	To write Verilog Program for flip flops
8	To write Verilog Program for adders
9	To write Verilog Program for multiplexers
10	Design and simulation of barrel shifter circuit in SPICE
11	To write Verilog code and simulation of barrel shifter
12	To study MOS characterization using simulation software

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

Books Recommended:

Text books:

1. Sung-Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits Analysis and Design", Tata McGraw Hill, Third Edition, 2012.
2. Samir Palnitkar," Verilog HDL: A Guide to Digital Design and Synthesis", PHI, Second Edition, 2017.

Reference Books:

1. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, Second Edition, 2003.
2. P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley & Sons, First Edition, 2006.

3. Frank Vahid, “Digital Design with RTL design, VHDL and VERILOG”, John Wiley and Sons Publisher, Second Edition, 2011.
4. Neil H. E. Weste, David Harris and Ayan Banerjee, “CMOS VLSI Design: A Circuits and Systems Perspective”, Pearson Education, 3rd Edition, 2006.

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Control Systems (DJS22EC6012)		
Course: Control Systems Laboratory (DJS22EL6012)		

Pre-requisite:

1. Basic Electrical Engineering & Digital Electronics (DJS22FECBE)
2. Engineering Mathematics-I (DJS22FEC11)
3. Engineering Mathematics-II (DJS22FEC21)

Objectives:

1. To provide fundamental concept of control systems.
2. To introduce mathematical modelling, time domain analysis & frequency domain analysis.
3. To develop concepts of stability and its assessment criteria of the system.
4. To study basic concepts of controllers.

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

1. Understand the basic concepts of control system.
2. Derive the mathematical model of different type of the systems.
3. Analysis of systems in time and frequency domain.
4. Understand & Find stability of given system using appropriate criteria.
5. Apply the control theory to design the conventional controllers widely used in the industries.

Control Systems (DJS22EC6012)		
Unit	**Description**	**Duration**
1	**Introduction to Control Systems:** Introduction: Open loop, closed loop systems, feed forward control, & adaptive control systems, examples of control systems. Modeling: Types of models, impulse response model, transfer function model. Dynamic Response: Standard test signals, transient and steady state behavior control systems, steady state errors in feedback control systems and their types.	**08**
2	**Mathematical Modeling of Systems:** Conversion of block diagram to signal Flow Graph and Vice-versa., Transfer Function models of various Electrical systems, Block diagram reduction for single inputs single outputs(SISO) and multiple inputs multiple outputs(MIMO) systems, signal flow graph, Mason's gain rule.	**10**
3	**State Variable Models:** Basic concepts, state variable and state models for electrical systems, general state space representation, conversion between state space and transfer function, concept	**07**

	of state transition matrix, properties of state transition matrix, controllability and observability, analysis of LTI systems, with Examples.	
4	**Stability Analysis:** Concept of stability, Routh stability criterion, Root-locus, general rules for constructing root-locus, Magnitude and phase plot; Method of plotting Bode plot; Stability margins on the Bode plots, Nyquist stability criterions gain and phase margins. Case study on stability of Control System in Thermal Power Plant.	**10**
5	**Controllers & Compensators:** Introduction of PI, PD, and PID Controllers, Lead and Lag compensators. Case study on a model-driven PID control system.	**05**
	Total	**40**

Control Systems Laboratory (DJS22EL6012)	
Exp.	**Suggested Experiment List**
1	To Verify the effect of zero and pole to the second order closed loop control system.
2	To find static errors for type 0, type 1, type 2 control System.
3	To plot frequency response of a 1st order and 2nd order control systems.
4	To find transfer function of a 1st order and 2nd order control systems.
5	To verify the effect of Zero and pole to open loop transfer function of a second order. system with unity feedback.
6	To find controllability & observability of the given control system.
7	To design root locus for given control system.
8	To design Bode plot for first and second order control system.
9	To design Nyquist plot for given control system.
10	Verification of observability and controllability for given control system.
11	To find Transfer functions of P, PI, and PID controller.
12	To study Servo mechanism and characteristics of servo motor.

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. I. J. Nagrath, Madan.Gopal, “Control System Engineering”, New Age International Publication, Seventh Edition, 2021.
2. K.Ogata, “Modern Control Engineering”, Pearson Education”, Fifth Edition, 2015.
3. Normon S. Nise, “Control System Engineering”, John Wiley & sons, Eighth Edition, 2020.

