



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)

Second Year B.Tech

in

Computer Science and  
Engineering (Data Science)

(Semester III)

*With effect from the Academic Year: 2025-2026*



**Scheme of Semester III for Department of Computer Science and Engineering (Data Science)**  
**Academic Year 2025-2026**

Sr. No.	Course Code	Course	Teaching Scheme (hrs.)				Semester End Examination(A)						Continuous Assessment (B)						Aggregate (A+B)	Total Credits	
			Theory (hrs)	Practical (hrs)	Tut (hrs)	Credits	Duration (hrs)	Theory/ Cb	Oral	Pract	Oral & Pract	Total SEE (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Term Test 3 (TT3)	Total (TT1,TT2,TT3)	Term Work Total	Total CA (A)			
1	DJS23DPC201	Computer System Fundamentals	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	4
	DJS23DPC201L	Computer System Fundamentals Laboratory	--	2	--	1	2	--	--	--	25	25				--	25	25	50	1	
2	DJS23DPC202	Database Systems	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	4
	DJS23DPC202L	Database Systems Laboratory	--	2	--	1	2	--	--	--	25	25				--	25	25	50	1	
3	DJS23DPC203L	DataScience Laboratory (Python)	1	2	--	2	2	--	--	--	50	50				--	50	50	100	2	2
4	DJS23DMD201	Mathematics for Intelligent Systems	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	3
5	DJS23XOE211	Product Lifecycle Management	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	3
	DJS23XOE212	Management Information System	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE213	Operations Research	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE214	Personal Finance Management	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE215	Public Systems & Policies	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE216	Fundamentals of Biomedical Instruments	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE217	IPR & Patenting	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
	DJS23XOE218	Entrepreneurship and Startup Ecosystem	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100		
6	DJS23XHS231L	Design Thinking Laboratory	--	2	--	1	--	--	--	--	--	--				--	25	25	25	1	1
7	DJS23XHS232	Universal Human Values	2	--	--	2	2	60	--	--	--	60	15	15	10	40	--	40	100	2	2
	DJS23XHS232T	Universal Human Values Tutorial	--	--	1	1	--	--	--	--	--	--				--	25	25	25	1	1
8	DJS23XEL201L	Community Engagement Service	--	2	--	1	--	--	--	--	--	--				--	25	25	25	1	1
9	DJS23XSC201P	Innovative Product Development I	--	2	--	1	--	--	--	--	--	--				--	25	25	25	1	1
		<b>Total</b>	<b>15</b>	<b>12</b>	<b>1</b>	<b>22</b>	<b>16</b>	<b>300</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>400</b>	<b>75</b>	<b>75</b>	<b>50</b>	<b>200</b>	<b>200</b>	<b>400</b>	<b>800</b>	<b>22</b>	<b>22</b>

**Continuous Assessment (A):**

Course	Assessment Tools	Marks	Time (hrs.)
Theory	a. Term Test 1 (based on 40 % syllabus)	15	45
	b. Term Test 2 (on next 40 % syllabus)	15	45
	c. Assignment / course project / group discussion / presentation / quiz/ any other.	10	--
	Total marks (a + b + c)	40	--
Audit course	Performance in the assignments / quiz / power point presentation / poster presentation / group project / any other tool.	--	As applicable
Laboratory	Performance in the laboratory and documentation.	25	
Tutorial	Performance in each tutorial & / assignment.	25	
Laboratory & Tutorial	Performance in the laboratory and tutorial.	50	

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

**Semester End Assessment (B):**

Course	Assessment Tools	Marks	Time (hrs.)
Theory / * Computer based	Written paper based on the entire syllabus.	60	2
	* Computer based assessment in the college premises.		
Oral	Questions based on the entire syllabus.	25	As applicable
Practical	Performance of the practical assigned during the examination and the output / results obtained.	25	2
Oral & Practical	Project based courses - Performance of the practical assigned during the examination and the output / results obtained. Based on the practical performed during the examination and on the entire syllabus.	As per the scheme	2

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**Program: Computer Science and Engineering (Data Science)**

**S.Y B.Tech Semester: III**

**Course: Computer System Fundamentals (DJS23DPC201)**

**Course: Computer System Fundamentals Laboratory (DJS23DPC201L)**

**Pre-requisite:** Basic Mathematics

**Course Objectives:** To understand the structure, functions and characteristics of computer system and operating systems.

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

1. Describe the fundamental organization of a computer system.
2. Apply appropriate memory mapping, process scheduling and disk scheduling methods.
3. Identify the need of concurrency and apply appropriate method to solve the concurrency or deadlock problem.
4. Differentiate between various processor architecture.

<b>Computer System Fundamentals (DJS23DPC201)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Introduction to System Fundamentals:</b> Realization of half adder and full adder using Logic Gates, Von Neumann model, Fixed point representation, Register Transfer and Micro-operations: Floating point representation, Arithmetic Micro-Operations, Arithmetic logical shift unit. Addition and subtraction, Multiplication Algorithms (Booth Multiplication Algorithm), Division Algorithms, Floating Point Arithmetic operations, Instruction Cycle with interrupt and DMA. <b>Operating System Architecture:</b> Basic functions and services, System calls, Types of Operating Systems: Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real -time O.S.	<b>08</b>
<b>2</b>	<b>Central Processing Unit:</b> Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, data transfer and manipulation, Program Control, Reduced Instruction Set Computer (RISC). <b>Process Management:</b> Process Concept, Process states, Process control Block, Threads, Uni-processor Scheduling: Types of scheduling: Pre-emptive, non-pre-emptive, Scheduling algorithms: FCFS, SJF, RR, Priority. Comparative study of process management in Windows, Linux and Android OS.	<b>06</b>
<b>3</b>	<b>Memory Organization:</b> Memory Hierarchy, Main Memory, Cache Memory, Memory Mapping, cache coherence, Pentium IV cache organization, ARM cache organization. <b>Memory Management:</b> Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Fragmentation, Swapping, Virtual Memory, Paging. Segmentation, Demand paging and Page replacement policies. Comparative study of memory management in Windows, Linux and Android OS.	<b>08</b>

4	<b>Concurrency control:</b> <b>Concurrency:</b> Principles of Concurrency, Mutual Exclusion: S/W approaches, H/W Support, Semaphores, Monitors, Classical Problems of Synchronization: Readers-Writers and Producer Consumer problems and solutions. <b>Deadlock:</b> Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Dining Philosopher problem. Comparative study of concurrency control in Windows, Linux and Android OS.	09
5	<b>File and I/O management:</b> File access methods, I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache, Arbitration methods, Comparative study of file and I/O management in Windows, Linux and Android OS.	04
6	<b>Advance Computer Architecture:</b> Characteristics of Multiprocessors, Flynn's taxonomy, Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Introduction to Multiprocessor network topologies.	02
	<b>Total</b>	<b>39</b>

<b>Computer System Fundamentals Laboratory (DJS23DPC201L)</b>	
<b>Exp.</b>	<b>Suggested Experiments</b>
1	Implement Booth's multiplication algorithm.
2	Implement CPU Non-Preemptive scheduling algorithms like FCFS, SJF, Priority etc.
3	Implement CPU Preemptive scheduling algorithms like SRTF, Round Robin, Preemptive priority etc.
4	Explore the internal commands of Linux.
5	Write shell scripts handling File, Directory, Networking and security aspects.
6	Implement Best Fit, First Fit and Worst Fit Memory allocation policy.
7	Implement Fully associative and set associative cache memory mapping.
8	Implement various cache/page replacement policies.
9	Implement order scheduling in supply chain using Banker's Algorithm.
10	Implement Disk Scheduling Algorithms.
	<b>Study Experiments</b>
11	Implement Restoring and Non-Restoring division algorithm.
12	Implement Solution to Producer Consumer Problem of Process Synchronization.
13	Implement Solution to Reader Writer Problem of Process Synchronization.
14	Implement Solution to Dining Philosopher Problem of Process Synchronization.
15	Implementation of Multithreading using parent process and child process using UNIX calls like fork, exec and wait.

Batch wise laboratory work of minimum eight experiment or mini project 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.

\*The term work will be calculated based on Laboratory Performance (15m) and Assignment (10m).

**Books Recommended:*****Text Books:***

1. William Stallings, “Computer Organisation and Architecture”, Pearson publication, 11<sup>th</sup> Edition, 2018.
2. Greg Gagne, Abraham Silberschatz, John Wiley & Sons, Inc. “Operating System Concepts”, 10<sup>th</sup> Edition, 2018.

***Reference Books:***

1. John Hayes, “Computer Architecture and Organization”, McGrawHill, 3<sup>rd</sup> Edition, 2017.
2. M. Morris Mano, “Computer System Architecture”, Pearson, 2017.
3. Andrew S. Tanenbaum and Todd Austin, “Structured Computer Organization”, 6<sup>th</sup> Edition, PHI, 2016.
4. M. Murdocca & V. Heuring, “Computer Architecture & Organization”, WILEY, 2017.
5. By Andrew S. Tanenbaum, “Modern Operating Systems”, PHI, 2009.
6. G. Meike, Lawrence Schiefer, “Inside the Android OS: Building, Customizing, Managing and Operating Android System Services (Android Deep Dive)”, 2021.

