B. Tech. Program (Electronics & Telecommunication Engineering)

Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and detailed syllabus (DJS23)

Third Year B. Tech.

In

(Semester VI)

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 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	DJS23ECPC601	Computer Networks	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPC601	Computer Networks Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
2	DJS23ECPC602	Image Processing	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPC602	Image Processing Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
3	DJS23ECPC603	Radiating System	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPC603	Radiating System Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
4	DJS23ECPE611	Power Electronics	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE611	Power Electronics Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
	DJS23ECPE612	Digital VLSI design	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE612	Digital VLSI design Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
	DJS23ECPE613	Operating Systems	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE613	Operating Systems Laboratory	-	2	-	1		25	25	-	25	-	-	25	50	
	DJS23ECPE614	Big Data Analytics	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE614	Big Data Analytics Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
	DJS23ECPE615	Data Compression & Encryption	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE615	Data Compression & Encryption Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
	DJS23ECPE616	Data Analytics	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE616	Data Analytics Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
	DJS23ECPE617	Basics of IOT	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELPE617	Basics of IOT Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
5	DJS23ECMD601	Machine Learning & Applications	3	-	-	3	40	-	40	60	-	-	-	60	100	4
	DJS23ELMD601	Machine Learning & Applications Laboratory	-	2	-	1	-	25	25	-	25	-	-	25	50	
6	DJS23IPSCXO4	Innovative Product Development-IV	-	2	-	1	-	25	25	-	-	-	25	25	50	1
		Total	**15**	**12**	**-**	**21**	**200**	**150**	**350**	**300**	**125**	**0**	**25**	**450**	**800**	**21**

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Computer Networks	Course Code: DJS23ECPC601	
Course: Computer Networks Laboratory	Course Code: DJS23ELPC601	

Pre-requisite:

1. Analog & Digital Communication (DJS23ECPC503)

Objectives:

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

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

1. Design a small or medium sized computer network including media types, end devices, and interconnecting devices that meets a customer's specific needs.
2. Perform basic configurations on routers.
3. Simulate computer networks and analyse the simulation results.
4. Develop knowledge and skills necessary to gain employment as computer network engineer and network administrator.

Computer Networks (DJS23ECPC601)		
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, Transmission mode, Networking devices: Repeater, hub, bridge, switch and routers, Network topology.	**07**
2	**Introduction to Physical Layer Services** Introduction to physical media, Coax, RJ 45, Optical fiber, twisted pair, bit transmission, frequency division multiplexing. Time division multiplexing.	**03**
3	**The Data Link Layer** Data link Layer Design Issues, Error Detection and Correction, Data Link Protocols, Sliding Window Protocols: Stop and Wait protocol, Go-back-n protocol, Selective-repeat protocol, Data Link Protocols: HDLC: High-Level Data Link Control, Channel Allocation Problem, Multiple Access Protocols.	**10**
4	**The Network Layer** Network functions for the Network Layer Functions, Routing Algorithms: Distance vector and Link state routing, shortest path first algorithm: Dijikstra	**10**

	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, suppernetting, The Interior Gateway Routing Protocol: RIP, OSPF, and The Exterior Gateway Routing Protocol: BGP.	
5	**The 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, UDP 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 (DJS23ELPC601)	
Exp.	**Suggested Experiment List**
1	Networking Commands using CISCO Packet Tracer.
2	Hardware and Software Network Components.
3	Web (HTTP and DNS), FTP and SMTP Server Configuration.
4	RIP Protocol.
5	OSPF Protocol.
6	TELNET Configuration using CISCO Packet Tracer.
7	Firewall using standard and extended ACL's.
8	VLSM using CISCO Packet Tracer.
9	Dijikstra's Algorithm.
10	Bellman Ford Algorithm.
11	Network Packet Analysis using Wireshark.
12	Virtual LAN using CISCO Packet Tracer.

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. S. Tanenbaum, "*Computer Network*", Prentice Hall, 4th Edition, 2003.
2. B. F. Forouzan, "*Data Communications and Networking*", Tata McGraw Hill, 5th Edition, 2022.

