Programme Structure and Syllabi for B. Tech. Computer Science & Engineering (Data Science)

(2023 batch onwards)

Department of Computer Science & Engineering
Punjab Engineering College
(Deemed to be University) Chandigarh, India

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Semester-I

Course Code	Course Name	L	T	P	Credits
OR 2301	Orientation	-	-	-	1
OR 2302	Introduction to Discipline Engineering, Introduction to Computer Science & Engineering, Computer Science & Engineering (Data Science) Computer Science & Engineering (Artificial Intelligence)	1	0	0	1
MA 2301	Calculus	3	0	2	4
PY 2301	Electromagnetic Theory and Quantum Physics	3	0	2	4
GS 2301	Introduction to Environmental Sciences	1	0	0	1
ES 2301	Introduction to Computer Programming⊕	3	0	2	4
HS 2351	Communication Skills	2	0	2	3
ES 2305	Introduction to Electronics and Electrical Engineering	3	0	2	4
Total					**22**

⊕Common to all Branches

Semester-II

Course Code	Course Name	L	T	P	Credits
MA 2302	Linear Algebra, Differential Equations and Vector Calculus	3	0	2	4
CH 2301	Applied Chemistry - I	3	0	2	4
GS 2302	Universal Human Values	1	0	0	1
ES 2302	Engineering Drawing with CAD Software	2	0	4	4
ES 2303	Workshop (Siemen's Skill Centre)	2	0	4	4
ES 2304	Introduction to Mechatronics	3	0	2	4
Total					**21**

Semester-III

Course Code	Course Name	L	T	P	Credits
	HSM-II				3
DSN 3001	Data Structures	3	0	2	4
DSN 3002	Python for Data Science	3	0	2	4
DSN 3003	Operating Systems	3	0	2	4
DSN 3004	Computer Networks	3	0	2	4
Total					**19**

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Semester-IV

Course Code	Course Name	L	T	P	Credits
DSN 4001	Statistical Thinking for Data Science	3	0	2	4
DSN 4002	Discrete Structures for Computer Science	3	1	0	4
DSN 4003	Artificial Intelligence	3	0	2	4
DSN 4004	Data Base Management System	3	0	2	4
DSN 4005	Data Science and Machine Learning	3	0	2	4
DSN 4006	Data Analytics and Visualization	3	0	2	4
Total					**24**

Semester-V

Course Code	Course Name	L	T	P	Credits
DSN 5001	Data Acquisition and Information Retrieval	3	0	2	4
DSN 5002	Analytical Tools for Data Science	3	0	2	4
DSN 5003	Software Engineering	3	0	2	4
DSN 5004	Internet of Things	3	0	2	4
DSP 5101	Minor Project	0	0	8	4
Total					**20**

Semester-VI

Course Code	Course Name	L	T	P	Credits
DSN 6001	Internship Part – I	0	0	12	6
DSN 6002	Internship Part – II	0	0	4	2
DSN 6003	Internship Part – III	0	0	8	4
	Internship Training (Optional) – Total Credits	0	0	24	12
Or					
Optional Course Work					
DSE 1001 – DSE 1005	Deptt. Elective Course-V	3	0/1	2/0	4
DSO 1001	Open Elective*	3	0	2	4
DSP 6001	Project Work	0	0	8	4
Total					**12**

*Open Elective course will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

Deptt. Elective Course-V:

Course Code	Course Name	L	T	P	Credits
DSE 1001	Web Technologies	3	0	2	4

DSE 1002	Mobile Computing and Sensor Networks	3	0	2	4
DSE 1003	Principles of Programming Languages	3	0	2	4
DSE 1004	Generative Artificial Intelligence	3	0	2	4
DSE 1005	Artificial Intelligence for Social Good	3	1	0	4

***Open Elective:**

Course Code	Course Name	L	T	P	Credits
DSO 1001	Web Technologies*	3	0	2	4

*Open Elective course will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

Semester-VII

Course Code	Course Name	L	T	P	Credits
	HSM-III/ HSM-IV				3
DSE 1006 – DSE 1013	Deptt. Elective Course-I	3	0/1	2/0	4
	Deptt. Elective Course-II	3	0/1	2/0	4
DSO 1002	Open Elective -I	3	0	2	4
DSO 1003	Open Elective-II	3	0	2	4
DSP 7001	Major Project-I	0	0	8	4
Total					**23**