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**Program: Computer Science and Engineering (Data Science)**

**S.Y B.Tech. Semester: III**

**Course: Database Systems (DJS23DPC202)**

**Course: Database Systems Laboratory (DJS23DPC202L)**

**Pre-requisite:**

1. Computer Basics

**Course Objectives:** To introduce the students to the management of database systems, with an emphasis on how to design, organize, maintain and retrieve information efficiently and effectively from a database.

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

1. Understand different types of database systems.
2. Construct SQL queries to perform operations on the database.
3. Apply suitable data management techniques for efficient data retrieval.

<b>Database Systems (DJS23DPC202)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Introduction Database Management System:</b> Data Independence, DBMS system architecture, Database Administrator. <b>Entity Relationship Modeling:</b> The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation. <b>Relational Model and Algebra:</b> Introduction, relational schema and concept of keys, Mapping the ER and EER Model to the Relational Model. Relational Algebra: Unary and Set operations, Relational Algebra Queries.	<b>07</b>
<b>2</b>	<b>Structured Query Language (SQL):</b> 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, Security and authorization in SQL.	<b>07</b>
<b>3</b>	<b>Relational-Database Design:</b> Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, Normal Forms- 1NF, 2NF, 3NF, BCNF. <b>Transaction Management and Recovery:</b> ACID properties, Transaction States, Concurrent Executions, Serializability, Concurrency Control Protocols: Lock-based, Timestamp based, Validation Based.	<b>06</b>
<b>4</b>	<b>Indexing Mechanism:</b> Hashing techniques, Types of Indexes: Single Level Ordered Indexes, Multilevel Indexes, Overview of B-Trees and B+ Trees.	<b>05</b>
<b>5</b>	<b>Data Warehouse and ETL:</b> Principles of Dimensional Modeling: The STAR Schema, STAR Schema Keys, Advantages of the STAR Schema, The Snowflake Schema, Dimension Tables, Fact Tables, ETL (Extract, Transform, Load) processes, Data Cube, Data Cube Computation Methods, Data Lake, OLAP, OLAP Characteristics, Major Features and Functions, OLAP Models.	<b>08</b>

<b>6</b>	<b>NoSQL Data Stores:</b> BASE Properties, Comparison of BASE and ACID, Types of NoSQL, Overview of Key-Value, Document, Wide-Column, Graph databases, Concept of Polyglot persistence, Case Study on different NoSQL.	<b>06</b>
	<b>Total</b>	<b>39</b>

<b>Database Systems Laboratory (DJS23DPC202L)</b>	
<b>Exp.</b>	<b>Suggested Experiments</b>
<b>1</b>	To draw an ER diagram for a problem statement.
<b>2</b>	Map the ER/EER to a relational schema.
<b>3</b>	To implement DDL and DML commands with integrity constraints.
<b>4</b>	To access & modify Data using basic SQL.
<b>5</b>	To implement Joins and Views.
<b>6</b>	To Examine the consistency of database using concurrency control technique (Locks).
<b>7</b>	To implement an ETL Pipeline with SQL Server Integration Services (SSIS) tool.
<b>8</b>	To build a Data Cube with PivotTables and perform OLAP operations.
<b>9</b>	To Perform CRUD Operations using NoSQL.
<b>10</b>	To Create a Basic Data Lake using Open-Source Technologies.

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

\*The Term Work will be calculated based on Laboratory Performance(15m) and Computer Based Assessment (10m).

#### **Books Recommended:**

##### ***Text books:***

1. Korth, Silberschatz, Sudarshan, "Database System Concepts", McGraw – Hill, 7th Edition, 2019.
2. Elmasri and Navathe, "Fundamentals of Database Systems", Pearson Education, 7th Edition, 2021.
3. Alejandro Vaisman, Esteban Zimányi, "Data Warehouse Systems: Design and Implementation", Springer, 2nd Edition, 2022.
4. Andreas Meier, Michael Kaufmann, "SQL & NoSQL Databases", Springer, 2019.

##### ***Reference Books:***

1. Raghu Ram Krishnan and Johannes Gehrke, "Database Management Systems", TMH, 2<sup>nd</sup> Edition, 2003.
2. Dr.P.S. Deshpande, "SQL and PL/SQL for Oracle 10g", Black Book, Dreamtech Press, 2006.
3. Patrick Dalton, "Microsoft SQL Server Black Book", Coriolis Group, U.S., 1997.
4. Paulraj Ponniah, "Data Warehousing Fundamentals a Comprehensive Guide for It Professionals", John Wiley & Sons, Inc., 2004.
5. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining. Concepts and Techniques", Elsevier Inc., 2012.

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**Program: Computer Science and Engineering (Data Science)**  
**Course: Data Science Laboratory (Python) (DJS23DPC203L)**

**S.Y B.Tech. Semester: III**

**Pre-requisite:**

1. Programming Fundamentals
2. Fundamentals of Data Analysis

**Objectives:**

1. To learn the basic and OOP concepts of Python.
2. To learn basic of Data manipulation and Analysis.

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

1. Implement python programs to solve real world problems.
2. Perform Data Manipulation and Analysis.

<b>Data Science Laboratory (Python) (DJS23DPC203L)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Python basics</b> Operators, Input and Output, Control statements, Arrays, String and Character.	<b>01</b>
<b>2</b>	<b>Functions and Collections in python</b> Functions in python, Calling a Function, Arguments, Arbitrary Arguments, *args, Keyword Arguments, Arbitrary Keyword Arguments, **kwargs, The pass Statement, Recursion, Collections in Python, List, Tuples and Dictionaries.	<b>02</b>
<b>3</b>	<b>Introduction to OOP</b> Classes, Objects, and Constructor, Methods, Abstraction, Inheritance, Magic Methods, Exception handling.	<b>02</b>
<b>4</b>	<b>Advanced Python Concepts</b> Modules, Packages, Python Collections Module, Opening and Reading Files and Folders, Python OS Module, Python Date Time Module, Python Math and Random Modules, Text Processing & Regular expression.	<b>02</b>
<b>5</b>	<b>Python Numpy Module</b> Construct Numpy arrays, Printing arrays, Arithmetic Operations on matrix's using Numpy Module, numpy zeros ().	<b>01</b>
<b>6</b>	<b>Exploratory Data Analysis (EDA)</b> Descriptive Statistics, Correlation Analysis, Handling Missing Data, Outlier Detection.	<b>02</b>
<b>7</b>	<b>Data Preprocessing</b> Introduction to Pandas Library, Working with Series and Data Frames, Data Cleaning and Preprocessing, Data Transformation and Aggregation, Indexing and Slicing Data, Combining and Merging DataFrames.	<b>02</b>
<b>8</b>	<b>Data Visualization</b> Matplotlib module, Seaborn module, Plotly, Heatmaps.	<b>01</b>
	<b>Total</b>	<b>13</b>

<b>Data Science Laboratory (Python) (DJS23DPC203L)</b>	
<b>Exp.</b>	<b>Suggested experiments</b>
<b>1</b>	Implement python program to demonstrate different decision-making statements
<b>2</b>	Implement python program on Arrays.
<b>3</b>	Implement python program on String.
<b>4</b>	Implement python program on Collections (List, Tuples and Dictionaries).
<b>5</b>	Implement python program on function, recursion.
<b>6</b>	Implement python program on Text Processing & Regular expression.
<b>7</b>	Implement python program to construct numpy arrays, printing arrays, arithmetic operations on matrix's using Numpy Module, numpy zeros ().
<b>8</b>	Implement python program to perform Descriptive Statistics, Correlation Analysis.
<b>9</b>	Implement python program to Handling Missing Data, outlier detection.
<b>10</b>	Implement python program to perform data cleaning and data preprocessing.
<b>11</b>	Implement python program for working with series and data Frames.
<b>12</b>	Implement python program to perform to perform data transformation and aggregation.
<b>13</b>	Implement Python program to perform data visualization.

A minimum of 10 experiments or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

\*The Term Work will be calculated based on Laboratory Performance (25m), and Computer based Assessment (25m).

### **Books Recommended**

#### ***Text books:***

1. Zed Shaw, "Learn Python the Hard Way", Addison-Wesley, 5<sup>th</sup> Edition, 2024.
2. Jake VanderPlas, "Python Data Science Handbook", Reilly, 2nd Edition, 2022.

#### ***Reference books:***

1. Wes McKinney, "Python for Data Analysis", O'Reilly Media, Inc., 3<sup>rd</sup> Edition, 2022.
2. Just Into Data, "Python for Data Analysis: Step-By-Step with Projects", Packt Publishing, 2021.
3. John Paul Mueller, Luca Massaron, "Python for Data Science for Dummies", Wiley, 3<sup>rd</sup> Edition, 2023.

#### ***Digital resources:***

1. The Python Tutorial: <http://docs.python.org/release/3.0.1/tutorial/>
2. Free and Open Source IITB Lab: <http://spoken-tutorial.org>
3. [www.staredusolutions.org](http://www.staredusolutions.org)

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# **MULTIDISCIPLINARY MINOR**

**Program: Computer Science and Engineering (Data Science)**  
**Course: Mathematics for Intelligent Systems (DJS23DMD201)**

**S.Y B.Tech. Semester: III**

**Pre-requisite:**

1. Basic Matrices
2. Partial Differentiation
3. Basic Probability

**Objectives:** To build a strong mathematical foundation in learners needed for building concepts of machine learning.

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

1. Analyze probability of random variable and probability distributions.
2. Demonstrate knowledge of linear algebra.
3. Apply concepts of matrix theory.
4. Demonstrate concepts of calculus.
5. Analyze different optimization techniques.