Reference Books:

1. Kurose, Ross, "*Computer Networking*", Addison Wesley, 7th Edition, 2016.
2. William Stallings, "*Data and Computer Communications*", Pearson, 9th Edition, 2011.
3. D. E. Comer, "*Computer Networks And Internets*", Prentice Hall,1st Edition,2008.
4. B. F. Forouzan , "*TCP/IP Protocol Suite*", Tata Mc-Graw Hill, 6th Edition, 2008.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Image Processing	Course Code: DJS23ECPC602	
Course: Image Processing Laboratory	Course Code: DJS23ELPC602	

Pre-requisite:

1. Signals & Systems **(**DJS23EPC251)
2. Digital Signal Processing (DJS23ECPC501)

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

1. Understand and analyze concept of sampling, quantization for image acquisition and interpretation.
2. Implement various image enhancement algorithms in spatial and frequency domain.
3. Apply various filters for image restoration.
4. Apply Morphological operations to images to perform image segmentation.
5. Represent images with chain and polygonal codes and describe them with Fourier descriptors.

Image Processing (DJS23ECPC602)		
Unit	**Description**	**Duration**
1	**Digital Image Fundamentals** Coordinate representation and Pixel, Image processing system components, Image sensing and acquisition, Sampling and quantization, Neighbors of pixel adjacency connectivity, regions and boundaries, Distance measures	**03**
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	**Image Restoration and Reconstruction:** Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, Inverse filtering.	**03**
4	**Image Segmentation** 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 **Morphological Image Processing**: Overview, Boundary extraction, Region filtering, connected component extraction, Convex hull, thinning; Thickening; skeletons; pruning.	**12**
5	**Image Representation and Description** Representation: Chain Codes, Polygonal Approximations Using Minimum-Perimeter Polygons, Signatures Boundary Segments : Skeletons, Boundary Descriptors Some Simple Descriptors Shape Numbers , Fourier Descriptors, Statistical Moments, , Regional Descriptors Some Simple Descriptors , Topological Descriptors, , Texture, Moment Invariants.	**10**
	Total	**40**

Computer Networks Laboratory (DJS23ELPC602)	
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	Statistical moments for texture detection

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. 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.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Radiating Systems	Course Code: DJS23ECPC603	
Course: Radiating Systems Laboratory	Course Code: DJS23ELPC603	

Pre-requisite:

1. Wave Theory & Radio Frequency Design (DJS23ECPC502)

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

1. Discuss the concepts of antenna fundamentals like radiation pattern, directivity and gain.
2. Analyse the basic radiating elements like linear wire antenna and loop antenna.
3. Design Antenna Arrays for Isotropic and Directional Sources.
4. Design regular shape MSAs and Aperture antennas.
5. Measure antenna parameters like impedance, gain, radiation pattern using techniques like two antenna and three antenna method.

Radiating Systems (DJS23ECPC603)		
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:**	**08**

	Small circular loop, comparison of small loop with short dipole, Ferrite loop, Radiation patterns, its parameters, and their applications. **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.**	**10**
4	**Microstrip Antenna:** 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 (DJS23ELPC603)	
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:

Textbooks:

1. C. A. Balanis, "*Antenna Theory: Analysis and Design*", John Wiley & Sons, 3rd Edition, Hoboken, NJ, 2016.
2. G. Kumar, K. P. Ray, "*Broadband Microstrip Antenna*", Artech House,1st Edition, 2002.

Reference Books:

1. R. E. Collin, "*Antennas and Radio Wave Propagation"*, International Student Edition, McGraw Hill, 4th Edition, 1985
2. John D Kraus, Ronald J Marhefka, and Ahmed S Khan, "*Antennas and Wave Propagation*", Tata McGraw Hill, 4th Edition, 2010.

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Power Electronics	Course Code: DJS23ECPE611	
Course: Power Electronics Laboratory	Course Code: DJS23ELPE611	

Pre-requisite:

1. Basic Electrical Engineering & Digital Electronics (DJS22FECBE)
2. Mathematics for Telecommunication Engineering (DJS23EPC201)
3. Electronics Circuit Design (DJS23EPC202)

Objectives:

1. To develop the understanding of fundamental principles of power electronics. introduce mathematical modelling, time domain analysis & frequency domain analysis.
2. To disseminate various power electronic semiconductor devices and their characteristics.
3. To develop the concept of power electronic converters and their topologies.

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

1. Describe the features and characteristics of power semiconductor devices.
2. Analyze and Design triggering, commutation and protection circuits.
3. Analyze and Design AC-DC & AC-AC converters.
4. Analyze and Design DC-DC & DC-AC converters.

