Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and detailed syllabus (DJS23)

Third Year B. Tech.

In

(Semester V)

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) (DJS23 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	DJS23ECPC501	Digital Signal Processing	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPC501	Digital Signal Processing Laboratory	-	2	-	1	-	25	25	-	25			25	50	
2	DJS23ECPC502	Wave Theory & Radio Frequency Design	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPC502	Wave Theory & Radio Frequency Design Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
3	DJS23ECPC503	Analog & Digital Communication	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPC503	Analog & Digital Communication Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
4	S23ECPE5011	Radar Engineering	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	S23ELPE5011	Radar Engineering Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
	DJS23ECPE5012	Computer Organization & Architecture	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE5012	Computer Organization & Architecture Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
	DJS23ECPE5013	Control System	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE5013	Control System Laboratory	-	2		1		25	25		25			25	50	
	DJS23ECPE5014	Linear Algebra	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE5014	Linear Algebra Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
	DJS23ECPE5015	Advanced Microcontroller	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE5015	Advanced Microcontroller Laboratory		2	-	1	-	25	25	-	25	-	-	25	50	
	DJS23ECPE5016	Neural Network & Fuzzy Logic	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE5016	Neural Network & Fuzzy Logic Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
5	DJS23ECMD501	Data Base Management System	2	-	-	2	40	-	40	60	-	-	-	60	100	2
	DJS23ELMD501	Data Base Management System Laboratory	-	2	-	1	-	25	25	-	-	-	-	-	25	1
6	DJS23ITHSX10	Environmental Studies	-	-	1	1	-	25	25	-	-	-	-	-	25	1
7	DJS23IPSCX03	Innovative Product Development III	-	2	-	1	-	25	25	-	-	-	25	25	50	1
		Total	**14**	**12**	**1**	**21**	**200**	**175**	**375**	**300**	**100**	**0**	**25**	**425**	**800**	**21**

Program: Electronics and Telecommunication Engineering	B. Tech	Semester: V
Course : Digital Signal Processing	Course Code: DJS23ECPC501	
Course : Digital Signal Processing-Laboratory	Course Code: DJS23ELPC501	

Pre-requisite:

1. Mathematics for Telecommunication Engineering (DJS23ECPC301)
2. Signals & Systems (DJS23ECPC401)
3. Signals & Systems Tutorial (DJS23ETPC401)

Objectives:

1. To develop a thorough understanding of DFT and FFT and their applications.
2. To design digital filters and analyse their performance.
3. To understand the effects of poles and zeros in the frequency response of digital filters.

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

1. Understand the concept of DFT and FFT and their use in analysis of the LTI system.
2. Apply the knowledge of LTI system to design FIR and IIR filter for given specifications and realize them.
3. Analyze the discrete time LTI systems and processors for measuring the performance of digital filters.
4. Evaluate the effect of finite word length on FIR and IIR filter performance.

Digital Signal Processing (DJS23ECPC501)		
Unit	**Description**	**Duration**
1	**Discrete Fourier Transform & Fast Fourier Transform:** Definition and Properties of DFT, IDFT, Linear and Circular convolution of sequences using DFT and IDFT. Filtering of long data sequences: Overlap-Save and Overlap-Add Method for computation of DFT, Frequency Analysis of Signals Using the 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.	**08**
2	**Analysis of Linear Time Invariant System:** Ideal Filter Characteristics, Position of Poles and Zeros for Low Pass, High Pass, Band Pass, Band Stop, All pass filters, Effect of Poles and Zeros on the Frequency Response, Digital Resonators, Notch Filters, Comb Filters, All-Pass Filters, Digital Sinusoidal Oscillators, Minimum-Phase, Maximum-Phase, and Mixed-Phase Systems.	**08**

3	**FIR Digital Filters and realization:** Characteristics of FIR digital filters, Design of Symmetric and Antisymmetric FIR Filters (Type 1 to Type 4) and its realization, Design of Linear Phase FIR filters using Window techniques (Rectangular, Bartlett, Hamming, Hanning, Blackman), Design of Linear Phase FIR filters using Frequency Sampling technique. FIR filter realization: Direct Form, Cascade and frequency sampling realization	**08**
4	**IIR Digital Filters and realization:** Mapping of S-plane to Z-plane using impulse invariance method (IIM) and bilinear transformation method (BLT), Conversion of analog filter to digital filter, Analog filter approximations: Butterworth, Chebyshev I, Types of IIR filter (Butterworth, Chebyshev-I, Chebyshev-II, Elliptical), Design of IIR digital filters (Butterworth and Chebyshev-I), Frequency Transformations, Compare FIR and IIR filter, IIR filter realization: Direct Form, Cascade and Parallel Form.	**10**
5	**Finite word length effect on FIR and IIR filter performance:** Errors Resulting from Rounding and Truncation, Analysis of Sensitivity to Quantization of Filter Coefficients, Quantization of Coefficients in FIR Filters, Output noise power from a digital system, Product quantization, Noise model for direct form and cascaded IIR structure (first order), Coefficient quantization error and zero input limit cycle, Limit-Cycle Oscillations in Recursive Systems, Scaling to Prevent Overflow	**06**
	Total	**40**

Digital Signal Processing (DJS23ELPC501)

Exp.	Suggested Experiment List
1	To determine linear and circular convolution using DFT/FFT.
2	To perform Overlap-Add/Overlap-Save methods for long data sequence using DFT/FFT.
3	To find the effect of poles and zeros on FIR/IIR filters (Frequency response).
4	To design linear phase filters and plot magnitude and phase responses.
5	To Design a FIR filter by window method.
6	To Design a FIR filter by frequency sampling method
7	To design Butterworth and Chebyshev-I IIR filters.
8	To perform basic signal processing operations with DSP processor (fixed point/Floating point).
9	To Generate elementary signal (Sine/Cosine) and find its frequency response using DSP processor (fixed point/Floating point).
10	To implement a system for Real time signal filtering by DSP Processor.
11	To design a FIR/IIR filter to remove a noise (sine wave with a given frequency) corrupting ECG/Speech signal.