Reference Books:

1. Madan Gopal, “Control Systems Principles and Design”, Tata McGraw hill, Seventh Edition, 2012.
2. Ajit K.Mandal, “Introduction to Control Engineering: Modeling, Analysis and Design”, New Age International Publication, Second Edition, 2010.
3. S.Hasan Saeed, “Automatic Control System”, S.K. Kataria & Sons, Ninth Edition, 2017.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Neural Networks & Fuzzy Logic (DJS22EC6013)		
Course: Neural Networks & Fuzzy Logic Laboratory (DJS22EL6013)		

Pre-requisite:

1. Engineering Mathematics-I (DJS22FEC11)
2. Engineering Mathematics-IV (DJS22EC401)

Objectives:

1. To introduce the concepts and understanding of artificial neural networks and fuzzy logic.
2. To introduce neural network design concepts
3. To expose neural networks based methods to solve real world complex problems
4. To provide knowledge of fuzzy logic to design the real world fuzzy systems

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

1. Explain training of Neural Networks using various training rules with consideration of different parameters like overfitting, under fitting,
2. Calculate and update the weights of the neural networks to Specify the working and applications of different types of neural networks.
3. Design fuzzy sets for various applications and solve fuzzy set theory problems.
4. Design various engineering application using Neural Networks/ Fuzzy Logic.

Neural Networks & Fuzzy Logic (DJS22EC6013)		
Unit	**Description**	**Duration**
1	**Introduction to Neural Networks:** Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Potential Applications of ANN.	**04**
2	**Essentials of Artificial Neural Networks:** Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.	**04**
3	**Supervised Neural Networks:** Feed forward neural network, Single-Layer feed forward architecture-Perceptron, Multiple-Layer feed forward architecture, Types of feed forward networks, Multi-layer perceptron, Training MLP: The back-propagation algorithm, Introduction to the concept of Support Vector Machine based classifier, GRADIENT-DESCENT algorithm, Generalization, Factors to be considered, Assessing the success of learning, Metrics for evaluation of	**10**

	classification method, Steps to use neural networks to data, Over fitting, Detecting over fit models: Cross validation	
4	**Unsupervised Learning Neural Networks:** Competitive Learning Networks – Maxnet, Mexican Hat Net, Kohonen Self-Organizing Networks – architecture, training algorithm, K-means, Radial Basis Function (RBF) neural network – architecture and algorithm, and Discrete Hopfield networks.	**10**
5	**Fuzzy logic:** Introduction to fuzzy logic, Basic Fuzzy logic theory, Fuzzy sets - properties & operations, Fuzzy relation - Operations on fuzzy relations, Fuzzy Membership functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzification and Defuzzification methods, Fuzzy Inference Systems, Mamdani Fuzzy Models, Fuzzy knowledge-based controllers, Sugeno Fuzzy Models.	**06**
6	**Applications of Fuzzy Logic and Fuzzy Systems:** Fuzzy pattern recognition, fuzzy C-means clustering, fuzzy image processing, Simple applications of Fuzzy knowledge-based controllers like washing machines, home heating system, and train break control.	**06**
	Total	**40**

Neural Networks & Fuzzy Logic Laboratory (DJS22EL6013)	
Exp.	**Suggested Experiment List**
1	Fuzzy Set Operations: AND, OR, D-Morgan's theorem.
2	(a)Simulation of Mamdani Fuzzy Inference System for washing machine control.
	(b) Summery of research paper based on Fuzzy logic.
3	Simulation of Sugeno Fuzzy Inference System for given application.
4	Simulation of Mamdani Fuzzy Inference System for image processing application. (Edge detection).
5	Write a program for perceptron training algorithm and test it for two input AND & OR gate function.
6	Write a program for training and testing of Multilayer Perceptron for two input EX-OR gate.
7	Write a program for training and testing of Multilayer Perceptron for character recognition application.
8	Program for Radial basis neural network for interpolation application.
9	Write a program for training and testing of RBF for pattern classification application.
10	Kohenan Self Organising map for image classification.
11	To Study the use of Microsoft Machine Learning Studio (classic) in Neural Network and Machine Learning.
12	Case study.