Power Electronics (DJS23ECPE611)		
Unit	**Description**	**Duration**
1	**Power Semiconductor Devices:** Principle of operation, constructional features and characteristics of: SCR, TRIAC, DIAC, GTO, MOSFET and IGBT.	**04**
2	**Triggering, Commutation and Protection:** Basic Gate Drive circuits for SCR, TRIAC, MOSFET and IGBT, Methods of commutation of SCR, Methods of protection of SCR.	**06**
3	**AC-DC Converters:** Uncontrolled half and full wave rectifiers with R and RL load, SCR controlled half and full wave rectifier with R and RL load. Power factor of the controlled rectifier. Effect of source and load inductances.	**06**
4	**DC-DC Converters:** Buck, Boost and Buck-Boost converters, Flyback and Cúk converter, DC-DC converters with R and RL load.	**08**
5	**DC-AC Converters:** Principle of operation and performance parameters, Voltage control of single phase inverters	**08**

6	**AC-AC Converters:** Principle of on-off and phase angle control; performance parameters, Single phase full-wave AC-AC converter with R and RL load	**08**
	Total	**40**

Power Electronics Laboratory (DJS23ELPE611)	
Sr. No.	**Suggested Experiment List**
1	To study V-I characteristics of SCR, DIAC and TRIC
2	To study V-I characteristics of IGBT.
3	To study different triggering circuits for SCR R Triggering circuit RC triggering circuit
4	To study class B commutation circuit of SCR.
5	To study Half wave controlled rectifiers using SCR.
6	To study AC phase control circuit using DIAC and TRIAC.
7	To study totem pole gate triggering circuit for MOSFET.
8	To study uncontrolled and controlled rectifiers.
9	To Study a controlled rectifier with (i) Source Inductance (ii) Freewheeling diode.
10	To study buck and boost converters.
11	To study flyback converters.
12	To study single phase DC to AC converters.
13	To study AC to AC converters.

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

Books Recommended:

Textbooks:

1. N. Mohan, T. M. Undeland, W. P. Robbins, "*Power Electronics:Converters Application and Design"*, John Wiley & Sons, USA, 2003.
2. M. H. Rashid, "*Power Electronics: Circuits, Devices, and Applications*", Pearson Education India, 2009.
3. P.S. Bhimbra, "*Power Electronics*", Khanna Publishers, 2012.

Reference Books:

1. P.C. Sen, "*Modern Power Electronics*", S Chand publications, 2014.
2. Ramamurthy, "*Thyristor & Their Applications"*, East-West Press, 2012.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Digital VLSI	Course Code: DJS23ECPE612	
Course: Digital VLSI Laboratory	Course Code: DJS23ELPE612	

Pre-requisite:

1. Electronics Devices & Circuits (DJS23EPC202)
2. Digital System Design (DJS23EPC203)
3. Integrated Circuits (DJS23EPC252)

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: At the end of course, students 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. Simulate and synthesize digital circuits using HDL language.

Digital VLSI (DJS23ECPE612)		
Unit	**Description**	**Duration**
1	**MOSFET Layout and Scaling** **MOSFET Scaling:** Types of scaling, short channel effects. **Layout:** Lambda based design rules(CMOS), MOSFET capacitances.	**07**
2	**MOS Circuit Design Styles** **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	**10**

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.	**09**
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	**09**
5	**Design methods** Semi-custom Full custom design PLA PAL PROM FPGA PLD. Introduction to Verilog.	**05**
	TOTAL	**40**

Digital VLSI Laboratory (DJS23ELPE612)	
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 VHDL/Verilog Program for flip flops
8	To write VHDL/Verilog Program for adders
9	To write VHDL/Verilog Program for multiplexers
10.	Design and simulation of barrel shifter circuit in SPICE
11.	To write HDL code and simulation of barrel shifter

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

Books Recommended:

Textbooks:

1) Sung-Mo Kang and Yusuf Leblebici, "*CMOS Digital Integrated Circuits Analysis and Design*", Tata McGraw Hill, 3rd Edition, 2012.

2) Samir Palnitkar, "*Verilog HDL: A Guide to Digital Design and Synthesis*", SunSoft Press, 2nd Edition, 2003.