12	To measure the effect of finite word length on FIR/IIR filter performance.
13	To realize FIR and IIR Filters using Direct Form, Cascade/Parallel form structures.
14	To simulate a system for signal analysis or synthesis.
15	To implement a discrete time system for signal processing using DSP Processor.

Minimum **eight** experiments from the above suggested list considering at least one experiment from each module or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Books Recommended:

Textbooks:

1. J. G. Proakis, D. G. Manolakis, "*Digital Signal Processing*," Pearson Education, Fourth Edition, 2007.
2. S. Salivahan, C. Gnanapriya, "*Digital Signal Processing*," McGraw Hill Education (India), Fourth Edition, 2015
3. B. Venkata Ramani and M. Bhaskar, "*Digital Signal Processors, Architecture, Programming and Applications*," Tata McGraw Hill, Second Edition, 2004.

Reference Books:

1. Alan V. Oppenheim, Ronald W. Schafer, "*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. Emmanuel C. Ifeachor, Barrie W. Jervis, "*Digital Signal Processing - A Practical Approach*," Pearson Education, Second Edition, 2001
4. Monson H. Hayes, "*Digital Signal Processing*" Schaum's Outline Series, Second Edition, 2011

NPTEL / Swayam Course:

1. Course: Digital Signal Processing by Prof. S. C. Dutta Roy, IIT Delhi
   http://www.nptelvideos.in/2012/12/digital-signal-processing.html
2. Course: Digital Signal Processing by Prof. V. M. Gadre, IIT Bombay
   https://nptel.ac.in/courses/108/101/108101174/
3. Course: Digital Signal Processing by Prof. T. K. Basu, IIT Kharagpur
   https://nptel.ac.in/courses/108/105/108105055/

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Wave Theory and RF Design	Course Code: DJS23ECPC502	
Course: Wave Theory and RF Design Laboratory	Course Code: DJS23ELPC502	

Pre-requisite:

1. Mathematics for Telecommunication Engineering (DJS23ECPC301)
2. Electrical Networks (DJS23FCPC2EC)

Objectives:

1. To learn concept of static and time varying electromagnetic fields.
2. To solve problems related to EM fields using Vectors and Partial differential equations.
3. To learn Electromagnetic radiation and propagation in space and within transmission lines.

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

1. Compute electric and magnetic fields for symmetrical charge and current configurations using basic static and time varying principles of electromagnetics.
2. Explain the basic concept of S matrix and ABCD matrix in network analysis.
3. Explain the behaviour of Inductor, Capacitor and Resistor at high frequency.
4. Calculate various parameters of transmission line analytically and using Smith Chart.
5. Develop passive RF filter configurations for given specifications.

Wave Theory and RF Design (DJS23ECPC502)		
Unit	**Description**	**Duration**
1	**Electrostatics** Coulomb's Law, Gauss's Law and its applications, Electric Potential, Relationship between E and V, Electric Dipole and flux lines, Convection and Conduction Currents, Electric Boundary Conditions, Poisson's and Laplace's Equations, Uniqueness Theorem, General Procedure for solving Poisson's or Laplace's Equations. **Magnetostatics** Biot-Savart's Law, Ampere's Circuital Law and its applications, Magnetic Flux density, Maxwell's equations for Static Fields, Magnetic Scalar and Vector potentials, Magnetic boundary conditions.	**08**
2	**Time varying Fields** Faraday's Law, Transformer and Motional Electromotive Forces, Displacement Current Maxwell's equations in point form and integral form, Boundary conditions for time varying field, magnetic vector potential, Time harmonic fields.	**08**

	Electromagnetic Wave Propagation Derivation of Wave equation and its solution, Wave Propagation in lossy dielectrics, Plane waves in loss less dielectrics, free space and good conductors, Power and Poynting Vector, Reflection of a Plane wave at normal incidence and oblique incidence.	
3	**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.**	**05**
4	**Importance of Radio Frequency Design** **RF behaviour of Passive Components** High-Frequency Resistors, High-Frequency Capacitors, High-Frequency Inductors.	**04**
5	**Transmission Lines** Parameters, Transmission line equations, Input impedance, reflection coefficient, Standing wave ratio. **Smith Chart** **From Reflection Coefficient to Load Impedance** Reflection coefficient in Phasor Form, Normalised Impedance Equation, Parametric Reflection Coefficient Equation, Graphical Representation. **Impedance Transformation** Impedance Transformation for General Load, Standing Wave Ratio, Special Transformation Conditions.	**07**
6	**RF Filter Design** **Basic Resonator and Filter configurations** Filter Types and Parameters, Low-Pass Filter, High-Pass Filter, Bandpass and Bandstop Filters, Insertion Loss. **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. **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.	**08**