Deptt. Elective Course-I / Deptt. Elective Course-II

Course Code	Course Name	L	T	P	Credits
DSE 1006	Big Data Analytics	3	0	2	4
DSE 1007	High Performance Computing	3	0	2	4
DSE 1008	Soft Computing	3	0	2	4
DSE 1009	Wireless and Mobile Networks	3	0	2	4
DSE 1010	Advances of Intelligent and Learning Agents	3	0	2	4
DSE 1011	Data and Internet Security	3	0	2	4
DSE 1012	Theory of Computation	3	1	0	4
DSE 1013	Digital Image Processing	3	0	2	4

***Open Elective-I**

Course Code	Course Name	L	T	P	Credits
DSO 1002	Computer Networks*	3	0	2	4

*Open Elective-I course will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

***Open Elective-II**

Course Code	Course Name	L	T	P	Credits
DSO 1003	Data Acquisition and Information Retrieval*	3	0	2	4

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

*Open Elective-II course will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

Semester-VIII

Course Code	Course Name	L	T	P	Credits
	HSM-IV/ HSM-III				3
DSE 1014 – DSE 1021	Deptt. Elective Course-III	3	0	2	4
	Deptt. Elective Course-IV	3	0	2	4
DSO 1004	Open Elective -III	3	0	2	4
	Proficiency	0	0	4	2
DSP 8001	Major Project-II	0	0	8	4
Total					**21**

Deptt. Elective Course-III / Deptt. Elective Course-IV

Course Code	Course Name	L	T	P	Credits
DSE 1014	Computer Vision	3	0	2	4
DSE 1015	Bioinformatics	3	0	2	4
DSE 1016	Information Retrieval and Recommendation Systems	3	0	2	4
DSE 1017	Pattern Recognition	3	0	2	4
DSE 1018	Web Information Retrieval and Crawling	3	0	2	4
DSE 1019	Introduction to Information Science	3	0	2	4
DSE 1020	Architectures for Management of Large Data Sets	3	0	2	4
DSE 1021	Blockchain Technology	3	0	2	4

***Open Elective-III**

Course Code	Course Name	L	T	P	Credits
DSO 1004	Modern Data Base Systems*	3	0	2	4

*Open Elective-III course will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

***Minor Specialization in Computer Science & Engineering (Data Science)**

Semester	Course Code	Course Name	L	T	P	Credits
III	DSM 1001	Python for Data Science	3	0	2	4
IV	DSM 1002	Statistical Thinking for Data Science	3	0	2	4
V	DSM 1003	Analytical Tools for Data Science	3	0	2	4
VII	DSM 1004	Minor Specialization Project-I	0	0	6	3
VIII	DSM 1005	Minor Specialization Project-II	0	0	6	3
Total						**18**

*Minor Specialization Courses and Minor Specialization Projects will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

Honours in Computer Science & Engineering (Data Science)

Semester	Course Code	Course Name	L	T	P	Credits
V	DSH 1001	Honours Project – I	0	0	6	3
VII	DSH 1002	Honours Project – II	0	0	8	4
VIII	DSH 1003	Honours Project – III	0	0	10	5
Total						**12**

Detailed Syllabus

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Semester-I

Course Code	Course Name	L	T	P	Credits
OR 2301	Orientation	-	-	-	1
OR 2302	**Introduction to Discipline Engineering, Introduction to Computer Science & Engineering, Computer Science & Engineering (Data Science) Computer Science & Engineering (Artificial Intelligence)**	**1**	**0**	**0**	**1**
MA 2301	Calculus	3	0	2	4
PY 2301	Electromagnetic Theory and Quantum Physics	3	0	2	4
GS 2301	Introduction to Environmental Sciences	1	0	0	1
ES 2301	**Introduction to Computer Programming⊕**	**3**	**0**	**2**	**4**
HS 2351	Communication Skills	2	0	2	3
ES 2305	Introduction to Electronics and Electrical Engineering	3	0	2	4
Total					**22**