Reference Books:

1. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "*Digital Integrated Circuits: A Design Perspective*", Pearson Education, 2nd Edition.
2. P. Uyemura, "*Introduction to VLSI Circuits and Systems*", John Wiley & Sons.
3. Frank Vahid, "*Digital Design with RTL design, VHDL and VERILOG*", John Wiley and Sons Publisher, 2011.
4. Neil H. E. Weste, David Harris and Ayan Banerjee, "*CMOS VLSI Design: A Circuits and Systems Perspective*", Pearson Education, 3rd Edition.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Operating Systems	Course Code: DJS23ECPE613	
Course: Operating Systems Laboratory	Course Code: DJS23ELPE613	

Pre-requisite:

1. Structured Programming using C (DJS23FCES101)

Objectives:

1. To introduce operating system as a resource manager, its evolutions and fundamentals.
2. To understand the structure, functions and characteristics of computer system
3. To analyze, evaluate and implement different policies for scheduling, deadlocks, memory management, synchronization, file management & I/O.
4. To understand real time applications of an operating system.

Outcomes: At the end of course, student 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, disk scheduling and concepts related to deadlock.
4. Apply appropriate memory mapping, memory allocation methods in Real Time Operating Systems.

Operating Systems (DJS23ECPE613)		
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** Process, process creation, process control block, process states, process state transition diagram, types of schedulers: preemptive and non- preemptive, types of scheduling algorithms, types of threads, multithreading models.	**10**
3	**Memory Management** Race condition, critical section, mutual exclusion, Deadlock Problem, deadlock characterization, deadlock prevention and deadlock avoidance deadlock detection and recovery, semaphores. Multiprogramming with fixed and variable partitions, memory allocation strategies, Logical and physical	**10**

	address space, paging and segmentation, Concept, performance of demand paging, page replacement algorithms.	
4	**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.	**10**
5	**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)	**06**
	Total	**40**

Operating Systems Laboratory (DJS23ELPE613)	
Exp.	**Suggested Experiment List**
1	To implement linux commands.
2	To implement linux shell script.
3	To implement preemptive and non-preemptive algorithms.
4	Implement Banker's Algorithm for deadlock avoidance.
5	To implement concept of memory management.
6	To implement demand and virtual memory implementation.
7	To implement file allocation strategies.
8	To implement disk scheduling techniques.
9	To implement file organization techniques.
10	To implement RTOS scheduling 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:

Textbooks:

1. A. S. Tanenbaum, "*Modern Operating Systems*", Pearson, 4th Edition, 2015.
2. Silberschatz A, Galvin P, and Gagne G, "*Operating System Concepts"*, Wiley, 10th Edition, 2018.

Reference Books:

1. William Stallings, "*Operating System-Internal and Design Principles*", Pearson, 9th Edition, 2018.
2. Rajib Mall, "*Real Time Systems: Theory and Practice"*, Pearson Education, 1st Edition, 2007.
3. Achyut S. Godbole, "*Operating Systems*", Tata McGraw Hill Education, 3rd Edition, 2011.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Big Data Analytics	Course Code: DJS23ECPE614	
Course: Big Data Analytics Laboratory	Course Code: DJS23ELPE614	

Pre-requisite:

1. Data Base Management System (DJS23ECMD501)

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

1. Understand the challenges of big data and scope of Hadoop and NoSQL for solving them.
2. Use Map Reduce for Big Data processing.
3. Apply software tools for big data analytics for interpretation of business models.
4. Examine the capabilities of big data using Apache Spark.

Computer Networks (DJS23ECPE614)		
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.	**06**
2	**NoSQL** Introduction to NoSQL, NoSQL business drivers, NoSQL data architecture patterns: Key-value stores, Graph stores, Column family stores, Document stores, NoSQL case studies, analyzing big data with a shared-nothing architecture, Choosing distribution models: master-slave versus peer-to-peer. Introduction to MongoDB, MongoDB commands.	**06**
3	**MapReduce** Introduction, The Map Tasks, The Reduce Tasks, Combiners, Components of MapReduce, Details of MapReduce Execution, MapReduce Algorithms and applications: Matrix-Vector Multiplication, Word count, Sorting, Relational-Algebra Operations	**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 and stream queries Frequent Itemset Mining: Market Basket Model- Applications, Association Rule,Confidence, Interest,Support, Apriori Algorithm :Pass1, Pass2 Recommendation Systems: Introduction, Collaborative-Filtering S y s t e m, Content based recommendation system Link analysis: Page rank algorithm, Structure of web Mining Social - Network Graphs : Social Networks as Graphs, Types of Social Networks, Clustering of Social Network Graphs, Clique Percolation Method.	**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.	**10**
	Total	**40**