	Total	**40**

Wave Theory and RF Design (DJS23ELPC502)	
Exp.	**Suggested Experiment List**
1	Numericals on Electrostatics & Electric Boundary conditions
2	Numericals on Magnetostatics
3	Numericals on Time varying fields and Maxwell Equations
4	Numericals on Wave Propagation in different material
5	Numericals on network parameters and properties
6	Characterization of R/L/C at high frequency
7	Transmission line impedance calculations Analytical and Smith chart
8	Transmission line reflection coefficient calculations Analytical and Smith chart
9	Filter Design by the Image Parameter Method
10	Filter Design by the Insertion Loss Method

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. William H. Hayt and John A Buck, "*Engineering Electromagnetics",* Tata McGraw-Hill Publishing Company Limited, 9th Edition, 2020.
2. Ludwig, Reinhold & Bretchko, Pavel, "*RF circuit design: Theory and applications"*, Prentice-Hall, 2nd Edition, Upper Saddle River, N.J, 2011.

Reference Books:

1. Matthew N. O. Sadiku, S. V. Kulkarni, "*Principles of electromagnetics"*, Oxford University Press, 6th Edition, 2015.
2. Pozar, David M, "*Microwave Engineering*", Hoboken, NJ: Wiley Publication, 2012.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	**T. Y. B. Tech**	**Semester: V**
Course: Analog and Digital Communication	**Course Code: DJS23ECPC503**	
Course: Analog and Digital Communication Laboratory	**Course Code: DJS23ELPC503**	

Pre-requisite:

1. Signal & Systems (DJS23ECPC401)

Objectives:

1. To Learn various Analog and Digital Communication Systems.
2. To equip students with the knowledge and skills to design, analyse, and implement efficient source and error coding techniques for data compression, error detection, and correction, enabling reliable and optimized communication across various digital systems.

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

1. Analyze Analog Communication techniques and reception.
2. Describe pulse communication and pulse code modulation systems.
3. Demonstrate and compare various digital modulation techniques.
4. Design and implement source and error control coding schemes.

Analog and Digital Communication (DJS23ECPC503)		
Unit	**Description**	**Duration**
1	**Analog Communication systems and reception** Introduction to communication system, Amplitude modulation, Frequency modulation, mathematical analysis of FM signal, Modulation index, BW requirement, pre-emphasis and de-emphasis, narrow &wideband FM. Radio receivers characteristics and TRF and super-Heterodyne receiver.	**08**
2	**Sampling Theorem and Pulse-Modulation Techniques** Sampling theorem and aliasing error. Types of Pulse modulation- PAM, PWM and PPM. PCM Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Commanding, DPCM, Adaptive DPCM, DM and Adaptive DM, Noise in PCM and DM.	**08**
3	**Digital Modulation Techniques** ASK- Modulator, M-ary scheme, Coherent ASK Detector, FSK- Modulator, Non- Coherent FSK Detector, BPSK- Modulator, Coherent BPSK Detection. Principles of QPSK, Differential PSK and QAM.	**10**
4	**Baseband Transmission and Optimal Reception of Digital Signal** A Baseband Signal Receiver, Probability of Error, Optimum Receiver, Coherent Reception, ISI, Eye Diagrams.	**4**

5	**Source and error control coding** Entropy, Source Encoding Theorem, Shannon Fano Coding, Huffman Coding, Mutual Information, Channel Capacity, Error Control Coding, Linear Block Codes, Cyclic Codes	**08**
	Total	**38**

Analog and Digital Communication (DJS23ECPC503)	
Exp.	**Suggested Experiment List**
1	Study of Amplitude Modulation.
2	Study 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	Entropy and Mutual Information
14	Source Coding Algorithms (Huffman coding)
15	Linear block codes (Error detection and correction)
16	Cyclic codes (comparison of performance of coded and un-coded system)
17	Convolutional Encoding.
18	ASK, FSK And PSK
19	Generation and Detection of Binary Amplitude Shift Keying (BASK)
20	Generation of Binary FSK signal modulation (FSK)

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. T. L. Singal, "*Analog and Digital Communications*", Tata Mc-Graw Hill, 1st Edition 2014.
2. Kennedy, Davis, "*Electronics Communication Systems"*, Tata Mc-Graw Hill, 4th Edition, 2012.

Reference Books:

1. Toub Schilling and Shaha, "*Principles of Communication Systems*", Tata McGraw Hill, 4th Edition, 2016.
2. Sklar B, and Ray P. K., "*Digital Communication: Fundamentals and applications*", Pearson, Dorling Kindersley (India), Delhi, 2nd Edition, 2009.
3. P Ramakrishna Rao, "*Digital Communication*", Tata Mc-Graw Hill, New Delhi, 1st Edition.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Radar Engineering	Course Code: DJS23EC5011	
Course: Radar Engineering Laboratory	Course Code: DJS23EL5011	

Pre-requisite:

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

Objectives:

1. To interpret Radar equations
2. To understand various types of Radar.
3. To identify various devices used in Radar transmitter and receiver.
4. To design Radar transmitter and receiver for given conditions.