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. S. N. Sivanandam and S. N. Deepa , "Introduction to Soft computing", Wiley India Publications, Third Edition, 2018.
2. S. Rajasekaran, G.A. Vijayalakshmi Pai , "Neural Networks, Fuzzy Systems And Evolutionary Algorithms: Synthesis And Applications", Second Edition , 2017.

Reference Books:

1. Thimothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India Publications, Third Edition, 2011.
2. John Yen and Reza Langari, "Fuzzy Logic- Intelligence, Control and Information", Pearson Publications, First Edition, 1998.
3. J. S. R. Jang, C.T. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, First Edition, 1996.
4. Simon Haykin, Neural Networks and Learning Machines, Pearson Education, Third Edition, 2016
5. S. N. Sivanandam, S. Sumathi, and S. N. Deepa, Introduction to Neural Network Using Matlab, Tata McGraw-Hill Publications, First Edition, 2017

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Operating Systems (DJS22EC6014)		
Course: Operating Systems Laboratory (DJS22EL6014)		

Pre-requisite:

1. Structured Programming using C (DJS23FCES101)

Objectives:

1. To introduce operating system as a resource manager, its evolutions and fundamentals.
2. To help student understand concept of process and different process (linear and concurrent) Scheduling policies.
3. To help student familiar with memory, file and I/O management policies.

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

1. Understand the fundamental concepts of OS.
2. Analyze the management policies adopted by processes, memory, File handling and I/O operations.
3. Apply the algorithms used for memory management, CPU scheduling and disk scheduling.
4. Apply concepts related to deadlock to solve the problems.
5. Analyze the functionalities of OS like Unix, Linux and Real Time Operating System.

Operating Systems (DJS22EC6014)		
Unit	**Description**	**Duration**
1	**Fundamental of Operating System (OS):** Definition, objectives, functions, evolution, services, types, and different views of OS Operating System as a resource manager, system calls, and shell, Monolithic systems, layered systems, client server model, monolithic kernel and Microkernel.	**04**
2	**Process Management and Memory Management:** Process, process creation, process control block, process states, process state transition diagram, Scheduling queues and schedulers, preemptive and non-preemptive scheduling algorithms, types of threads, multithreading models, Race condition, critical section, mutual exclusion, semaphores, monitors, Multiprogramming with fixed and variable partitions, memory allocation strategies, Logical and physical address space, paging and segmentation, Concept, performance of demand paging, page replacement algorithms, Deadlock Problem, deadlock characterization, deadlock prevention and deadlock avoidance deadlock detection and recovery.	**08**

3	**File Management and Input Output Management:** File Naming, File Structure, File Types, File Access, File Attributes, File Operations, Memory Mapped Files, Implementing Files, contiguous allocation, linked list allocation, indexed allocations, Single level directory system, Two level directory system, Hierarchical Directory System, Principles of Input/output H/W: I/O Devices, Device Controllers, Direct Memory Access, Principles of Input/output S/W: Goals Of I/O S/W, Interrupt Handler, Device Driver, Device Independent I/O Software, Disks :RAID levels, Disks Arm Scheduling Algorithms, Management of free blocks.	**08**
4	**Unix Operating System:** History of UNIX, UNIX Goals, Unix Shell, interfaces to Unix, UNIX utility programs, Traditional UNIX Kernel, Modern UNIX Systems, Unix process management: Concept, Scheduling in Unix, Unix Memory management: Paging, Page replacement strategies, Unix file management: I-node, File allocation, I/O management, Unix Security measures.	**08**
5	**Linux Operating System:** History, Linux Processes and Thread management, Scheduling in Linux, Linux System calls, Memory management: Virtual memory, Buddy Algorithm, Page replacement policy, Linux File System, I/O management: Disk Scheduling, Advantages of Linux and Unix over Windows.	**08**
6	**Real Time Operating System (RTOS):** Introduction, Characteristics of real-time operating systems, Real Time task Scheduling, Modeling Timing constraints, Table-driven scheduling, Cyclic schedulers, Earliest Deadline First (EDF) scheduling, Rate Monotonic Algorithm. (RMA)	**04**
	Total	**40**

Operating Systems Laboratory (DJS22EL6014)	
Exp.	**Suggested Experiment List**
1	To implement Linux commands.
2	To implement Linux shell script.
3	To implement any one the basic commands of Linux like ls, cp, mv and others using kernel APIs.
4	To implement preemptive and non-preemptive algorithms.
5	To implement concept of deadlock.
6	To implement concept of memory management.
7	To implement demand and virtual memory implementation.
8	To implement file allocation strategies.