Computer Networks Laboratory (DJS23ELPE614)	
Exp.	**Suggested Experiment List**
1	Execution of Hadoop file handling commands.
2	Execution of PIG SCRIPTING language.
3	Execution of HIVE SCRIPTING language.
4	Design graphical datastore and querying using Neo4j
5	Execution of MongoDB CRUD commands.
6	Execution of wordcount using MapReduce.
7	Execution of Matrix multiplication using MapReduce
8	Execution of pagerank algorithm.
9	Implementation of Apriori algorithm in Python
10	Execution of Spark application to perform data Analysis using PySpark

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. Radha Shankarmani, M Vijayalakshmi, "*Big Data Analytics*", Wiley, 2nd Edition, 2016.
2. Alex Holmes, "*Hadoop in Practice*", Manning Press, Dreamtech Press, 2nd Edition, 2015.
3. Holden Karau, Andy Konwinski, Matei Zaharia, "*Learning Spark*" O'Reilly, 2nd 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, 1st Edition, 2017
2. Vignesh Prajapati, "*Big Data Analytics with R and Hadoop*", Packt Publishing Limited , 1st Edition, 2013.
3. Tom White, "*Hadoop: The Definitive Guide*", O'Reilly Publications, 2nd Edition, 2016.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Data Compression and Encryption	Course Code: DJS23ECPE615	
Course: Data Compression and Encryption Laboratory	Course Code: DJS23ELPE615	

Pre-requisite:

1. Mathematics for Telecommunication Engineering (DJS23EPC201)
2. Signals & Systems(DJS23EPC251)

Objectives:

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

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

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

Data Compression and Encryption (DJS23ECPE615)		
Unit	**Description**	**Duration**
1	**Text compression:** Introduction to data compression, Comparison of lossy and lossless compression, Modelling and Coding, Compression Parameters. Huffman Coding, Adaptive Huffman Coding, Arithmetic coding, Dictionary based compression: Static and Dynamic Dictionary, LZ77, LZ78, LZW.	**10**
2	**Image Compression:** Differential lossless compression DPCM, JPEG-LS, DCT, JPEG, JPEG 2000.	**06**
3	**Audio and Video Compression:** Digital Audio, μ law and A law companding, MPEG-1 Audio layer (MP3 audio format), Digital Video, MPEG-2, H.261 encoder and decoder.	**04**
4	**Symmetric key cryptography & Key management:** **Introduction**: Security Goals, Security techniques – Cryptography and Steganography, Cryptographic attacks. **Symmetric Key Cryptography**: Substitution cypher, Transposition Cypher, Stream and Block cypher, DES, Double DES, Triple DES, AES. Key management, Diffie- Hellman Key Exchange.	**08**

5	**Asymmetric key cryptography and Message Integrity:** Prime numbers, Fermat's and Euler's theorem, Chinese Remainder theorem. Principles of Public Key cryptosystem, RSA. Message Integrity: Message authentication and Hash functions, SHA, HMAC, Digital Signature Standard.	**08**
6	**Network Security:** Email, PGP, S/MIME, Intrusion detection system, Secure Electronic transaction, X.509 authentication service, **Introduction to cryptocurrency security.**	**04**
	Total	**40**

Data Compression and Encryption Laboratory (DJS23ELPE615)	
Exp.	**Suggested Experiment List**
1	To find compression ratio after compression of various file formats.
2	To implement Huffman coding.
3	To implement Arithmetic coding.
4	To implement μ law and A law companding for Audio compression.
5	To implement DCT for image compression.
6	To implement Substitution cypher for text/ image.
7	To implement Transposition cypher for text/ image.
8	To implement square and multiply algorithm.
9	To implement Fermat's theorem.
10	To implement RSA.
11	To implement Diffie-Hellman Key exchange mechanism.
12	To implement PGP.
13	Case study on specific topics.
14	To study X.509 certificate format by downloading few samples from internet.