<b>Mathematics for Intelligent Systems (DJS23DMD201)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Probability</b> <ul style="list-style-type: none"><li>• Conditional probability.</li><li>• Bayes' theorem.</li></ul>	<b>2</b>
	<b>Random variables</b> <ul style="list-style-type: none"><li>• Discrete random variable, probability mass function, discrete distribution function.</li><li>• Continuous random variable, probability density function, continuous distribution function.</li><li>• Mathematical expectation.</li><li>• Moment generating function.</li><li>• Two-dimensional random variable and its joint probability mass and density function, marginal distribution function, conditional distribution functions, covariance, joint moments.</li></ul>	<b>4</b>
	<b>Probability Distributions</b> <ul style="list-style-type: none"><li>• Discrete: Binomial distribution, Poisson distribution, Hypergeometric distribution.</li><li>• Continuous: Uniform distribution, Exponential distribution, Normal distribution, Beta distribution, Gamma distribution.</li></ul>	<b>4</b>
<b>2</b>	<b>Linear Algebra</b> <ul style="list-style-type: none"><li>• Vectors in n-dimensional vector space, properties, dot product, cross product, norm, and distance.</li><li>• Vector spaces over real field, properties of vector spaces over real field, subspaces.</li><li>• Linear independence and dependence of vectors, span of vectors.</li><li>• Basis and dimension of a vector space.</li></ul>	<b>07</b>

	<ul style="list-style-type: none"> <li>• Cauchy Schwarz inequality.</li> <li>• Linear transformation.</li> </ul>	
3	<b>Matrix Theory</b> <ul style="list-style-type: none"> <li>• Characteristic equation.</li> <li>• Eigen values and Eigen vectors and their properties.</li> <li>• Cayley-Hamilton theorem (verification and application).</li> <li>• Similarity and diagonalization of matrices.</li> <li>• Functions of square matrix.</li> <li>• Derogatory and nonderogatory matrices.</li> <li>• Matrix Factorization.</li> </ul>	08
4	<b>Calculus</b> <ul style="list-style-type: none"> <li>• Gradient.</li> <li>• Directional derivatives.</li> <li>• Jacobian and hessian matrices.</li> <li>• Convex, concave functions and their properties.</li> </ul>	04
5	<b>Optimization</b> <ul style="list-style-type: none"> <li>• Unconstrained optimization techniques: newton's method, quasi newton method.</li> <li>• Constrained optimization techniques: gradient descent, Lagrange's multiplier method with 2 or 3 variables and one equality constraint, Karush–Kuhn–Tucker method with 2 variables and 1 or 2 constraints, Simplex method, Penalty and Duality, Dual Simplex method.</li> </ul>	10
	<b>Total</b>	<b>39</b>

\*The Term Work will be calculated based on an Assignment / Quiz on each module for 10 marks each scaled to 25 marks.

### Books Recommended:

#### Textbooks:

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication, 44th Edition, 1965.
2. Kanti B. Datta, Mathematical Methods in Science and Engineering, Cengage Learning India, 1<sup>st</sup> Edition, 2011.
3. Hamdy A. Taha, Operations Research - An Introduction, Pearson, 10th Edition, Publication Year 2010.
4. P. K. Gupta, Mohan Man, Operations Research, Kanti Swarup, S Chand Publication, 1<sup>st</sup> Edition, 2005.

#### Reference Books:

1. W. Cheney, Analysis for Applied Mathematics, New York: Springer Science Business Media, 1<sup>st</sup> Edition, 2001.
2. S. Axler, Linear Algebra Done Right, Springer International Publishing, 3<sup>rd</sup> Edition, 2015.
3. J. Nocedal and S. J. Wright, Numerical Optimization, New York: Springer Science Business Media, 2nd Edition, 2006.
4. J. S. Rosenthal, A First Look at Rigorous Probability Theory, Singapore: World Scientific Publishing, 2nd Edition, 2006.
5. Seymour Lipschutz and Marc Lipson, Linear Algebra Schaum's outline series, Mc-Graw Hill Publication, 4<sup>th</sup> Edition, 2009.
6. Erwin Kreysizg, Advanced Engineering Mathematics, John Wiley & Sons Inc, 10th Edition, 2000.

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**VOCATIONAL AND SKILL**  
**ENHANCEMENT COURSE**

**Program: Computer Science and Engineering (Data Science)**  
**Course: Innovative Product Development I (DJS23XSC201P)**

**S.Y. B.Tech Semester: III**

**Course Objectives:**

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value-added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualize and create a successful product.

**Course Outcome:**

Learner will be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualizing a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyze the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills, while working as a member of the team or as the leader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare them to be successful entrepreneurs.
7. Demonstrate product/project management principles during the design and development work and excel in written (Technical paper preparation) as well as oral communication.

**Guidelines for the proposed product design and development:**

- Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).
- Students should carry out a survey and identify the need, which shall be converted into conceptualization of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
- Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
- Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
- A record in the form of an activity logbook is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
- The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department.
- Efforts are to be made by the students to try and publish a technical paper, at a suitable publication

(National /International), approved by the department research committee/ Head of the department.

- The focus should be on self-learning, the capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the yearlong course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, ie during the semesters III and IV.

**Guidelines for Assessment of the work:**

- The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
- In the continuous assessment, the focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.

**Review/Progress monitoring committee may consider the following points during the assessment.**

The tentative rubrics that can be followed can be as follows:

**Review 1:**

- i. Literature Review (Algorithms, Techniques, Methodologies) / Product Review (Review of atleast 5 technical papers).
- ii. Presentation Quality.
- iii. Contribution as a team member and Punctuality.

**Review 2:**

- i. Analysis of Literature Review.
- ii. Problem Statement and proposed solution.
- iii. System Process Flow Diagram.
- iv. Presentation Quality.
- v. Contribution as a team member and Punctuality.
- vi. Project Documentation.

Prepared by

Checked by

Head of the Department

Principal



**ENTREPRENEURSHIP /**  
**ECONOMICS / MANAGEMENT**  
**COURSES**

**Program: Common to all Programs (Group A / B)**

**S.Y B.Tech.**

**Semester: III & IV**

**Course: Design Thinking Laboratory (DJS23XHS231L)**

**Pre-requisite:**

1. Understanding of product / process / software / service development life cycle.
2. Knowledge of agile frameworks (or any similar iterative framework) would be an added advantage but will not be mandatory.

**Objectives:**

1. To instill an innovative mindset in students to solve the digital-age business, societal and wicked type of problems using design thinking methods and tools, and its application.
2. To equip students with techniques to empathize with users, ideate innovative and sustainable solutions for real world problems through iterative approach to design.

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

1. Understand the importance of Human-Centric design approach for developing a solution.
2. Generate innovative ideas to design sustainable solutions for real world problems.
3. Apply design thinking principles to solve the real-world problems.

<b>Design Thinking Laboratory (DJS23XHS231L)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Introduction to Design Thinking</b> <ul style="list-style-type: none"><li>• Understanding the fundamentals of design thinking.</li><li>• Exploring the history and evolution of design thinking.</li><li>• The importance of empathy in the design thinking process.</li><li>• Conduct market &amp; industry research by observing and contextualizing various macro &amp; micro trends.</li><li>• Case Study - conduct their own research on how Design Thinking helped solve some of the biggest and critical problems of our time.</li></ul>	<b>06</b>
<b>2</b>	<b>Empathize Phase</b> <ul style="list-style-type: none"><li>• Techniques for conducting user research and gathering insights.</li><li>• Creating user personas and empathy maps.</li><li>• Practicing active listening and observation skills.</li><li>• To apply various empathizing techniques on the problem statement selected.</li><li>• Use walk-a-mile immersion and heuristic reviews to first empathize with end users and then to build empathy map and customer journey map.</li></ul>	<b>04</b>
<b>3</b>	<b>Define Phase</b> <ul style="list-style-type: none"><li>• Defining problem statements and reframing challenges.</li><li>• Tools for synthesizing research findings.</li><li>• Developing a clear and actionable problem statement.</li><li>• Start building from Persona map and conduct interviews/ Gemba walk to plot user's journeys from start to end.</li><li>• Define the problem space using HMW statement. Now highlight areas of opportunities in the journey map and enlist potential channels/touchpoints as well as stakeholders for proposed solution interventions.</li></ul>	<b>04</b>
<b>4</b>	<b>Ideate Phase</b>	<b>04</b>

	<ul style="list-style-type: none"> <li>Generating creative ideas through brainstorming sessions.</li> <li>Techniques for divergent and convergent thinking.</li> <li>Prototyping and experimenting with ideas.</li> <li>Apply suitable ideation technique to quickly generate diverse ideas that could be applied to target problem space – either partially or in full.</li> <li>Brain Writing – Build on each other's ideas and constructively &amp; creatively develop better ideas using SCAMPER technique.</li> </ul>	
5	<b>Prototype and Validation</b> <ul style="list-style-type: none"> <li>Introduction to prototyping tools and techniques.</li> <li>Rapid prototyping methods.</li> <li>Testing prototypes with users and gathering feedback.</li> <li>Refining solutions based on user insights.</li> <li>Develop user storyboard to layout solution proposition in visual and easily explainable form. Run a quick peer validation.</li> <li>peer-validated the storyboard.</li> <li>Build an interactive digital prototype using any digital rapid prototyping platform and seek user validation.</li> </ul>	06
6	<b>Design Thinking for Strategic Innovation:</b> <ul style="list-style-type: none"> <li>Types of innovations, strategic innovation.</li> <li>Features of strategic innovation.</li> <li>Design thinking and strategic innovation.</li> <li>Practices of integrating design thinking in strategic innovation.</li> </ul>	02
	<b>Total</b>	<b>26</b>

\*The term work will be based on minimum 5 Assignments (15 marks) and mini project of individual or in a group of 2-3 students (10 marks).