9	To implement disk scheduling techniques.
10	To implement file organization techniques.

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. Andrew Tanenbaum, "Modern Operating Systems", PHI Publication, Third Edition, 2009.
2. William Stallings, "Operating System-Internal & Design Principles", Pearson, Sixth Edition, 2008.

Reference books:

1. Silberschatz A., Galvin P., and Gagne G, "Operating Systems Concepts", Wiley, Eight Edition, 2009.
2. Richard Blum and Christine Bresnahan, "Linux Command Line & Shell Scripting", Wiley, Second Edition, 2011.
3. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson, First Edition, 2009.

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Big Data Analytics (DJS22EC6015)		
Course: Big Data Analytics Laboratory (DJS22EL6015)		

Pre-requisite:

1. Data Base Management System laboratory (DJS22EL406)

Objectives:

1. To Provide an Overview of an exciting growing field of Big Data Analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSql, Map Reduce, Spark.
3. To teach the fundamental techniques in achieving big data analytics with scalability and streaming capability.

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

1. Understand the key issues in big data management and its associated applications for business decisions and strategy.
2. Understand and Develop problem solving and critical thinking skills in fundamental enabling techniques like Hadoop and NoSQL in big data analytics.
3. Evaluate Big Data processing by using Map Reduce.
4. Interpret business models and scientific computing paradigms and apply software tools for big data analytics.
5. Exploring the capabilities of big data using Apache Spark.

Big Data Analytics (DJS22EC6015)		
Unit	**Description**	**Duration**
1	**Introduction to Big Data Analytics & Hadoop:** Introduction to Big Data, Big Data characteristics, Types of Big Data, Traditional vs. Big Data business approach. Technologies available for Big Data, Infrastructure for Big Data, Big Data challenges, Case Study of Big Data solutions. Introduction to Hadoop, Core Hadoop components, Hadoop Ecosystem, Physical architecture, Hadoop limitations.	**08**
2	**NoSQL:** Introduction to NoSQL, NoSQL business drivers, NoSQL case studies. NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns. Analysing big data with a shared-nothing architecture, Choosing distribution models, master-slave versus peer-to-peer Introduction to MongoDB, MongoDB commands.	**07**

3	**MapReduce:** MapReduce and The New Software Stack: Distributed File Systems, Physical organization of compute Nodes, Large scale file-system organization. MapReduce: The Map tasks, grouping by key, The Reduce tasks, Combiners, Details of MapReduce execution, Coping with node failures. Matrix vector multiplication using MapReduce, Relational operators using MapReduce	**08**
4	**Techniques in Big Data Analytics:** Finding Similar Item: Nearest Neighbour Search, Similarity of Documents. Mining Data Streams: Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications: Sensor Networks, Network Traffic Analysis. Frequent Itemset Mining: Market Basket Model- Applications, Association Rule- Confidence, Interest, Support, Apriori Algorithm - Pass1, Pass2 Recommendation Systems: Introduction, Collaborative-Filtering System, Content based recommendation system Link analysis: Page rank algorithm, Structure of web	**10**
5.	**Big Data Analytics using Apache Spark:** Introduction to Spark: Features, Spark built on Hadoop, Components of Spark**.** Resilient Distributed Datasets: Data sharing using Spark RDD, Iterative operations on Spark RDD, Interactive operations on Spark RDD, RDD transformations, Execution of word count transformation.	**07**
	Total	**40**

Big Data Analytics Laboratory (DJS22EL6015**)**	
Exp.	**Suggested Experiment List**
1	Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2	Execution of Hadoop file handling commands.
3	Installation of MongoDB and execution of CREATE, INSERT, DELETE and UPDATE operations.
4	Querying in MongoDB using FIND command, aggregate functions etc.
5	Designing of graphical data store and querying in Neo4j.
6	Execution of PIG SCRIPTING language.
7	Execution of HIVE SCRIPTING language.
8	Execution of Matrix Multiplication Using MapReduce.