⊕Common to all Branches

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Introduction to Discipline Engineering, Introduction to Computer Science and Engineering, Computer Science and Engineering (Data Science), Computer Science and Engineering (Artificial Intelligence)**
Course Code	**:**	**OR 2302**
Credits	**:**	**1**
L T P	**:**	**1 0 0**

Course Objectives:
The students should know about various disciplines in Computer Science and Engineering, Computer Science and Engineering (Data Science), Computer Science and Engineering (Artificial Intelligence) and are aware of emerging trends in each of these domains

Total No. of Lectures: 14

Lecture wise Breakup		**No. of Lectures**
Unit 1	**INTRODUCTION TO COMPUTER SCIENCE AND ENGINEERING** Fundamentals of Computers, Number System, Memory, applications of computers	**3**
Unit 2	**INTRODUCTION TO COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)** Data, types of data, storage, pre-processing, data analysis and analytics, application of data science	**3**
Unit 3	**INTRODUCTION TO COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE)** Historical development, Agents and environments, machine learning, applications of artificial intelligence	**3**
Unit 4	**Current and future trends and challenges in various fields of computing** Social, ethical and economic issues related to computing technology. Exploration of career and professional development opportunities.	**5**

Course Outcomes: At the end of the course, students will be able to:	
1	Understand various fields of Computer Science and Engineering, Computer Science and Engineering (Data Science), Computer Science and Engineering (Artificial Intelligence)

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1.	Computing Fundamentals, Peter Nortan, 4th Ed., Tata McRaw Hill	Latest Edition
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1.	Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media	Latest Edition
2.	Artificial Intelligence: A Modern Approach, 4th Edition, S. J. Russel and P. Norvig, Pearson	Latest Edition

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1.	Fundamentals of Computing Systems, https://onlinecourses.swayam2.ac.in/nou22_cs01/preview	Swayam
2.	Foundation of Data Science, https://onlinecourses.swayam2.ac.in/imb23_mg64/preview	Swayam
3.	An Introduction to artificial Intelligence, https://onlinecourses.nptel.ac.in/noc22_cs56/preview	NPTEL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	-	-	-	-	1	-	-	-	-	1	1	1

1: Low, 2: Medium, 3: High

NAME OF DEPTT : **Department of Chemistry**
Course name : Applied Chemistry I (CSE, ECE, EE, DS, VLSI, AI)
Course Code : CH2301
Year : 23-24 (2nd semester)
Credits : 4
L T P : 3 0 2 **Total No. of Lecture-42**

Objective: To teach the fundamentals and applications of Chemical Sciences essential for the development of electrical and electronic materials and technologies. Students will be learning various analytical techniques for the characterizations of electronic organic/inorganic materials.

Lecture wise breakup	***No. of Lectures = 42***

1	**Fundamentals for Applied Chemistry** Molecular orbital theory, Jahn-Teller Effect in Crystal Field Theory, Solid state chemistry: Crystal defects and line imperfections, Reaction mechanism in organic chemistry: Principles and methods of determination, Chemical Kinetics: Langmuir–Hinselwood Mechanism, acid-base equilibria in non aqueous media, Introduction to Computational chemistry and open source softwares	**(10)**
2	**Polymeric Materials** Mechanism and methods of polymerization, structure-activity relationship, Conducting Polymers: types (n- or p- doping) and applications, Polymeric fibre materials	**(6)**
3	**Spectroscopic Methods for structural Analysis:** Principle and applications (UV, IR, NMR, SEM and TEM)	**(9)**
4	**Energy Storage and Sensing Devices:** Fundamentals of Electrochemistry, types of electrodes, Reference electrodes, Ion-selective electrodes, Fuel cells, Batteries (Lithium-ion Batteries and EV Batteries), Renewable energy (Artificial photosynthesis), Solar cells, Sensors for IoT	**(8)**
5	**Chemistry of Electronic and Electrical Materials** Semi-conductor and super conducting Materials, Carbon materials, Optical Materials (OLED), 2D Materials, Magnetic materials.	**(9)**

Outcomes: 1. To be able to apply the fundamentals of chemistry towards developing new Technologies based on new materials.
2. To attain the essential analytical skills and designing of materials for electrical and electronic applications.
3. Application of software as important tools in technological applications.