#### List of Experiments:

- Below is a list of assignments / activities / experiments that would be carried out by students as a mini project in groups of size not more than Three students in each group.
- Problem statement for these assignments/ activities/ experiments will be provided by facilitator/ instructor/ faculty to the groups/ teams/ batches within each class.
- This list of experiment will help students to learn various design thinking methods and practice corresponding tools available.

Exp.	Suggested Experiment
1	To conduct market and industry research and analyze case studies demonstrating the application of design thinking. (Increased understanding of how design thinking has been applied to solve critical problems in various contexts.)
2	To exercise empathizing techniques to understand the needs and pain points of a target audience.
3	Developing empathy maps and customer journey maps based on collected insights.
4	To exercise different tools and techniques (such as affinity diagrams, journey mapping, and user story mapping) for synthesizing research findings).
5	Develop user personas to represent different user archetypes and their needs concerning the problem at hand.
6	To practice SCAMPRE technique, Brainstorming and brain writing as a

	collaborative ideation technique to create multiple creative ideas / solution for the problem at hand.
7	Create a mind map to generate a wide range of solutions to a problem at hand.
8	To explore different prototyping tools and platforms, such as Adobe XD, Figma, Sketch, and InVision.
9	To Conduct rapid prototyping sessions to build low fidelity / High fidelity prototype based on the ideas generated in Ideation phase and iterate based on feedback received.
10	Develop a plan for implementing the final solution, considering factors like scalability and feasibility.
11	<ul style="list-style-type: none"> <li>• Conduct usability testing to gather feedback on prototypes.</li> <li>• Use A/B testing to compare different versions of a solution and determine which performs better.</li> </ul>

**Note** – A minimum of eight experiments from the above-suggested list (experiments 01 to 07) or any other assignment based on the syllabus will be included, which would help the learner to apply the concept. The mini-project is mandatory.

### Books Recommended

#### Text books:

1. I. Mootee, “Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School” Wiley, 2013.
2. M. Lewrick, P. Link, and L. Leifer, “The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems” Wiley, 2018.
3. T. Lockwood, “Design Thinking: Integrating Innovation, Customer Experience, and Brand Value”, Allworth Press, 2010.
4. K. T. Ulrich and S. D. Eppinger, “Product Design and Development”, McGraw-Hill Hill Education, 6<sup>th</sup> Edition, 2016.
5. C. J. Meadows and C. Parikh, “The Design Thinking Workbook: Essential Skills for Creativity and Business Growth”, Emerald Publishing, 2022.

#### Reference books:

1. T. Kelley and D. Kelley, “Creative Confidence: Unleashing the Creative Potential Within Us All”, HarperCollins Publisher, 2013.
2. T. Brown, “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, HarperCollins, 2013.
3. J. Knapp, J. Zeratsky, and B. Kowitz, “Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days”, Simon & Schuster, 2016.
4. A. Chakrabarti, “Engineering Design Synthesis: Understanding, Approaches and Tools”, Springer, 2002.
5. K. Otto, and K. Wood, “Product Design”, Prentice Hall, 2000.

#### Online Reference:

##### 1) Design and Innovation:

- a) <https://openstax.org/books/entrepreneurship/pages/4-suggested-resources>

##### 2) Overview of Design Thinking :

- a) <https://www.interaction-design.org/literature/topics/design-thinking>
- b) [10 Models for Design Thinking. In 2004, business consultants Hasso... | by Libby Hoffman | Medium](#)

- c) <https://www.tgen.com/design-thinking/#What is Design Thinking and How Does it Relate to Product Development>

**3) Understand, observe and define the problem:**

- a) <https://www.nngroup.com/articles/empathy-mapping/>
- b) <https://uxdesign.cc/the-purpose-of-a-journey-map-and-how-can-it-galvanize-action-9a628b7ae6e>

**4) Ideation and prototyping:**

- a) <https://www.interaction-design.org/literature/topics/prototyping>
- b) <https://www.uxmatters.com/mt/archives/2019/01/prototyping-user-experience.php>

**5) Testing and implementation:**

- a) <https://www.nngroup.com/articles/usability-testing-101/>
- b) <https://www.interaction-design.org/literature/article/test-your-prototypes-how-to-gather-feedback-and-maximise-learning>

**6) Design thinking in various sectors:**

- a) [https://www.tutorialspoint.com/design\\_thinking/design\\_thinking\\_quick\\_guide.htm](https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm)

**Web References:**

1. Creative Engineering Design (<https://nptel.ac.in/courses/107108010>)
2. Understanding Creativity and Creative Writing (<https://nptel.ac.in/courses/109101017>)
3. Understanding Design Thinking & People Centred Design (<https://nptel.ac.in/courses/109104109>)
4. Design Thinking - A Primer (<https://nptel.ac.in/courses/110106124>)
5. Product Engineering and Design Thinking (<https://nptel.ac.in/courses/112105316>)

# **VALUE EDUCATION COURSE**

**Program: All (SY B.Tech)**

**S.Y B.Tech. Semester: III**

**Course: Universal Human Values (DJS23XHS232)**

**Course: Universal Human Values Tutorial (DJS23XHS232T)**

**Objectives:**

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession.
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

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

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Understand the harmony in nature and existence and work out their mutually fulfilling participation in the nature.
5. Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

<b>Universal Human Values (DJS23XHS232)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Course Introduction - Need, Basic Guidelines, Content and Process for Value Education</b> Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration-what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels	<b>4</b>
<b>2</b>	<b>Understanding Harmony in the Human Being - Harmony in Myself</b> Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body'. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body; correct appraisal of Physical needs, meaning of	<b>5</b>

	Prosperity in detail, Programs to ensure Self-regulation and health.	
3	<b>Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship</b> Understanding harmony in the Family- the basic unit of human interaction, understanding values in human-human relationship; meaning of Justice and program for its fulfillment. Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family). Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family!	9
4	<b>Understanding Harmony in the Nature and Existence - Whole existence as Co-existence</b> Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence	4
5	<b>Implications of the above Holistic Understanding of Harmony on Professional Ethics:</b> Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations	4
	<b>Total</b>	<b>26</b>

#### Tutorials: (Term work)

Term work shall consist of minimum 5 activities based on activities conducted.

The tutorials could be conducted as per the following topics: -

Activity No 1	Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony, and co-existence) rather than as arbitrariness in choice based on liking-disliking.
Activity No 2	Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.
Activity No 3	Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.



Activity No 4	Practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.
Activity No 5	Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

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

### **Books Recommended:**

#### ***Textbooks:***

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

#### ***Reference Books:***

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher. 6. Slow is Beautiful - Cecile Andrews.
6. Economy of Permanence - J C Kumarappa.
7. Bharat Mein Angreji Raj – PanditSunderlal.
8. Rediscovering India - by Dharampal.
9. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.
10. India Wins Freedom - Maulana Abdul Kalam Azad.
11. Vivekananda - Romain Rolland. (English)
12. Gandhi - Romain Rolland. (English)

Prepared by

Checked by

Head of the Department

Principal

**COMMUNITY ENGINEERING**  
**PROJECT / FIELD PROJECT**

**Program: Common for all Programs**

**S.Y B.Tech. Semester: III**

**Course: Community Engagement Service (DJS23XEL201L)**

**Pre-requisite:**

1. Fundamentals of core branch
2. Communication Skills

**Objectives:**

1. To sensitise the student / learner into recognising social problems & challenges and give them an opportunity to engage in activities for solving the same.

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

1. Knowledge application: Applies knowledge understandings acquired from one's academic study/ field/ discipline for community level education, information dissemination by participation and engagement in community welfare activities.
2. Commitment for cause: Identify and experience commitment for community engagement activities that reinforce sense of belongingness and gratitude towards societal cause.
3. Diversity: Witness diversity in communities and cultures and demonstrate change in approach / attitude as an evidence of unconditional acceptance.
4. Team: Recognise, experience and value effectiveness of working in a team, demonstrating co-existence of the roles - sincere worker and effective leader.

<b>Community Engagement Service (DJS23XEL201L)</b>	
<b>Unit</b>	<b>Description</b>
<b>1</b>	<b>Open Activities</b> <ul style="list-style-type: none"><li>• Participation in: blood donation camps organizer / donor, day-long tree plantation or afforestation / seed dispersal / cleanliness (water bodies, surrounding etc.) drives.</li><li>• Literacy drives for child / youth / adults. One day hand holding activities in work-shop conduct for under privilege kids in the areas of – basic science, math, technical skill demonstration and building.</li></ul>
<b>2</b>	<b>Technical (Program core related)</b> <ul style="list-style-type: none"><li>• Cyber-crime, security awareness and vulnerabilities – sensitization, information dissemination and awareness sessions in indicated focus areas.</li></ul> Promotion and Sensitization for Sustainable living – focusing on solar power, water recycling, e-waste responsible disposal, waste recycling etc. in indicated focus areas. Focus areas: residential societies, schools, under-privileged areas, governments /private offices, and similar other establishments. <b>OR</b> <b>Field Survey</b> <ul style="list-style-type: none"><li>• Reporting on proactively conducted survey in the areas of resource management for – water, vegetables, electricity, crops etc.</li></ul>

**Suggested Activities**

1. Undertaking cyber safety / security awareness sensitization drive / program especially for un-initiated students / individuals in schools / colleges / residential complex / offices etc. Typical suggested tabulation.