9	Execution of Word Count using MapReduce.
10	Execution of Word Count using Apache Spark

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. Radha Shankarmani, M Vijayalakshmi, "Big Data Analytics", Wiley, Second Edition, 2016.
2. Alex Holmes, "Hadoop in Practice", Manning Press, Dreamtech Press, Second Edition, 2015.
3. Holden Karau, Andy Konwinski, Matei Zaharia, "Learning Spark" O'Reilly, Second Edition, 2015.

Reference Books:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Big Data Series, Edition, 2017.
2. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing Limited First Edition, 2013.
3. Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, Second Edition, 2016.

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Radar Engineering (DJS22EC6016)		
Course: Radar Engineering Laboratory (DJS22EL6016)		

Pre-requisite:

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

Objectives:

1. To interpret Radar equations.
2. To explain different types of radar.
3. To design Radar transmitters and receivers for given conditions.

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

1. Understand generalized concept of RADAR & its applications.
2. Solve problems using radar equations.
3. Describe different types of radar for specific application.
4. Explain concept of tracking radar.
5. Evaluate the design constraints for transmitter and receiver.

Radar Engineering (DJS22EC6016)		
Unit	**Description**	**Duration**
1	**Introduction to Radar:** Basic Radar, basic ranger equation, Block Diagram, Radar Frequencies, Applications of Radar.	**08**
2	**Radar Range Equation:** Detection of signal in noise, Receiver Noise and Signal-to-noise Ratio, Probability of detection and false alarm: Simple, complex Targets, Pulse Repetition Frequency	**08**
3	**MTI and Pulse Doppler Radar:** Introduction to Doppler and MTI radar, Doppler frequency shift**,** Simple CW Doppler radar, MTI radar block diagram**,** Delay line canceler**,** Moving-target-detection**,** Pulse Doppler radar	**10**
4	**Tracking Radar:** Mono pulse tracking, Conical scan and sequential lobbing, Limitation of tracking accuracy, Low angle tracking.	**06**
5	**Radar Transmitter and Receiver:** Radar RF power sources: Klystron, Travelling wave tube , Magnetron, Low power transmitter, high power transmitter, Advantages of solid state RF power source, Duplexer, and Mixer and their types, Receiver noise figure, Radar Display: Types of displays	**08**
	Total	**40**

Radar Engineering Laboratory (DJS22EL6016)	
Exp.	**Suggested Experiments List**
1	To study basic Radar and range equation.
2	To Study CW Radar and find the relative speed of the object.
3	Derive Radar range equation with noise figure and find the distance.
4	To study MTI Radar and find the blind speed.
5	Calculate pulse repetition frequency and velocity of the moving object.
6	To study various displays used in Radar systems.
7	To study clutters and its effects on Radar range equation.
8	To study delay line canceller.
9	Find the speed of the fan using Doppler Radar.
10	To study duplexer and mixer.
11	To study tracking Radar.

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. Merrill Skolnik," Introduction to Radar Systems", Tata McGra Hill, Second Edition, 2010
2. G S N Raju, "Radar Engineering", Willey publication, First Edition,2020.
3. Bassem R. Mahafza, "Radar Signal Analysis", CRC press, First Edition, 2021.

Reference Books:

1. E David Jansing, "Introduction to Synthetic Aperture Radar", McGraw Hill, Second Edition, 2021.
2. Clive Alabaster,"Pulse Doppler Radar", SciTech Publishing, Second Edition, 2012.
3. William L Melvin, James A Scheer, "Principals of Modern Radar", SciTech Publishing, First Edition, 2014.

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Linear Algebra (DJS22EC6017)		
Course: Linear Algebra Laboratory (DJS22EL6017)		

Pre-requisite:

1. Engineering Mathematics-IV (DJS22EC401)

Objectives:

1. Understanding basic concepts of linear algebra to illustrate its power and utility through applications.
2. Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in Engineering.

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

1. Explain the abstract concepts of matrices and system of linear equations using decomposition Methods.
2. Demonstrate the basic notion of vector spaces and subspaces.
3. Apply the concept of vector spaces using linear transforms and inner product spaces applications in cryptography.