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

1. Understand generalized concept of RADAR & its applications.
2. Analyse radar range equations in various conditions.
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 (DJS23EC5011)		
Unit	**Description**	**Duration**
1	**Introduction to Radar** Basic Radar, basic ranger equation, Block Diagram, Radar Frequencies, Applications of Radar.	**06**
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.	**08**

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, PPI, H-Scope, A-Scope, B-Scope, C-Scope, D-Scope, E-Scope, R-Scope etc.	**08**
	Total	**40**

Radar Engineering Laboratory (DJS23EL5011)	
Exp.	**Suggested Experiment 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 to be included, which would help the learner to apply the concept learnt.

Books Recommended:

Textbooks:

1. Merrill Skolnik," *Introduction to Radar Systems*", Tata McGra Hill, 2nd Edition, 2010.
2. G S N Raju, "*Radar Engineering*", Willey publication, 1st Edition, 2020.

Reference Books:

1. E. David Jansing, "*Introduction to Synthetic Aperture Radar*", McGraw Hill, 2nd Edition, 2021.
2. Clive Alabaster,"*Pulse Doppler Radar*", SciTech Publishing, 2nd Edition, 2012.
3. William L Melvin, James A Scheer, "*Principles of Modern Radar*", SciTech Publishing, 1st Edition, 2014.
4. Bassem R. Mahafza, "*Radar Signal Analysis*", CRC press, 1st Edition, 2021.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Computer Organization and Architecture	Course Code: DJS23EC5012	
Course: Computer Organization and Architecture Laboratory	Course Code: DJS23EL5012	

Pre-requisite:

1. Digital System Design (DJS23ECPC303)

Objectives:

1. To conceptualize the basics of organizational and architectural issues of a digital Computer.
2. To analyse performance issues in processor and memory design of a digital Computer.
3. To understand various data transfer techniques in digital computer.
4. To analyse processor performance improvement using instruction level parallelism

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

1. Understand the basic concepts and structure of computers and functionality of central processing unit.
2. Implement computer arithmetic operations.
3. Understand the basics of instructions sets and their impact on programming.
4. Understand the concepts of memory and I/O organization.

Computer Organization and Architecture (DJS23EC5012)		
Unit	**Description**	**Duration**
1	**Introduction of Computer Organization and Architecture.** Basic organization of computer, Evolution of Computers, Von Neumann model. Performance measure of Computer Architecture. The Evolution of the Intel 8086 Architecture , Embedded Systems and the ARM.	**04**
2	**Data Representation and Arithmetic Algorithms** Number representation: Binary Data representation, two's complement representation and Floating-point representation. Integer Data arithmetic: Addition, Subtraction. Multiplication: Unsigned & Signed multiplication- Add & Shift Method, Booth's algorithm. Division of integers: Restoring and non-restoring division, signed division, Basics of floating point representation IEEE 754 floating point (Single & double precision) number representation. Floating point arithmetic: Addition, subtraction.	**08**

3	**Control Unit** Soft wired (Micro programmed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations. Introduction to RISC and CISC architectures and design issues. Introduction to Concepts of multiprocessors.	**04**
4	**Instruction Sets: Characteristics and Functions:** Machine Instruction Characteristics, Types of Operands, Intel 8086 and ARM Data Types, Types of Operations, Intel 8086 and ARM Operation Types. Instruction Sets: Addressing Modes and Formats: Addressing, 8086 and ARM Addressing Modes, Instruction Formats, 8086 and ARM Instruction Formats, Assembly Language, Instruction cycle, Instruction Pipelining, For 8086, The ARM Processor Instruction-Level Parallelism and Superscalar Processors: Design Issues, Flynn's classifications, Pipeline processing.	12
5	**Memory Organization** Introduction to Memory and Memory parameters. Classifications of primary and Secondary memories. Types of RAM and ROM, Allocation policies, Memory Hierarchy and characteristics. Cache memory: Concept, architecture (L1, L2, L3), Mapping techniques. Cache Coherency, Interleaved and Associative memory.	**08**
6.	**I/O Organization** Input/output systems, I/O modules and IO processors. Types of data transfer Techniques: Programmed I/O, Interrupt driven I/O and DMA.	**04**
	Total	**40**

Computer Organization and Architecture (DJS23EL5012)	
Exp.	**Suggested Experiment List**
1	To study Full Adder (7483).
2	To study ALU (74181).
3	To study MASM (Micro Assembler).
4	A program for hexadecimal addition and multiplication.
5	A program for binary multiplication.
6	A program for Hamming code generation, detection and correction.
7	A program for Booth's multiplication
8	A program for LRU page replacement algorithm.
9	A program for FIFO page replacement algorithm.
10	A program to simulate the mapping techniques of Cache memory.

11	Direct Mapped cache
12	Associative Mapped cache

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. William Stallings, "*Computer Organization and Architecture: Designing for Performance*", 8th Edition, Pearson Publication, 2019.
2. Douglas V Hall," *Microprocessors and Interfacing*", Tata McGraw-Hill., 2nd edition, 2006
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "*Computer Organization and Embedded Systems*", 6th Edition, McGraw-Hill, 2022.

Reference Books:

1. B. Govindarajulu, "*Computer Architecture and Organization: Design Principles and Applications*", Second Edition, McGraw-Hill, 2017.
2. John P. Hayes, "*Computer Architecture and Organization*", Third Edition, McGraw-Hill, 1997.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Control System	Course Code: DJS23EC5013	
Course: Control System Laboratory	Course Code: DJS23EC5013	

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: At the end of course, student 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. in the industries.