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

Books Recommended:

Text books:

1. Khalid Sayood , "*Introduction to Data Compression*", Elsevier, 5th Edition, 2017.

2. William Stallings, "*Cryptography and Network Security Principles and Practices*", Pearson Education, 5th Edition, 2020.
3. Behrouz A. Forouzan, "*Cryptography and Network Security*", Tata McGraw-Hill, 3rd Edition, 2015

Reference Books:

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

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Data Analytics	Course Code: DJS23ECPE616	
Course: Data Analytics Laboratory	Course Code: DJS23ELPE616	

Pre-requisite:

1. Mathematics for Telecommunication Engineering (DJS23EPC201)

Objectives:

1. Understanding basic principles of probability, hypothesis testing and correlation between data.
2. Apply the concepts of Data Analysis using Sampling theory.
3. Apply Linear Programming methods to solve engineering problems.

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

1. Identify the relationship amongst various attributes of sample data sets using suitable techniques.
2. Perform data cleaning and transformations on a given dataset.
3. Perform data modeling using regression and classification methods.
4. Apply dimensionality reduction on high dimensional datasets.

Data Analytics (DJS23ECPE616)		
Unit	**Description**	**Duration**
1	**Data Exploration** Data objects and attributes: nominal, binary, ordinal, numeric, discrete, continuous; Characteristics of datasets: dimensionality, sparsity, resolution; Types of data sets: record data, data matrix, graph-based data, sequential data, sequence data, time-series data, spatial data. Seven Stages of Data Visualization, Types of charts (comparison, distribution, composition, relationship), Structured Data: bar chart, pie chart, histogram, stacked bar graph, box plot, scatter plot, heat map, line chart, Node-link, dual axis chart. Unstructured Data: word count, bar chart, word tree, line chart diagrams, Word clouds.	**08**
2	**Descriptive Statistics** Population Vs Sample; Measure of Central Tendency: arithmetic mean, weighted mean, median, mode, grouped and ungrouped data, empirical relationship between mean, median and mode, geometric mean, harmonic mean and outliers; Measure of Dispersion: Range, quartile deviation, mean deviation, standard deviation, variance, empirical relationship between measures of dispersion, absolute and relative dispersion, skewness, kurtosis	**06**

	and histogram; Measure of Position: Quartiles, interquartile range, semi interquartile range, percentile, percentile rank, box and whisker plot.	
3	**Sampling Theory** Sampling distribution. Test of Hypothesis. Level of significance, critical region. One tailed and two tailed tests. Interval Estimation of population parameters. Large and small sample. Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples. Student's t-distribution and its properties. Test of significance of small samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two Samples, paired t-test. Chi-square test, Test for the Goodness of fit, Association of attributes. ANOVA: One way classification, Two-way classification	**12**
	Regression & Decision Tree Explore algorithms such as: linear regression, polynomial regression, logistic regression. Decision tree using Gini index and CART (Classification and Regression Tree)	**10**
5	**Feature Engineering** Curse of Dimensionality, Feature Selection: Univariate methods and Multivariate methods.	**04**
	Total	**40**

Data Analytics Laboratory (DJS23ELPE616)	
Exp.	**Suggested Experiment List**
1	Analysis of different types of datasets.
2	Plotting of probability distribution using different dataset.
3	Plotting and visualization of dataset using different types of graphs.
4	Different types data cleaning methods.
5	Implementation of logistic regression model for predictive analysis.
6	Implementation of linear regression model for predictive analysis.
7	Implement PCA on dataset with high dimensionality and perform prediction using KNN.
8	Implement clustering methods on unsupervised dataset.
9	Hypothesis testing for given dataset.
10	ANOVA using dataset.

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. Dr. J Ravichandran, "*Probability and Statistics for Engineering",* 6th Edition, Wiley, 2019.
2. Ethem Alpaydin, "*Introduction to Machine Learning*", 4th Edition, MIT Press, 2020.

Reference Books:

1. Seymour Lipschut, "*Probability*", 3rd Edition, McGraw-Hill, 2021.
2. S. C. Gupta, V. K. Kapoor, "*Fundamentals of Mathematical Statistics*", 12th Edition, Sultan Chand & Sons, 2020.

Prepared by Checked by Head of the Department Principal

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Basics of IoT	Course Code: DJS23ECPE617	
Course: Basics of IoT Laboratory	Course Code: DJS23ELPE617	

Pre-requisite:

1. Microcontroller & Applications (DJS23EPC253)
2. Analog & Digital Communication (DJS23ECPC503)

Objectives:

1. To understand basic building block of IoT.
2. To understand various IoT protocols.
3. To analyse IoT data using Data handling.
4. To study design methodology in IoT through case studies.