Participant No.	Name	Age	School/ College/ Residence/ Office	Email	Contact Number	Awareness Level	Remarks

2. Energy / Power assessment for establishments (societies, schools, colleges, residential complex, shops etc.) involving computing power devices ratings, power consumption over operating period, calculating energy cost from tariff card / rates for every group of appliances / devices or equipment. Typical suggested tabulation pattern.

Device/Appliance Group	Number of appliances / devices	Power Rating (kW)	Operating Hours (h/day)	Energy Consumption (kWh/day)	Tariff Rate (Rs. / kWh)	Energy Cost (Rs.)
Lighting Fixtures						
Ceiling Fans						
Air Conditioner (AC)						
Security Systems						
Water Pump						

3. Traffic light monitoring viz-e-viz average traffic density on road. Analysing the data and commenting on results. Evaluating and comparing impact on road repairs related lane blockage and proportional recommendation for lights timing variations. Typical suggested tabulation pattern.

Sr. No.	Timestamp	Traffic Density	Traffic Light Status	Road Repair Status	Remarks

4. Help compute green footprint of select number of household (per member) - say 10 houses of 3+ members. This is for evaluating dependence upon non green energy sources and habits and changes in lifestyle for attempts at their reductions. Learners are

encouraged to use typically available online carbon-footprint calculators. The table herewith maybe used for reference calculations.

House No.	House hold Name	Number of Members	Energy Usage (kWh)	Water Usage (liters)	Waste Production (kg)	Transportation Habits	Green Footprint

5. Compulsion of having a borewell for non-potable water supply in city residential complexes is a modern-day rule. Increased pace of re-development, as well as number of occupants in given area, has resulted in increased number of borewells being dug within and outside city limits.

Reduced yield, quality and quantity of water adds to the recurring maintenance cost of borewells, especially in the city areas. Poor water recharge systems along-with depleting open soil cover area in wake of wall-to-wall of concrete carpet aggravate the problem. Study, analyse and report a residential society's – capacity of water requirement, present day borewells in action, approximate yield, maintenance cost and frequency, borewell flushing iterations in wake of redevelopment in neighborhood. A typical tabulation mechanism for inferences can be as below:

Borewell No.	Location	Depth (ft)	Yield (Liters/Day)	Water Quality	Maintenance Cost (Rs.)	Remarks

6. Detection of Adulteration in food / fruits / vegetables / milk / mava /saffron etc. or contamination of potable drinking water.

Ex. Adulteration in fruits could be apple waxing, injecting chemicals in watermelon, pomegranate etc. to give it a bright red color, artificial ripening of mangos etc.

For a given activity, samples from more than one area, specifically from mofussil /interiors / ‘gaothans’ etc, may be obtained, to evaluate sample purity or extent of adulteration. Learners are encouraged to use online resources provided by ‘Food Safety and Standards Authority of India’ (*fssai*), for handholding in requisite procedures.

**YouTube link:**

Food Safety and Standards Authority of India: [goo.gl/Y8Lzbu](http://goo.gl/Y8Lzbu)

Ex. 1 Milk Adulteration:

<https://www.youtube.com/watch?v=pbnmeRUBxKk>

Ex.2 Watermelon Adulteration:

<https://www.youtube.com/watch?v=yrLAj7oJies>

Product	Adulterant	Testing Method	Result	Remarks

**Certificates and Formats:**

**Activity Endorsement Certificate**

Date:

Community engagement service is a mandatory course, of two credits, introduced at second year of engineering under the autonomous structure of the institute.

Course objective: To sensitise the student / learner into recognising social problems & challenges and give them an opportunity to engage in activities for solving the same.

Course outcomes:

1. Knowledge application: Applies knowledge understandings acquired from one’s academic study/ field/ discipline for community level education, information dissemination by participation and engagement in community welfare activities.
2. Commitment for cause: Identify and experience commitment for community engagement activities that reinforce sense of belongingness and gratitude towards societal cause.
3. Diversity: Witness diversity in communities and cultures and demonstrate change in approach / attitude as an evidence of unconditional acceptance.

4. Team: Recognise, experience and value effectiveness of working in a team, demonstrating co-existence of the roles - sincere worker and effective leader.

This is to certify that Mr./Ms. \_\_\_\_\_ bearing SAP ID \_\_\_\_\_ is a student of S.Y. B.Tech., \_\_\_\_\_ branch of engineering. He / She is a bonafide student of SVKM's Dwarkadas J. Sanghvi College of Engineering, Mumbai. He / She is reliable, sincere, hardworking and capable of conducting \_\_\_\_\_ activity in your premises. We request you to kindly allow for the conduction of the activity and we also solicit your earnest co-operation in the same.

**Signature**

**Name of Department Head:**

**Disclaimer**

(This form must be read, signed, and submitted prior to the beginning of the community service activity.)

Student Details	Activity Details
Name	
SAPID	Date
Program	Time
Class/Div	Address

I, the undersigned \_\_\_\_\_ accept the following terms and conditions unconditionally:

1. I accept and understand that the community activity identification and selection has been done willingly by me.

2. I undertake to convey that, I am apparently in good health and well-being, and suffer no physical impairment that would or should prevent my participation in the activity.
3. I undertake to bear all related expenses and risk of travel related to the activity and shall not hold any personnel from the institute responsible with regards to claims and / or loss in the process of conduct of activity.
4. I undertake that my parents or legal/local guardians are aware of said activity and agree to above mentioned terms and conditions.

**Student's name & signature:** \_\_\_\_\_

**Parent or Guardian's name & signature:** \_\_\_\_\_

### **Guidelines for Assessment of the work**

- The review/progress monitoring committee shall be constituted by the Head of the Department. The progress of selected/assigned activities is to be evaluated on a continuous basis, holding at-least one review in the semester.
- In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
- Each group needs to submit following forms to respective supervisor after conducting both the activities,
  - o Activity Conduction Report
  - o Participant Feedback (online / offline)
  - o Participant Attendance (online / offline)
  - o Survey Report
  - o Participation certification

### **Forms for Technical Activity:**

#### **1. Activity Conduction Report**

<b>Sr. No.</b>	<b>Name of the Activity</b>	
1	Date of Activity	



2	Activity type Open / Technical	
3	Activity objectives	
4	Place of Activity	
5	SAP id and Names of students	
6	Name of the Association	
7	Activity description	
8	No. of participants	
9	Photos (Geo tagged)	

## 2. Participant feedback (online / offline):

Sr. No.	Indicators	Scale: 1 (Lowest) to 5 (Highest)
1	The objectives of the training were clearly defined.	
2	The content was organized and easy to follow.	
3	This training experience will be useful to me.	
4	The trainer was knowledgeable about the training topics.	
5	The training objectives were met	

### Evaluation Scheme:

#### Continuous Assessment (A):

Term Work: - 25 marks, distribution as herewith:

#### 1. Rubric for Open Ended Activity (10 marks)

- Participation certificate/proof

**2. Rubric for Technical Activity (15 marks)**

<b>Sr. No.</b>	<b>Performance Indicators</b> (Maximum marks per indicator are given in bracket)	<b>Marks</b>
1	Pre-requisite documents (permission letter, presentation material, permission letters, etc.) [05 marks]	
2	Participant Feedback [05 marks]	
3	Participant attendance [05 marks]	
	<b>TOTAL</b>	

**OR**

**3. Rubric for Field Survey Activity:**

<b>Sr. No.</b>	<b>Performance Indicators</b> (Maximum 03 marks per indicator)	<b>Marks</b>
1	Topic selection	
2	Survey preparation	
3	Field work	
4	Analysis	
5	Report writing	
	<b>TOTAL</b>	

Prepared by

Checked by

Head of the Department

Principal

**OPEN ELECTIVE**

**Program: All Courses**

**S.Y B.Tech.**

**Semester: III**

**Course: Product Life Cycle Management (DJS23XOE211)**

**Pre-requisite:**

1. Basic Management knowledge

**Objectives:**

1. To familiarize the students with the need, benefits and components of PLM.
2. To acquaint students with Product Data Management & PLM strategies.
3. To give insights into new product development program and guidelines for designing and developing a product.
4. To familiarize the students with Virtual Product Development.
5. To acquaint students with the need of Environmental aspects in PLM & its implementation.

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

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Acquire knowledge in applying virtual product development tools.
4. Acquire knowledge in implementation of Environmental aspects in PLM.