Control System (DJS23EC5013)		
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 of state transition matrix, properties of state transition matrix, controllability and observability, analysis of LTI systems, with Examples.	**07**
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 System Laboratory (DJS23EC5013)	
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 1^{st} order and 2^{nd} order control systems.
4	To find transfer function of a 1^{st} order and 2^{nd} order control systems.
5	To verify the effect of Zero and pole to open loop transfer function of a second order.
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	Verification of observability and controllability for given control system.
10	To design Nyquist plot for given control system.
11	To find Transfer functions of P, PI, and PID controller.

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. I. J. Nagrath, Madan.Gopal, "*Control System Engineering*", New Age International Publication, 7th Edition, 2021.
2. K.Ogata, "*Modern Control Engineering*", Pearson Education", 5th Edition, 2015.

Reference Books:

1. Madan Gopal, "*Control Systems Principles and Design*", Tata McGraw hill, 7th Edition, 2012.
2. Ajit K.Mandal, "*Introduction to Control Engineering: Modeling, Analysis and Design*", New Age International Publication, 2nd Edition, 2010.
3. S.Hasan Saeed, "*Automatic Control System*", S.K. Kataria & Sons, 9th Edition, 2017.
4. Normon S. Nise, "*Control System Engineering*", John Wiley & sons, 8th Edition, 2020.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Linear Algebra	Course Code: DJS23EC5014	
Course: Linear Algebra Laboratory	Course Code: DJS23EL5014	

Pre-requisite:

1. Mathematics for Telecommunication Engineering (DJS23ECPC301)

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: At the end of course, student 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 (DJS23EC5014)		
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 orthogonalization, 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 (DJS23EL5012)	
Exp.	**Suggested Experiment List**
1	Gaussian elimination and Gauss Jordan method
2	LU factorizations
3	The four fundamental spaces
4	Linear Transformations
5	Gram-Schmidt orthogonalization
6	QR factorization
7	Linear Dependence and Independence
8	Least Squares Approximation
9	Case Study: Classical Cryptosystems
10	Gaussian elimination and Gauss Jordan method

Minimum eight tutorials/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. J. H. Kwak and S. Hong, "*Linear Algebra",* Second Edition, Springer, Boston, 2012.
2. Kolman, Bernard, and Hill, David Ross, "*Elementary Linear Algebra*", United Kingdom, Prentice Hall, 2000.

Reference Books:

1. Stephen Andrilli, David Hecker, "*Elementary Linear Algebra*", 5th Edition, Academic Press, 2016.
2. Rudolf Lidl, Guter Pilz, "*Applied Abstract Algebra*", 2nd Edition, Springer, 2004.
3. Howard Anton, Robert C Busby, "*Contemporary Linear Algebra*", Wiley, 2003.
4. Gilbert Strang, "*Introduction to Linear Algebra*", 5th Edition, Cengage Learning, 2015.

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Advanced Microcontroller	Course Code: DJS23EC5015	
Course: Advanced Microcontroller Laboratory	Course Code: DJS23EL5015	

Pre-requisite:

1. Digital System Design (DJS23ECPC303)
2. Microcontroller & Applications (DJS23ECPC403)

Objectives:

1. To provide an in-depth understanding of the ARM Cortex-M architecture, focusing on the STM32F401RE microcontroller
2. To equip students with the skills to program and debug advanced microcontrollers.
3. To enable the design and implementation of real-world embedded systems using STM32F401RE.

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

1. Understand the architecture and functionality of the ARM Cortex-M family.
2. Understand the architecture and functionality of the STM32F401RE microcontroller.
3. Develop the programs for peripherals, sensors and actuators.
4. Design and implement microcontroller-based systems for real world applications.

Advanced Microcontroller (DJS23EC5015)		
Unit	**Description**	**Duration**
1	**ARM Family and Cortex-M Architecture** Introduction to ARM Microcontrollers: ARM Cortex-M Family: ARM Cortex-M series overview (M0, M3, M4, M7), Features of ARM Cortex-M4: Harvard architecture, pipeline, and instruction set.	**06**
2	**Introduction to STM32 Microcontrollers** STM32 family overview (F0, F1, F4, L4 series), Features of STM32F401RE: processor core, clock speed, overview of bus architecture (AHB, APB), memory organization, memory mapping and peripherals, Introduction to STM32 development tools: STM32CubeIDE and STM32CubeMX..	**08**
3	**GPIO and Interrupt Programming** GPIO Configuration: Input, output, alternate function, Pull-up/pull-down resistors and pin speed configuration, Basic input/output operations: LED blinking and push-button interfacing, Interrupt Handling NVIC and its configuration, External interrupts.	**08**

4	**Timers, PWM, and ADC** Timers and Delay Generation: Overview of STM32 timers, Configuring general-purpose timers for delay generation, PWM and Applications: PWM generation using timers, Controlling brightness of an LED and speed of a DC motor using PWM Analog-to-Digital Conversion (ADC): ADC architecture and configuration, Single-channel and multi-channel ADC, Interfacing analog sensors (e.g., temperature sensors)	**09**
4.	**Communication Protocols and Applications** Serial Communication (UART): Configuring UART for data transmission and reception, I2C and SPI Communication: Overview and comparison of I2C and SPI protocols, Configuring STM32F401RE for I2C and SPI communication, IoT Applications: Interfacing STM32F401RE with Wi-Fi modules (ESP8266/ESP32), Cloud integration using MQTT/HTTP protocols	**09**
	Total	**40**