Books:

1. Concise Inorganic Chemistry, by J. D. Lee, 5th Edition, 2003 (Chapman & Hall).
2. Organic Chemistry by S. M. Mukherji, and S. P. Singh, 2017 (Newagepublishers).
3. Principles of Physical Chemistry by Puri, Sharma and Pathania, 2008 (W.H. Freeman& Co).
4. Atkin's Physical Chemistry by Peter Atkins, Julio de Paula, 7th Edition (Oxford University Press).
5. Principle of Polymerization by G. Odian, 4th Edition, (John Wiley & Sons, Inc.).
6. D. S. Pavia, G.M. Lasmpman and G.S. Kriz: Introduction to Spectroscopy, 4th Edition,(Thomson learning, Indian Edition).
7. Computational chemistry: Introduction to theory and applications of molecular andquantum mechanics: Lewars Errol G. (Springer)
8. NPTEL web lectures: Chemistry of Materials, Engineering Chemistry I & III.

Practicals	
Sr. No.	**Name of Experiment**
1.	To find the strength of the given sodium hydroxide solution by titrating it against standard solution of hydrochloric acid using pH meter.
2.	To determine the ferrous content in the supplied sample of iron ore by titrimetic analysis against standard $K_2Cr_2O_7$ solution using potassium ferricyanide $[K_3Fe(CN)_6]$ as external indicator.
3.	To find the strength of Sodium hydroxide (NaOH) solution by titrating it against 0.1 N hydrochloric acid conductometrically.
4.	Determination of reaction rate constant of acid catalyzed Hydrolysis of Ester.
5.	Verify Beer-Lambert's law for $KMnO_4$ colorimetrically.
6.	Synthesis of Polyaniline based conducting polymer.
7.	To determine the value of rate constant (k) for the inversion of sucrose by polarimeter.
8.	To prepare nickel dimethyl glyoxime complex, $[Ni(DMG)_2]$. Illustrate the structure of the complex using FTIR.
9.	Synthesis of iron oxide nanoparticles and characterization using FTIR.
10.	Predicting the best Molecular docking conformations of a protein with the help of Swiss Dock.

NAME OF DEPTT. : **Department of Chemistry**

Course name : Applied Chemistry II (Mech.,Prod.,Metta,Aero.,Civil Engg.)
Course Code : CH2302
Year : 23-24 (1st semester)
Credits : 4
L T P : 3 0 2 **Total No. of Lecture-42**

Objective: To teach the fundamentals and applications of Chemical Sciences essential for the development of engineering materials and processing technologies. Students will be learning various analytical techniques for the characterizations of composites and hybrid materials.

Lecture wise breakup	***No. of Lectures = 42***

1	**Fundamentals for Applied Chemistry** Molecular orbital theory, Jahn-Teller Effect in Crystal Field Theory, Solid state chemistry: Crystal defects and line imperfections , Reaction mechanism in organic chemistry: Principles and methods of determination, Chemical Kinetics: Langmuir –Hinshelwood Mechanism, Acid -base equilibria in non aqueous media	**(8)**
2	**Polymer Chemistry** Mechanism and methods of polymerization, Structure-Activity relationship, High performance polymers and applications, Natural and synthetic fibers, biodegradable polymers	**(5)**
3	**Fuels and Catalysis** Petroleum processing**,** Solid and liquid Fuels for Propellants, Chemistry of combustion and equations, Catalytic convertors	**(5)**
4	**Electrochemistry and Corrosion:** Introduction to Electrochemistry, Fuel cells, Batteries (Lithium-ion Batteries and EV Batteries), Corrosion control and protective coatings	**(7)**
5	**Spectroscopic Methods for structural analysis:** Principle and Applications (UV, IR, NMR, AAS/ICP-AES, SEM, TEM, XRD).	**(10)**
6	**Chemistry of Engineering Materials** Ceramic and Cement Materials, Metals and Alloys ,Phase change materials, Bio-inspired materials, Composite materials, Smart materials: Chemical compositions and its applications	**(7)**

Outcomes:

1. To be able to apply the fundamentals of chemistry towards emerging materials to benefit the societal needs.
2. To attain the essential analytical skills and designing of materials for various applications.
3. To be able to identify the chemical compositions required for designing of high performance materials.