<b>Product Life Cycle Management (DJS23XOE211)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Introduction to Product Lifecycle Management (PLM):</b> Product Lifecycle management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications. <b>PLM Strategies:</b> Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM.	<b>07</b>
<b>2</b>	<b>Product Design and Development:</b> Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design.	<b>07</b>
<b>3</b>	<b>Methodological Evolution of Product Design:</b> Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering, Life Cycle Approach, Characteristic Features of Life Cycle Approach. The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process. New Product Development (NPD) and Strategies, Product Configuration and	<b>10</b>

	Variant Management. <b>Integration of Environmental Aspects in Product Design:</b> Sustainable Development Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design, Tools and techniques for integrated design, Implementation of international standards.	
4	<b>Product Data Management (PDM):</b> Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation. <b>Virtual Product Development Tools:</b> For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modelling and simulations in Product Design, Examples/Case studies.	07
5	<b>Engineering Methods for product Duration design &amp; evaluation:</b> Durability of Products and Components, Design for Fatigue, Infinite Life Approach, Design for Finite Life. <b>Product Recovery Planning &amp; Analysis:</b> Approach to the Recovery Problem, Method for Recovery Cycles Planning, Calculation Models for Recovery Cycles Planning, Basic procedure, Determinant Factors for Recovery, Effective Component Reusability, Recovery Fractions, Extension of Useful Life.	08
	<b>Total</b>	<b>39</b>

### **Books Recommended:**

#### ***Textbooks:***

1. John Stark, — Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, — Product Design for the environment-A life cycle approach, Taylor & Francis 2006, ISBN: 0849327229

#### ***Reference Books:***

1. Saaksvuori Antti, Immonen Anselmie, — Product Life Cycle Management, Springer, Dreamtech, ISBN: 3540257314
2. Michael Grieve, — Product Lifecycle Management: Driving the next generation of lean thinking, Tata McGraw Hill, 2006, ISBN: 0070636265
3. François Villeneuve, Luc Mathieu, Max Giordano —Product Life-Cycle Management: Geometric Variations. (2010). United Kingdom: Wiley.

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**Program: All Courses**

**S.Y B.Tech.**

**Semester: III**

**Course: Management Information System (DJS23XOE212)**

**Pre-requisite:** Nil

**Objectives:**

1. The course is blend of management and technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
4. Identify the basic steps in systems development.

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

1. Explain the fundamental concepts of the management information systems used in business.
2. Describe IT infrastructure and its components and its current trends.
3. Use the tools and technologies for accessing information from databases to improve business performance and decision making
4. Identify and explain the security and ethical challenges in MIS along with the measures to be taken
5. Select a suitable social computing platform for the given requirements that integrates AI and IoT.
6. Explain the processes involved in the information system within the organization includes information acquisition and enterprise and global management technologies.

<b>Management Information Systems (DJS23OCOE302)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Foundation Concepts</b> <ul style="list-style-type: none"><li>• Definition and scope of Management Information Systems (MIS) in business,</li><li>• Functional area information system,</li><li>• The components of information systems,</li><li>• Impact of IT on organizations and society,</li><li>• Business Process – BPR and BPI.</li><li>• Business Pressure, Organizational responses.</li><li>• Competitive Advantage and Strategic IS's.</li></ul>	<b>04</b>
<b>2</b>	<b>Information Technology Infrastructure:</b> <ul style="list-style-type: none"><li>• Overview of IT infrastructure,</li><li>• Hardware and software,</li><li>• Computer systems: End user and enterprise,</li><li>• Computing computer peripherals: Input, output, and storage technologies,</li><li>• Application software: End user applications,</li><li>• System software: Computer system management,</li><li>• Data resource management: Technical foundations of database management, Managing data resources, Big data, Data warehouse and data marts, Knowledge management,</li></ul>	<b>05</b>

	<ul style="list-style-type: none"> <li>• Networks: The networked enterprise (wired and wireless), Pervasive computing, Cloud computing models,</li> </ul>	
3	<b>MIS Tools and applications for Decision making</b> <ul style="list-style-type: none"> <li>• ERP and ERP support of business</li> <li>• Business intelligence (BI): Managers and Decision Making.</li> <li>• Decision Support System (DSS): types, components, Data mining.</li> <li>• Executive information system.</li> <li>• Role of AI in decision making.</li> <li>• Role of predictive analytics and data visualization in business</li> </ul>	10
4	<b>Security and Ethical Challenges</b> <ul style="list-style-type: none"> <li>• Information security fundamentals,</li> <li>• Key principles of information security,</li> <li>• Common threats and vulnerabilities in MIS</li> <li>• Security measures and controls,</li> <li>• Access control mechanisms: authentication, authorization, and accounting (AAA),</li> <li>• Encryption techniques and cryptographic protocols,</li> <li>• Ethical, and societal challenges of IT,</li> <li>• Legal and regulatory framework</li> <li>• Privacy Policies.</li> </ul>	08
5	<b>Social Computing (SC)</b> <ul style="list-style-type: none"> <li>• Web 2.0 and 3.0: static and dynamic platform, integration with AI and IoT.</li> <li>• SC in business-shopping: leveraging social media platforms, Social listening and sentiment analysis.</li> <li>• Social computing in Customer Relationship Management (CRM)</li> <li>• Marketing, operational and analytic CRM,</li> <li>• E-business and E-commerce – B2B B2C, E-commerce platforms and payment gateways</li> <li>• Mobile commerce: growth trends, mobile wallets, contactless payments, shopping apps and platforms</li> </ul>	06
6	<b>Information System within Organization</b> <ul style="list-style-type: none"> <li>• Acquiring Information Systems and Applications: Various System development life cycle models.</li> <li>• Enterprise and Global Management of Information Technology: Managing Information Technology, Managing Global IT.</li> <li>• Business processes and information systems</li> </ul>	06
	<b>Total</b>	<b>39</b>

#### **Books Recommended:**

#### **Textbooks:**

1. A. K. Gupta, "Management Information System", S. Chand Limited, 2010.
2. K. K. Ghosh, Saini Das, and S. Mukherjee, "Management Information System", Management, IIT, Kharagpur, 2021.

***Reference Books:***

1. J. A. O'Brien, G. Marakas, "Management Information Systems", McGraw-Hill Companies, Incorporated, 2006.
2. K. Rainer, B. Prince, "Management Information Systems", Wiley, 2016.

***Web References:***

- Management Information System (<https://nptel.ac.in/courses/110105148>)
- Management Information System (<https://archive.nptel.ac.in/courses/110/105/110105148/>)

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**Program: All Courses**

**S.Y B.Tech. Semester: III**

**Course: Operations Research (DJS23XOE213)**

**Pre-requisite:** Knowledge of

1. Mathematics.
2. Probability

**Objectives:**

1. Formulate a real-world problem as a linear programming problem and able to solve.
2. Understand the optimisation tools that are needed to solve linear programming problems.

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

1. Formulate the real-world optimisation problem into a Linear Programming Problem (LPP) and analyse the solution obtained using LPP optimisation models.
2. Solve Linear Programming Problems using transportation and assignment models.
3. Apply Decision Theory to determine the optimal course of action when a number of alternatives are available, and their consequences cannot be forecast with certainty and uncertainty.
4. Apply Game Theory for decision making under conflicting situations where there are one or more opponents (players).
5. To breaking down a large problem into smaller sub problems and solved recursively or iteratively using Dynamic Programming models.

<b>Operation Research (DJS23XOE213)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Introduction to Operations Research:</b> Introduction, Structure of the Mathematical Model, Limitations of Operations Research.  <b>Linear Programming:</b> Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method, Penalty Cost Method or Big M-method, Two Phase Method.	<b>12</b>
<b>2</b>	<b>Transportation Problem:</b> Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: MODI method. <b>Assignment Problem:</b> Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem	<b>08</b>
<b>3</b>	<b>Decision Theory:</b> Steps in Decision Theory approach, Decision-making Environment, Decision making under condition of certainty, Decision making under condition of uncertainty, Decision making under condition of risk, Maximum likelihood criterion.	<b>06</b>

<b>4</b>	<b>Game Theory:</b> Competitive games, rectangular game, saddle point, minimax/maximin method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	<b>06</b>
<b>5</b>	<b>Dynamic programming:</b> Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stagecoach/Shortest Path, cargo loading and Reliability problems.	<b>07</b>
	<b>Total</b>	<b>39</b>

### **Books Recommended:**

#### ***Textbooks:***

1. Operations Research - An Introduction: Taha, H. A., Pearson Education, 2022.
2. Operations Research, Gupta, P. K. and Hira, D. S., S. Chand Publications, 2014.

#### ***Reference Books:***

1. Operations Research: Introduction to Models and Methods, Boucherie, R. J., Tijms, H. and Braaksma, A., 2021.
2. Introduction to Operations Research: Hiller, F. S. and Lieberman, G. J., McGraw-Hill Higher Education, 2010.
3. Operations Research: Principles and Practice: Ravindran, A., Phillips, D. T. and Solberg, J. J., Wiley India Pvt. Limited, 2009.

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**Program: All Courses**

**S.Y B.Tech.**

**Semester: III**

**Course: Personal Finance Management (DJS23XOE214)**

**Pre-requisite:** Nil

**Objectives:**

1. To create awareness and educate consumers on access to financial services.
2. To make the students understand the basic concepts, definitions and terms related to direct taxation.
3. To help the students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.
4. To familiarize the students with microfinance for accelerating the expansion of local microbusinesses.

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

1. Understand the Indian financial system.
2. Use a framework for financial planning to understand the overall role finances play in his/her personal life.
3. Compute income from salaries, house property, business/profession, capital gains and income from other sources.
4. Compute the amount of CGST, SGST and IGST payable after considering the eligible input tax credit.
5. Understand how Microfinance can help in financial inclusion.