Advanced Microcontroller Laboratory (DJS23EL5015)	
Exp.	**Suggested Experiment List**
1	Setting up STM32 IDE and writing a basic LED blinking program.
2	Interfacing an LED and Push-Button with GPIO Input and Output Operations
3	Implementing Push-Button Controlled LED Toggle Using External Interrupt
4	Implementing LED Blinking Using Delay Generation with General-Purpose Timers
5	Interfacing and Speed Control of a DC Motor Using PWM
6	Timer-based PWM generation for LED brightness control
7	ADC-based temperature sensor interfacing
8	UART communication for data transmission and reception.
9	Interfacing and Reading Sensor Data from MPU6050 using I2C Communication
10	Interface an SPI device, such as an EEPROM, and perform read/write operations.
11	Interfacing STM32F401RE with a Wi-Fi module (ESP8266/ESP32)

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. Joseph Yiu , "*The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors*", Newnes Publications, 3rd Edition, 2013.

2. Indranil Sengupta and Kamalika Dutta "*Embedded System Design with ARM*", NPTEL course book.
3 Muhammad Ali Mazidi, Shujen Chen, and Sepehr Naimi, "*Microcontroller Programming and Interfacing with ARM Cortex-M Processor"*, MicroDigitalEd, 1st Edition, 2017.

Reference Books:

1. STM32F401RE Reference Manual and Datasheet.
2. Donald Norris , *"Programming with STM32: Getting Started with the Nucleo Board and C/C++"* , McGraw-Hill Education , 1st Edition, 2018.
3. Carmine Noviello, "*Mastering STM32"*, Leanpub, 1st Edition, 2018.

.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Neural Network and Fuzzy Logic	Course Code: DJS23EC5016	
Course: Neural Network and Fuzzy Logic Laboratory	Course Code: DJS23EL5016	

Pre-requisite:

1. Mathematics for Telecommunication Engineering (DJS23ECPC301)

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: At the end of course, student 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 Network and Fuzzy Logic (DJS23EC5016)		
Unit	**Description**	**Duration**
1	**Essentials of Artificial Neural Networks** Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, Artificial Neuron Model, Operation of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, McCulloch-Pitts Model, Potential Applications of ANN, Classification Taxonomy of ANN Connectivity, Learning Strategy (Supervised, Unsupervised, Reinforcement),Learning Rules.	**04**
2	**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, Metrics for evaluation of classification method, Steps to use neural networks to data, Over fitting, Detecting over fit models: Cross validation	**12**

3	**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.	**12**
4	**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**
5	**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 Network and Fuzzy Logic Laboratory (DJS23EL5016)	
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.
3	(b) Summery of research paper based on Fuzzy logic
4	Simulation of Sugeno Fuzzy Inference System for given application
5	Simulation of Mamdani Fuzzy Inference System for image processing application. (Edge detection)
6	Write a program for perceptron training algorithm and test it for two input AND & OR gate function
7	Write a program for training and testing of Multilayer Perceptron for two input EX-OR gate
8	Write a program for training and testing of Multilayer Perceptron for character recognition application
9	Program for Radial basis neural network for interpolation application
10	Write a program for training and testing of RBF for pattern classification application
11	Kohenan Self Organising map for image classification
12	To Study the use of Microsoft Machine Learning Studio (classic) in Neural Network and Machine Learning

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. S. N. Sivanandam and S. N. Deepa, "*Introduction to Soft computing*", Wiley India Publications , 3rd Edition, 2018
2. S. Rajasekaran, G.A. Vijayalakshmi Pai, "*Neural Networks, Fuzzy Systems And Evolutionary Algorithms: Synthesis And Applications*", Prentice hall Learning India,2nd Edition, 2017.

Reference Books:

1. Thimothy J. Ross, "*Fuzzy Logic with Engineering Applications",* Wiley India Publications, 3rd Edition,2010.
2. J. S. R. Jang, C.T. Sun, and E. Mizutani, "*Neuro-Fuzzy and Soft Computing"*, Prentice hall Learning India, 1997.
3. S. N. Sivanandam, S. Sumathi, and S. N. Deepa, "*Introduction to Neural Network Using Matlab",* Tata McGraw-Hill Publications , 2006.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Data Base Management System	Course Code: DJS23ECMD501	
Course: Data Base Management System Laboratory	Course Code: DJS23ELMD501	

Pre-requisite:

1. Structured Programming using C (DJS23FCES101)
2. Object Oriented Programming using Java (DJS23FCES201)

Objectives:

1. Learn and practice data modelling using the entity-relationship and developing database designs
2. Understand the use of Structured Query Language (SQL) and learn SQL syntax

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

1. Understand about the fundamental concepts of databases, including design, architecture, and data models.
2. Design E-R diagrams, convert to relational schema and use relational algebra queries.
3. Construct SQL queries to perform operations on the database.
4. Understand transaction management technique.