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

1. Understand concepts, functional blocks, communication methodology related to IoT.
2. Introduce Different components of IoT.
3. Introducing sensor, actuator integration with Raspberry Pi.
4. Understanding various methods of data handling.
5. Design and exploring different applications of IoT.

Basics of IoT (DJS23ECPE617)		
Unit	**Description**	**Duration**
1	**Introduction to Internet of Things** Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication models, IoT Protocols, Sensor Networks.	**10**
2	**Components in IoT** Examples of sensors and actuators sensor like LM35 (temperature), IMU-MPU 9250 / 6050; Actuators like – dc stepper motors, servo motors	**04**
3	**Machine-to-Machine Communications** Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with ESP32	**04**
4	**Introduction to IoT ready platforms - typically Raspberry Pi** Raspberry Pi features & specifications, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi, Implementation ~~of IoT with Raspberry Pi~~.	**10**
5	**Introduction to Data Analytics** Data acquisition and storage, Data Handling and Analytics,	**04**

6	**Cloud Computing,** Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring	**08**
	Total	**40**

Basics of IoT Laboratory (DJS23ELPE617)	
Exp.	**Suggested Experiment List**
1	Serial Monitor, LED, Servo Motor – Controlling:
2	Distance Measurement of an object:
3	Controlling relay state based on ambient light levels using LDR sensor
4	Basic Burglar alarm security system with the help of PIR sensor and buzzer
5	Displaying humidity and temperature values on LCD
6	Advanced burglar alarm security system with the help of PIR sensor, buzzer and keypad. (Alarm gets disabled if correct keypad password is entered)
7	Upload humidity & temperature data to Thing Speak, periodically logging ambient light level to Thing Speak
8	Introduction to HTTP. Hosting a basic server from the ESP32 to control various digital based actuators (led, buzzer, relay) from a simple web page
9	Displaying humidity and temperature data on a web-based application
10	Python program to read GPS coordinates from Flight Controller
11	Controlling LEDs/Motors from an Android/Web app, Controlling AC Appliances from an android/web app with the help of relay
12	Advanced burglar alarm security system with the help of PIR sensor, buzzer and keypad. (Alarm gets disabled if correct keypad password is entered)

Minimum seven 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.

Mini project on understanding and reporting specifications and features of sensors and instrumentation used in the doppler radar mounted on our terrace.

Min project on understanding and analyzing the data obtained from the doppler radar.

Books Recommended:

Textbooks:

1. *P. Raj and A. C. Raman "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases", (CRC Press), 1st Edition,2022.*
2. T., kemo, karvinen and V. valtokari, "Make sensors":, maker media, 1st edition 2014.
3 A. Bahga and V. Madisetti ,"Internet of Things: A Hands-on Approach", Universities Press, 4th Edition, 2019.

Reference Books:

1. W. Dargie, C. Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley, 2011.
2. C. Bell, “Beginning Sensor networks with Arduino and Raspberry Pi” –Apress, 2013,
3 J. Fraden “Handbook of Modern Sensors-Physics, Design and Applications”, 4th Edition, Springer.

NPTEL Web Course:

https://onlinecourses.nptel.ac.in/noc25_ee186/preview
https://onlinecourses.nptel.ac.in/noc19_cs65/preview
https://onlinecourses.swayam2.ac.in/ntr24_ed44/preview

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Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Machine Learning & Applications	Course Code: DJS23ECMD601	
Course: Machine Learning & Applications Laboratory	Course Code: DJS23ELMD601	

Pre-requisite:

1. Mathematics for Telecommunication Engineering(DJS23EPC201)
2. Digital Signal Processing (DJS23EPC301)

Objectives:

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

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

1. Recall key concepts and fundamentals relevant to machine learning and Applications.
2. Understand the theoretical foundations of linear, non-linear models, and the principles behind probabilistic and advanced Machine Learning models.
3. Apply various machine learning and Signal Processing algorithms and techniques, in problem solving.
4. Analyze the performance and suitability of different learning techniques for specific applications.