<b>Personal Finance Management (DJS23XOE214)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Overview of Indian Financial System:</b> Characteristics, Components and Functions of Financial System. Financial Instruments and Financial Markets, Financial inclusion. <b>Introduction to Personal Finance</b> Personal Financial Planning in Action, Money Management Skills, Taxes in Your Financial Plan, Savings and Payment Services. Consumer Credit: Advantages, Disadvantages, Sources and Costs.	<b>07</b>
<b>2</b>	<b>Personal Financial Management</b> <b>Loans:</b> Home, Car, Education, Personal, Loan against property and Jewel loan. <b>Insurance:</b> Types of Insurance – ULIP and Term; Health and Disability Income Insurance, Life Insurance. <b>Investment:</b> Investing Basics and Evaluating Bonds, Investing in Stocks and Investing in Mutual Funds, Planning.	<b>07</b>
<b>3</b>	<b>Income Tax</b> <b>Income Tax Act Basics-</b> Introduction to Income Tax Act, 1961 <b>Heads of Income and Computation of Total Income and Tax Liability-</b> Heads of Income and Computation of Total Income under various heads, Clubbing Provisions, Set off and carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons. <b>Tax Management, Administrative Procedures and ICDS - TDS, TCS and Advance Tax Administrative Procedures, ICDS.</b>	<b>09</b>
<b>4</b>	<b>Goods and Services Tax</b>	<b>08</b>

	<p>GST Constitutional framework of Indirect Taxes before GST (Taxation Powers of Union &amp; State Government); Concept of VAT: Meaning, Variants and Methods; Major Defects in the structure of Indirect Taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST &amp; IGST); GST Council, GST Network, State Compensation Mechanism, Registration.</p> <p><b>Levy and Collection of GST</b></p> <p>Taxable event- "Supply" of Goods and Services; Place of Supply: Within state, Interstate, Import and Export; Time of supply: Valuation for GST- Valuation rules, taxability of reimbursement of expenses; Exemption from GST: Small supplies and Composition Scheme: Classification of Goods and Services</p>	
5	<p><b>Introduction to Micro – finance</b></p> <p>Micro-Finance: Definitions, Scope &amp; Assumptions, Types of Microfinances, Customers of Micro-finance, Credit Delivery Methodologies, SHG concept, origin, Formation &amp; Operation of Self-Help Groups (SHGs).</p> <p><b>Models in Microfinance</b> - Joint Liability Groups (JLG), SHG Bank Linkage Model and GRAMEEN Model: Achievements &amp; Challenges.</p> <p><b>Institutional Mechanism</b></p> <p>Current Challenges for Microfinance, Microfinance Institutions (MFIs): Constraints &amp; Governance Issues, Institutional Structure of Microfinance in India: NGO-MFIs, NBFC-MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand &amp; Supply of Microfinance Services in India, Impact assessment and social assessments of MFIs</p>	08
	<b>Total</b>	<b>39</b>

### Books Recommended:

#### Textbooks:

1. Banking and Financial Sector Reforms in India, by Asha Singh, M.S. Gupta, Serials Publication.
2. Indian Banking Sector: Essays and Issues (1st), by M.S. Gupta & J.B. Singh, Serials Publication.
3. Basics Of Banking & Finance, by K.M. Bhattacharya O.P. Agarwal, Himalaya Publishing House.
4. Agricultural Finance and Management, by S. Subba Reddy, P. Raghu Ram.
5. The Indian Financial System and Development, by Dr.Vasant Desai, Himalaya Publishing House; Fourth Edition.
6. Income Tax Management, Simple Way of Tax Management, Tax Planning and Tax Saving, By Sanjay Kumar Satapathy.
7. Direct Tax System Income Tax by Dr. R. K. Jain, SBPD Publications.
8. Simplified Approach to GST Goods and Services Tax, By S K Mishra, Educreation Publishing.
9. Introduction To Microfinance, By Todd A Watkins, World Scientific Publishing Company

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**Program: All Courses**

**S.Y B.Tech.**

**Semester: III**

**Course: Public Systems and Policies (DJS23XOE215)**

**Pre-requisite:**

1. Basic Knowledge of Social science and Current affairs

**Objectives:**

1. To explain public policy and its operations with special focus on policy relating to Government finance.
2. To analyze and evaluate the impact of public policy on firms and the economy at large.

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

1. Understand the importance of public systems in a fast-changing environment in the global context.
2. Analyse the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
3. Explain public policy and its operations with special focus on policy relating to Government finance.
4. Make policies and know about the happenings in the world, in the nation and those in their locality.
5. Analyze and evaluate the impact of public policy on firms and the economy at large and work under various fields as policymakers.

<b>Public Systems and Policies (DJS23XOE215)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Introduction and Overview of Public Systems:</b> Ideology of Public Systems; Mechanistic and Organic view of Society and Individuals, The Legal Framework; Federal Government; State and Local Governments, Government growth; The size of Government.	<b>10</b>
<b>2</b>	<b>Public Sector in the Economics Accounts:</b> Public Sector in the circular flow; Public Sector in the National Income Accounts.	<b>06</b>
<b>3</b>	<b>Public Choice and Fiscal Politics:</b> Direct Democracy; Representative Democracy; The Allocation Function; The Distribution Function; The Stabilization Function; Coordination of Budget Functions; The Leviathan Hypothesis.	<b>08</b>
<b>4</b>	<b>Introduction and Overview of Public Policy:</b> Markets and Government; Social goods and Market failure, public expenditure and its evaluation; Cost Benefit Analysis, Public policy and Externalities, Taxation Policy and its impact, Income distribution, redistribution and social security issues Fiscal & Budgetary Policy, Fiscal Federalism in India.	<b>10</b>
<b>5</b>	<b>Case Studies in Expenditure Policy: Public Services</b> A) National Defense B) Highways C) Outdoor Recreation D) Education	<b>05</b>
	<b>Total</b>	<b>39</b>

**Books Recommended:*****Reference Books:***

1. Charles J, Wheelan, "Introduction to Public Policy", W.W. Norton & Company, New York, 2011.
2. Thomas R, Dye, "Understanding Public Policy", Prentice Hall, 2008.
3. Anderson, James E, "Public Policy-Making: An Introduction", Boston, 2011.
4. Avasthi & Maheshwari, "Public Administration", Lakshmi Narain Agarwal, 2008.
5. Mohit Bhattacharya, "New Horizons of Public Administration", Jawahar Publishers, New Delhi, 2011
6. Nicholas Henry, "Public Administration and Public Affairs", Prentice Hall of India, New Delhi, 2017.
7. Harvey S Rosen and Ted Gayer, "Public Finance" 10th Edition, McGraw-Hill Education, 2013.
8. Richard A Musgrave and Peggy B Musgrave, "Public Finance in Theory and Practice", 5<sup>th</sup> Edition, Mcgraw Hill Book, 2017.

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**Program: All Courses**

**S.Y B.Tech. Semester: III**

**Course: Fundamentals of Biomedical Instruments (DJS23XOE216)**

**Pre-requisite:**

1. Basic knowledge of Human Anatomy
2. Basic knowledge of Electronics

**Objectives:**

1. To understand the basic principles and working of various medical instruments
2. To familiarize the learners with the various medical imaging modalities, their operating principles, instrumentation and clinical applications

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

1. Explain the different physiological processes taking place within the human body.
2. Explain the use of biomaterials and apply principles of various transducers & sensors.
3. Describe the working principle of various medical instruments
4. Describe principles used in imaging modalities and analysis
5. Explain different processes used in telemetry and telemedicine

<b>Fundamentals of Biomedical Instruments (DJS23XOE216)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Basic Human Physiology</b> <ul style="list-style-type: none"><li>• <b>Cell:</b> Electrical activity of excitable cells (Structure and functions of cell. Polarization and depolarization of cell)</li><li>• <b>Cardiovascular System:</b> Heart, Conductive tissues of heart, Cardiac cycle, Heart Valves, System and Pulmonary Circulation, Transmission of Cardiac Impulse, Blood Pressure, ECG (Einthoven's Triangle, Various leads and Waveforms).</li><li>• <b>Muscle Physiology:</b> Muscle physiology and aspects of skin resistance. Generation of EMG</li><li>• <b>Nervous System:</b> Different parts, their functions. Reflex actions and reflex arc, Function of Sympathetic and Parasympathetic nervous system. Generation of EEG</li></ul>	<b>04</b>
<b>2</b>	<b>Biomaterial, Transducers and Sensors:</b> <ul style="list-style-type: none"><li>• <b>Biomaterials used in fabrication of biodevices and implants:</b> Polymeric, Composite biomaterials, Metallic biomaterials, and Ceramic biomaterials.</li><li>• <b>Biopotential electrodes:</b> Electrode tissue interface, Electrode electrolyte interface Electrodes used for ECG, EEG &amp; EMG.</li><li>• <b>Transducers &amp; sensors:</b> temperature transducer, pulse sensor, glucose sensor, respiration sensor</li><li>• <b>Introduction of biomaterials, Classification of biomaterials</b></li></ul>	<b>10</b>

3	<b>Overview of Medical Instruments</b> <ul style="list-style-type: none"> <li>• Classification, application and specifications of <b>diagnostic, therapeutic and clinical laboratory equipment</b></li> <li>• Method of operation of these Bio Medical Instruments</li> <li>• ECG , EEG,EMG</li> </ul>	08
4	<b>Imaging Modalities and Analysis:</b> <ul style="list-style-type: none"> <li>• Radio graphic techniques, Computer Tomography,</li> <li>• MRI, PET, SPECT</li> <li>• Ultrasonography</li> <li>• Endoscopy</li> <li>• Thermography, Retinal Imaging</li> <li>• Imaging application in Biometric systems</li> <li>• Analysis of digital images</li> </ul>	09
5	<b>Telemetry &amp; Telemedicine:</b> <ul style="list-style-type: none"> <li>• Introduction to Biotelemetry</li> <li>• Physiological parameters compliant to biotelemetry</li> <li>• Components of Biotelemetry system</li> <li>• Applications of telemetry in medical field (ECG, EEG &amp; EMG)</li> </ul>	08
	<b>Total</b>	<b>39</b>

#### **Books Recommended:**

##### ***Textbooks:***

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.
2. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.
3. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, 2 Edition, 2003.
4. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, NewYork, 1998.
5. Biomaterials Science - An Introduction to Materials in Medicine. B.D. Ratner, A.S. Hoffmann, F. J. Schoen, J. E. Lemons, Academic Press, 1997.