Data Base Management System (DJS23EL5015)		
Unit	**Description**	**Duration**
1	**Introduction to Databases and Data models** Introduction, Characteristics of databases, File system v/s Database system, Users of Database system, Schema and Instance, Data Independence, level of abstraction, DBMS system architecture, The importance of data models , Types of data models	**6**
2	**Relational Data Model** Entity–Relationship Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation. Relational Model: Introduction to the Relational Model, relational schema and concept of keys, Mapping the ER Model to the Relational Model Relational Algebra: Unary and Set operations, Relational Algebra Queries.	**8**
3	**Structured Query Language (SQL) and Normalization** **SQL:** Overview of SQL, Data Definition Commands, Data Manipulation commands, Integrity constraints - key constraints, Domain Constraints, Referential integrity, check constraints, Data Control commands, Transaction Control Commands, Set and String operations, aggregate function - group by, having, Views in SQL, joins, Nested and complex queries, Triggers	**8**

	Normalization : Concept of normalization, Function Dependencies, Normal Forms- 1NF, 2NF, 3NF, BCNF	
4	**Transaction management and Concurrency control** **Transaction management:** ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management	**6**
	Total	**28**

Data Base Management System Laboratory (DJS23EL5016)	
Exp.	**Suggested Experiment List**
1	Design an Entity-Relationship (ER) model for a problem statement.
2	Convert the designed ER model to a Relational Database. Create this database in MySQL/SQL Server (any other suitable software) with required tables. Use DDL commands and Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.
3	Execute DML commands.
4	Perform aggregate function
5	Perform SELECT statement for retrieval of data from Database
6	Perform various JOIN operations on tables
7	Create views and access data from it using SQL statements
8	Perform queries for triggers
9	Perform Nested queries
10	Identify dependencies in a table and accordingly convert it to 1NF, 2NF, 3NF and BCNF
11	Mini Project

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. A Silberschatz, H Korth, S Sudarshan, "*Database System and Concepts"*, McGraw Hill, 7th Edition, 2019.
2. Ramez Elmasri, Shamkant B. Navathe, "*Fundamentals of Database System"*, 7th Edition, Person,2017.

Reference Books:

1. Peter Rob, Carlos Coronel, "*Database Systems Design, Implementation and Management", Cengage Learning* ,8th Edition, 2007.
2. Lynn Beighley, "*Head First SQL*", O'Reilly Media ,1st Edition, 2007.
3. Raghu Ramakrishnan and Johannes Gehrke, "*Database Management Systems*", McGraw – Hill, 3rd Edition, 2014.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: V
Course: Innovative Product Development III	Course Code: DJS23IPSCX03	

Pre-requisite:

1. Electronics Devices & Circuits (DJS23ECPC302
2. Digital System Design (DJS23ECPC303)
3. Innovative Product Development – I (DJS23ELVS305)
4. Microcontroller & Applications (DJS23ECPC403)
5. Innovative Product Development –II (DJS23ELVS405)

Objectives:

1. To identify and investigate real world social and industrial challenges, to develop practical solutions with business value, using either traditional or innovative methods and practices.
2. To prepare students with knowledge of design planning and financial planning processes for a project or product, while engaging them in teamwork designing and building a functional prototype.

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

1. Identify problem statement, design and develop product prototype in predefined timeline.
2. Provide problem solutions by learning/exploring various ideas from multi-disciplinary domains across different disciplines.
3. Carry out collaborative project work by interacting and dividing project work amongst the team members.
4. Draw proper inferences through theoretical/ simulations/ experimental and analyze the impact of the proposed method towards design and development of the product.
5. Develop and enhance skills associated with literature survey, market research, hardware and software co-integrations, documentation, product design, development and testing.

Syllabus:

Domain knowledge (any field of knowledge and beyond) needed from the following areas for the effective implementation of the product:

Electronic devices and circuits, Integrated circuits, Control systems, Microcontroller and Embedded Systems, Signal Processing, Microwave and Antennas, Networking and Internet of Things, Data science and Big data, Web and Application development, Robotics, Artificial Intelligence (AI), Machine learning (ML), CAD design and Additive manufacturing (3d printing).

The above areas can be updated (expanded), based on the needs of technological innovations and development needed for a specific project/product.

Guidelines:

The main purpose of this course is to give students an opportunity to work in collaboration as a team around the product idea, to realize and improve their technical skills, market research skills, problem solving skills, communication skills, documentation skills, presentation skills, Debugging skills and teamwork skills.

1. The project/product work is to be carried out by a group of 4 students (2 students from SY B. Tech and 2 students from T. Y. B. Tech).
2. Each group will be allotted a faculty member as guide and may allot a final year student as mentor.
3. Project topics are floated in various domains by the faculty coordinators. Students can select the domain of their choice for the same. Students approach domain specific faculties for guidance/discussions on streamlining product or a fraction of a product in discussion with the faculty guide. The final project title in the preferred domain is allotted in discussion with faculty guide and faculty coordinators.
4. Students are encouraged to explore and focus more on problem solving solutions.
5. Each group identifies the hardware and software requirements for their problem statement.
6. Student groups are expected to perform all initial testing on breadboard.
7. Student groups are encouraged to explore EDA tools to design schematics, simulate, design PCB, fabricate, assemble and carry functional testing of their product ideas.
8. Student groups are encouraged to identify and suggest a business value for the proposed product idea, supported with a market research and possible business potential. They may propose it through a business canvas. Students may use this IPD platform to work on their ideas and turn them into startup/business.
9. Student groups are encouraged to explore both open source and commercially off-the table solutions (COTS) available for quick time to prototype and understand importance of "quick time to market". Adopt, design and deploy various frontend and backend jobs as per their project/product requirements. This would help them explore ready tools/ technologies already available in the market for their product integrations.
10. Student groups are encouraged to use CAD methods to model part or complete product housings as per their requirement and utilize 3d printing (additive technology) facilities of the department.
11. Student groups are encouraged to use various market research journals subscribed by institute for market/customer identification of their proposed product/idea and thus better understand the business value of their idea.
12. Each group is reviewed twice a semester. First review would be around 3rd week and second review would be around 9th week from the start of the semester. Marks are awarded based on the various points mentioned in the evaluation scheme.
13. Each group is expected to complete literature survey/market research, budget plan and documentation of adopted methodology along with 50% project implementation.
14. Next subsequent reviews will be done in the sixth semester.
15. Faculties may suggest online (NPTEL and alike) video tutorials / lectures in various application-

oriented areas as additional references. Sample/partial list of resources is attached at end of this document.