Linear Algebra (DJS22EC6017)		
Unit	**Description**	**Duration**
1	**System of Linear Equations:** Gaussian elimination and Gauss Jordan method Elementary matrices Permutation matrix inverse matrices System of linear equations LU factorizations.	**06**
2	**Vector Spaces:** The Euclidean space and vector space, subspace linear combination, span-linearly dependent-independent bases, dimensions, finite dimensional vector space, The four fundamental spaces, Rank and nullity Bases for subspace	**12**
3	**Linear Transformations:** Linear transformations, Basic properties, invertible linear transformation, matrices of linear transformations, vector space of linear transformations, change of bases	**10**
4	**Inner Product Spaces and Applications:** Dot products and inner products, the lengths and angles of vectors, matrix representations of inner products, Gram-Schmidt Orthogonalisation, QR factorization- Projection - orthogonal projections	**07**

5	**Applications:** An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption.	**05**
	Total	**40**

Linear Algebra Laboratory/Tutorial (DJS22EL6017)	
Tuts	**Suggested Tutorial List**
1	Gaussian elimination and Gauss Jordan Method
2	LU Factorizations
3	The Four Fundamental Spaces
4	Linear Transformations
5	Gram-Schmidt Orthogonalisation
6	QR Factorization
7	Linear Dependence and Independence
8	Least Squares Approximation
9	Case Study: Classical Cryptosystems

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

Books Recommended:

Text books:

1. Jin Ho Kwak and Sungpyo Hong, “Linear Algebra”, Springer, Second Edition, 2004.
2. Bernard Kolman and David, R., “Introductory Linear Algebra- An applied first course”, Pearson Education, Ninth Edition, 2011.

Reference Books:

1. Stephen Andrilli and David Hecker, “Elementary Linear Algebra”, Academic Press, Fifth Edition, 2016.
2. Rudolf Lidl and Guter Pilz,, “Applied Abstract Algebra, Springer, Second Edition, 2004.
3. Howard Anton, Robert C Busby, “Contemporary linear algebra”, Wiley, First Edition, 2003.
4. Gilbert Strang, “Introduction to Linear Algebra”, Cengage Learning, Fifth Edition, 2015.

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Innovative Product Development-IV (DJS22ILLL2)		

Pre requisite:

1. Analog Communication
2. Microcontroller & Applications-I and II (DJS22EC404 and DJS22EC503)

Objectives:

1. To implement the solution as per the problem statement.
2. To develop the team building, writing, logical reasoning and management skills.
3. To provide the connections between the designs and concepts across different disciplinary boundaries.
4. To encourage students to become independent personnel, critical thinkers and lifelong learners.

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

1. Apply engineering knowledge to produce solution of a problem considering cultural, social, environmental, and economic factors using appropriate tools and methods.
2. Demonstrate the idea of project based learning by Integrating and synthesizing different perspectives of a project from relevant disciplines.
3. Develop an ability to work in teams and manage the conduct of the research study.

Syllabus Domain knowledge (and beyond) needed from the following areas for the effective implementation of the project:

Microcontroller and Embedded Systems, Signal Processing, Microwave and Antennas, Networking and Internet of Things, Data science and Big data, Communication, Web and Application development, Robotics, AI and Machine learning

The above areas can be updated based on the technological innovations and development needed for specific project.

Guidelines:

The main purpose of this course is to improve the students' technical skills, communication skills and team management skills by integrating technical knowledge, technical writing, presentation and teamwork. Each project group have already under gone project topic allotment followed by two reviews in their fifth semester and in this semester, the students are expected to continue the project work.

1. Each group will be reviewed twice in a semester and marks will be allotted based on the various points mentioned in the evaluation scheme.
2. In the first review of this semester, each group is expected to implement 60% of project.

3. In the second review of this semester, each group is expected to implement 90% of project.
4. The students may use this opportunity to learn different computational techniques towards development of a product.
5. Interaction with alumni mentor will also be appreciated for the improvement of project.

Evaluation Scheme:

Semester End Examination (A):

Laboratory:

Oral examination should be conducted by Internal and External examiners. Students have to give presentation and demonstration based on 100% implementation of their project.

Continuous Assessment (B):

Laboratory: (Term work)

Each group will be reviewed twice in a semester by faculty guide and faculty coordinators based on the following criteria:

1. Project progress
2. Documentation/Technical paper writing
3. Key findings
4. Validation of results
5. Product Development

Each review consists of 25 marks. Average of the marks scored in both the reviews will be considered for final grading. The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

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