##### ***Reference Books:***

1. Electronic Measurement and Instrumentation by Dr Rajendra Prasad
2. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
3. Curry, T. S., Dowdey, J. E., & Murry, R. C. (1990). Christensen's physics of diagnostic radiology. Lippincott Williams & Wilkins.
4. Biomaterials: An Introduction, Joon Park, R. S. Lakes, Springer Science & Business Media

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**Program: All Courses**

**S.Y B.Tech. Semester: III**

**Course: IPR & Patenting (DJS23XOE217)**

**Pre-requisite:**

- NIL

**Objectives:**

1. To promote the knowledge of intellectual property laws of India and international treaties.
2. To encourage innovation.

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

1. Map a given project/ idea to a suitable intellectual property rights.
2. Explain the fundamentals of the patents, copyrights, and design registrations.
3. Draft applications to protect various intellectual property rights.
4. Communicate with national and/or international intellectual property organisations.

<b>IPR &amp; Patenting (DJS23XOE217)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Introduction to Intellectual Property Rights (IPR):</b> <ul style="list-style-type: none"><li>• Concept &amp; meaning of IP and IPR.</li><li>• General principles of intellectual property rights.</li><li>• Need for intellectual property.</li><li>• Categories of IPR instruments - Patents, Trademarks, Copyrights, Industrial. Designs, Plant variety protection, Trade secrets, Geographical Indications etc.</li><li>• Ownership, assignment, licenses, infringement, validity period.</li><li>• International treaties on IPR.</li></ul>	<b>03</b>
<b>2</b>	<b>Copyright and Design</b> <ol style="list-style-type: none"><li>1. The Indian Copyright Act, 1957.</li><li>2. Meaning of copyrights and rights of copyrighted works.</li><li>3. Types of copyright.</li><li>4. Process of filing a copyright application.</li><li>5. Introduction to Designs Law – Definitions.</li><li>6. Registration of designs and procedure.</li></ol>	<b>09</b>
<b>3</b>	<b>Basics of Patents</b> <ul style="list-style-type: none"><li>• The Indian Patent Act and The Indian Patent Rules.</li><li>• Conditions of patentability.</li><li>• Patentable and non-patentable inventions.</li><li>• Types of patent applications and patent specification.</li><li>• Inventors and Applicants.</li><li>• Category of applicants - natural person, small entity, startup and others.</li><li>• Patent databases and patent search.</li><li>• International Patent Classification code.</li></ul>	<b>09</b>

4	<b>Patent Application Drafting</b> <ul style="list-style-type: none"> <li>Patent application drafting: <ul style="list-style-type: none"> <li>Application.</li> <li>Specification.</li> <li>Claims drafting: <ul style="list-style-type: none"> <li>Independent and dependent claims drafting.</li> <li>Process patent and product patent claims.</li> </ul> </li> <li>Abstract.</li> <li>Drawings.</li> <li>Declaration as to inventorship.</li> <li>Statement and undertaking.</li> </ul> </li> <li>Drafting response to communications from patent office. <ul style="list-style-type: none"> <li>Reading and understanding examination reports.</li> <li>Drafting response.</li> </ul> </li> </ul>	09
5	<b>Procedure for Filing a Patent Application, Timelines and Fees</b> <ul style="list-style-type: none"> <li>Application for grant of patent.</li> <li>Forms and Fees.</li> <li>Request for (early) publication and / or (early) examination.</li> <li>Patent examination and hearing.</li> <li>Pre-grant and post-grant opposition.</li> </ul>	09
	<b>Total</b>	<b>39</b>

### Books Recommended:

#### Textbooks:

1. A Durafe and D Toradmalle, “Intellectual Property Rights”, Wiley, 2020.
2. H Rockman, “Intellectual property law for engineers, scientists, and entrepreneurs”, Wiley-IEEE Press, 2020.

#### Reference Books:

1. Bare Act, “The Patents Act, 1970 with The Patents Rules, 2003”, Universal, 2023.
2. Bare Act, “The Copyright Act, 1957”, Universal and LexisNexis, 2021.
3. Bare Act, “The Designs ACT, 2000”, Commercial Law Publishers (India) Pvt. Ltd. 2021

#### Online Resources:

1. W. Fisher, “Maps of Intellectual Property” <https://cyber.harvard.edu/people/tfisher/IP/IPMaps.htm>
2. World Intellectual Property Organisation courses  
<https://www.wipo.int/academy/en/>
3. Prof. Feroz Ali, “Patent Drafting for Beginners”,  
[https://onlinecourses.nptel.ac.in/noc24\\_hs59/preview](https://onlinecourses.nptel.ac.in/noc24_hs59/preview)

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Principal

**Program: All Courses**

**S.Y B.Tech. Semester: III**

**Course: Entrepreneurship and Startup Ecosystem (DJS23XOE218)**

**Pre-requisite:**

Nil

**Objectives:**

1. To foster an entrepreneurial mindset.
2. To guide participants in building effective Business Models.
3. To educate participants regarding Intellectual property and Fundraising for Innovative Ventures.

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

1. Effectively Navigate the Global Startup Landscape:
2. Cultivate an Entrepreneurial Mindset.
3. Create Effective Business Models.
4. Understand the significance of Intellectual Property rights.
5. Master Fundraising Strategies

<b>Entrepreneurship and Startup Ecosystem (DJS23XOE218)</b>		
<b>Unit</b>	<b>Description</b>	<b>Duration</b>
<b>1</b>	<b>Understanding the Entrepreneurial Ecosystem</b> <ul style="list-style-type: none"><li>• Introduction to Entrepreneurship and Startups</li><li>• Role of Entrepreneurship in economy</li><li>• Global and Local Entrepreneurial Landscapes</li><li>• Role of Incubators and Accelerators</li><li>• Case Studies of Successful Startups</li></ul>	<b>6</b>
<b>2</b>	<b>Developing a Startup Mindset</b> <ul style="list-style-type: none"><li>• Cultivating an Entrepreneurial Mindset</li><li>• Market Analysis and Segmentation</li><li>• Opportunity Recognition</li><li>• Innovation and Idea Generation</li><li>• Feasibility Analysis of Business Ideas</li><li>• Role of innovation in Entrepreneurship</li><li>• Fostering creativity</li><li>• Practical Exercises and Workshops on Creative Problem Solving</li></ul>	<b>8</b>
<b>3</b>	<b>Business Model Development</b> <ul style="list-style-type: none"><li>• Introduction to Business Models</li><li>• Lean Startup Methodology</li><li>• Prototyping and Minimum Viable Product (MVP)</li><li>• Financial Projections and Budgeting</li><li>• Various forms of Business Ownership</li><li>• Compliance and Legal Regulations</li><li>• Operations and Supply Chain Management</li><li>• Human Resource Management</li></ul>	<b>10</b>

	<ul style="list-style-type: none"> <li>• Developing a marketing Strategy</li> <li>• Managing Growth Challenges</li> </ul>	
<b>4</b>	<b>Technological Innovation and Intellectual Property</b> <ul style="list-style-type: none"> <li>• Technology and Entrepreneurship</li> <li>• Intellectual Property Basics (Patents, Trademarks, Copyrights)</li> <li>• Patent Search and Analysis</li> <li>• Strategies for Protecting Intellectual Property</li> <li>• Ethical Considerations in Technology and Innovation</li> </ul>	<b>8</b>
<b>5</b>	<b>Fundraising and Investment Strategies</b> <ul style="list-style-type: none"> <li>• Fundraising Options for Startups</li> <li>• Angel Investors and Venture Capital</li> <li>• Crowdfunding Platforms</li> <li>• Financial Modelling for Startups</li> <li>• Crafting an Effective Pitch</li> </ul>	<b>7</b>
	<b>Total</b>	<b>39</b>

#### **Books Recommended:**

1. Alexander Osterwalder and Yves Pigneur, Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, John Wiley & Sons, Jul2010.
2. Peter Thiel and Blake Masters, Zero to One: Notes on Startups, or How to Build the Future, Virgin Books, 2015.
3. Alejandro Cremades, The Art of Startup Fundraising: Pitching Investors, Negotiating the Deal, and Everything Else Entrepreneurs Need to Know" by, John Wiley & Sons, Inc., Hoboken, New Jersey, 2016.
4. Christensen, Clayton M. The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Boston, MA: Harvard Business School Press, 1997.
5. Brad Feld and Jason Mendelson, Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist, Wiley; 4th edition, 1 October 2019.

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