Machine Learning & Applications (DJS23ECMD601)		
Unit	**Description**	**Duration**
1	**Linear Models for Regression:** Linear Regression with one variable, Cost function, Gradient descent, Polynomial Curve fitting, least squares, Geometry of least squares, Regularisation.	**08**
2	**Linear Models for Classification:** Classifying with k-Nearest Neighbors, Decision Trees, Naïve Bayes, Logistic regression, Least Squares for Classification.	**08**
3	**Non Linear Models-Neural Networks:** Parameter Optimization, Gradient descent Optimization, Evaluation of error-function derivatives, A simple example, Efficiency of backpropagation.	**07**
4	**Probabilistic models and Expectation Maximisation Algorithm:** k- means clustering, Gaussian Mixture Model, Maximum likelihood for Gaussian Mixtures, EM for Gaussian Mixtures.	**07**

5	**Applications of Machine Learning in Audio Classification, Speech Recognition & Image Processing:** Signal Compression with SVD, Dimensionality reduction with PCA, LSTMs and CNNs, Hidden Markov Models, Viterbi Algorithm, Transfer Learning.	**10**
	Total	**40**

Machine Learning & Applications Laboratory (DJS23ELMD601)	
Exp.	**Suggested Experiment List**
1	Given a dataset, Predicting feature values with Linear Regression.
2	Binary Classification using Logistic Regression.
3	Find the minimum of a polynomial by Steepest Descent Method.
4	Dimensionality reduction by Principal Component Analysis.
5	Classification with Naïve Bayesian algorithm.
6	Image Compression and Reconstruction by SVD Decomposition.
7	Polynomial Regression: To generate a dataset and fit a Polynomial through it.
8	Reducing Overfitting by Ridge and Lasso Regression of A Given Dataset.
9	Backpropagation Implementation in Simple Neural Network with one hidden layer.
10	Implementation of Dropout Using Convolutional Neural Network.
11	Implementation Of Data Augmentation In Python.
12	Reducing Overfitting by Ridge and Lasso Regression of A Given Data.

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. Tom M. Mitchell, *Machine Learning*, McGraw Hill Education, 2020.
2. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.

Reference Books:

1. Ethem Alpaydin, *Introduction to Machine Learning*, 2020, MIT Press.
2. Kevin P. Murphy, *Machine Learning, A Probabilistic Perspective*, 2012, MIT Press.

Program: Electronics and Telecommunication Engineering	T. Y. B. Tech	Semester: VI
Course: Innovative Product Development IV	Course Code: DJS23IPSCXO4	

Pre-requisite:

1. Digital Signal Processing (DJS23ECPC501)
2. Wave Theory & Radio Frequency Design (DJS23ECPC502)
3. Analog & Digital Communication (DJS23ECPC503)
4. Innovative Product Development III (DJS23XSC301P)

Objectives:

1. To develop a functional prototype aligned with the product requirements.
2. To enhance problem-solving skills, communication proficiency and managerial abilities while encouraging effective teamwork.

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

1. Implement project-based learning that enables students to identify and adapt existing ideas into innovative applications or products.
2. Present their project work through a technical report, with the option for a business report, to enhance their documentation abilities.
3. Demonstrate the ability to work in a team and manage the execution of project/ conduct of research.
4. Incorporate interdisciplinary concepts to support students in securing internships, employment opportunities, higher education admissions, or launching a startup.

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 improve the student's technical skills, communication skills (oral and written) by integrating writing, presentation and teamwork opportunities. Each project group has already undergone project topic allotment followed by review and assessments in their third semester. In this semester, the students are expected to continue the same project/product 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 the semester (2^{nd} week from the starting of the semester), each group is expected to complete 80% implementation of the project along with first draft of technical paper.
3. In the second review of the semester (8^{th} week from the starting of the semester), each group is expected to complete 100% implementation of the project along with final draft of technical paper.
4. The students may use this opportunity to learn different computational techniques and hardware challenges towards the development of a product.
5. Interaction with alumni mentor will also be appreciated for the improvement of the project/product. Alumni talks/sessions are regularly conducted at institute to give students clear picture around current and possible new trends.
6. 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.
7. Student groups are encouraged to explore intellectual property (IP) possibilities out of their work and explore the process of IP Filings/Registrations. Awareness talks/sessions are regularly conducted at institute in this context.
8. The technical paper will be published in DJS Strike magazine with ISBN number.

Evaluation scheme:

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

1. Project progress
2. Documentation/Technical paper writing
3. Overall presentation and Teamwork
4. Validation of results (functional testing results)
5. Product Development

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

The final certification and acceptance of Term work ensure satisfactory performance and the outcome of evaluation centered about evaluation scheme.

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