16. A record in the form of an activity logbook is to be prepared by each group, wherein the group can record weekly progress of work. The project guide should verify the recorded notes/comments and approve the same weekly.

Evaluation Scheme:

Each group will be reviewed twice in a semester by review panel based on the following criteria:

1. Innovative ideas and Motivation
2. Objectives, Expected outcome and long-term social impact
3. Literature survey/market research and Comparative Methodology
4. Timeline and budget planning, progress and execution (Product progress /Implementation)
5. Documentation/ synopsis of project
6. Overall presentation and teamwork

Marks scored in the semester reviews will be considered as a part of the term work.

The final certification and acceptance of Termwork ensures satisfactory performance and the outcome of evaluation centered about evaluation scheme.

Project Resource material:

1. Kicad – Open-Source PCB layout and design tool
   a) Link herewith is an introductory tutorial set of YouTube videos that offer a significantly good level of hand holding activity for introduction to PBB layout and design.
   https://www.youtube.com/watch?v=vaCVh2SAZY4&list=PL3bNyZYHcRSUhUXUt51WKvxx2ORvUQB
   b) A no-nonsense thoroughly professional insight into PCB design is provided by the channel 'Phils Labs' available at:
   https://www.phils-lab.net/courses
   Although the courses are priced, this very neat tutorial on YouTube:
   https://www.youtube.com/watch?v=aVUqaB0IMh4&t=3358s by same author.
2. The ubiquitous hand-held cellphone is an extremely powerful and resource rich electronic device at hand. Explore various sensors, like accelerometer, magnetometer, gyroscope, thermometer, light-sensor, proximity sensor, sound intensity sensor etc. their functionalities, part numbers of implementations, as well visualization graphs by using Android based app like – Sensor Box Android: https://sensor-box-for-android.en.softonic.com/android
3. Acquiring sensor data for processing and subsequent decision implementation is the crux for most of the applications. A decent introduction into this activity without much investment of time, energy and effort is the Android app – MATLAB Mobile:

https://play.google.com/store/apps/details?id=com.mathworks.matlabmobile&hl=en&gl=US
Obtain live data-log (.csv or .m file) of say accelerometer sensor, in the process of walking and use the same for analysis to develop applications like say – Step Counting, Gait Analysis, region contour mapping etc.

4. Android based app development is an extensive and detailed activity.
   a) A reasonably powerful and open-source tool is Kotlin. Explore Android based app development using Kotlin with the help of SWAYAM / NPTEL course. https://onlinecourses.swayam2.ac.in/aic20_sp02/preview
   b) A simpler alternative although less powerful tool, that uses block based visual programming for Android app development is MIT App Inventor 2, available at: https://appinventor.mit.edu/
5. Affordable desktop 3D printers have opened new dimensions in exploring additive manufacturing. Objects / tools / implements created using 3D design and visualization tools can be fabricated very easily.
   a) Watch the demonstration video available at https://youtu.be/T-Z3GmM20JM, for an introduction to 3D printer – Creality Ender 3, files involved like. stl and typical tool to convert it to layered file representation ie .gcode file.
   b) Watch the demonstration video available at https://youtu.be/ yYUGMvZsu3w, for a comprehensive hand-holding activity into use of open source tool - 'blender' for designing a sample object.

Online (NPTEL) video tutorial / lectures in various application-oriented areas by faculty of repute:

1. Prof. T. V. Prabhakar, Principal Research Scientist, IISc. (Banglore) - Design for Internet of Things: https://archive.nptel.ac.in/courses/108/108/108108179/
   An outstanding online resource from a senior faculty from IISc – Banglore. The course videos contains extensive design demonstrations and very encouraging and involving activities into reading into specs and parameters of data sheets and interpretating the same for translating into working implements.
2. Prof. Mythili Vutukuru, Professor CSE, IIT-Bombay. Design and Engineering of Computer Systems: https://nptel.ac.in/courses/106101234
   An extremely well conducted broad range course whose content starts from basic digital logic circuit covering digital systems, microprocessors, computer organization, cloud computing and distributed computing systems. The course covers detail with vivid and relevant examples.
3. Prof. Krishna Vasudevan, Professor, IIT Madras. Modelling and Analysis of Electric Machines, IIT Madras: https://nptel.ac.in/courses/108106023
   Extremely simple, lucid and step-by-step coverage of principles of electrical machines along-with practical insights, although extensively detailed.
4. Prof. Krishna Vasudevan and others. Introduction to robotics, NPTEL course available at: https://nptel.ac.in/courses/107106090

Week 5 to 8 of above course offer a very simple yet practically relevant introduction into electrical actuators – DC Motors, Brushless motors, Permanent Magnet Synchronous Motors. Very basic and simple, yet detailed coverage

Prepared by Checked by Head of the Department Principal