Books:

1. Concise Inorganic Chemistry, by J. D. Lee, 5th Edition, 2003 (Chapman & Hall).
2. Organic Chemistry by S. M. Mukherji, and S. P. Singh, 2017 (Newagepublishers).
3. Principles of Physical Chemistry by Puri, Sharma and Pathania, 2008 (W.H. Freeman & Co).
4. Atkin's Physical Chemistry by Peter Atkins, Julio de Paula, 7th Edition (Oxford University Press).

5. Principle of Polymerization by G. Odian, 4th Edition, (John Wiley & Sons, Inc.).
6. D. S. Pavia, G.M. Lasmpman and G.S. Kriz: Introduction to Spectroscopy, 4th Edition, (Thomson learning, Indian Edition).
7. NPTEL web lectures: Chemistry of Materials, Engineering Chemistry I & III.

Practicals	
Sr. No.	**Name of Experiment**
1.	Measurement of acid base equilibria by pH meter in water sample.
2.	To determine the ferrous content in the supplied sample of iron ore by titrimetric analysis against standard K2Cr2O7 solution using potassium ferricyanide $[K_3Fe(CN)_6]$ as external indicator.
3.	Synthesis of polyaniline based conducting polymer.
4.	To find the strength of given NaOH solution by titrating it against 0.05 N Hydrochloric acid solution using a conductivity meter.
5.	Synthesis of iron oxide nanoparticles and characterization using various techniques (UV/ FTIR/ SEM/XRD).
6.	To determine the value of rate constant (k) for the inversion of sucrose by polarimeter.
7.	To verify Lambert Beer's law for $KMnO_4$ using UV-Visible Spectrophotometer.
8.	To determine the percentage of Cu in the copper alloy solution provided 0.1 N hypo solution.
9.	To prepare nickel dimethyl glyoxime complex, $[Ni(DMG)_2]$. Illustrate the structure of compound using FTIR.
10.	Determination of reaction rate constant of acid catalyzed hydrolysis of ester.

Course Name	**:**	**Introduction to Computer Programming**
Course Code	**:**	**ES 2301**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

- To develop logical skills so that students should be able to solve basic programming problems
- To use programming knowledge to develop small projects including basic GUI design

Total No. of Lectures: 42

Lecture wise Breakup		**No. of Lectures**
Unit 1	**INTRODUCTION TO PROGRAMMING** Evolution of languages: Machine languages, Assembly languages, High-level languages. Software requirements for programming: System softwares like operating system, compiler, linker, loader; Application softwares like editor. Flowcharts. Algorithm, specification of algorithm. Industrial uses of programming in various domains	**3**
Unit 2	**DATA TYPES and OPERATORS AND EXPRESSION** Storing integers, numbers with decimals, characters and strings, typecasting. User input and output, use of command line arguments Operators: arithmetic operators, relational operators, logical operators, bitwise operators, miscellaneous operators. Expressions and their evaluation. Precedence and associativity rules.	**7**
Unit 3	**ITERABLE CONTAINERS and STATEMENTS** List, set, tuple and dictionaries; range function; difference between various iterable containers Decision making statements: if, if-else, nested if and if-else. Control statements: for & while loops, nested loops; Role of statements like break, continue	**7**
Unit 4	**FUNCTIONS and CLASSES** Advantage of modularizing program into functions, function definition and function invocation. Function arguments: default, keyword and positional arguments. Scope and lifetime of a variable. Recurrence relations and Recursion Advantage of using classes, defining class data members & functions and accessing using objects. Constructors and destructors in a class, parameterized constructors.	**8**

Unit 5	**GUI design** Introduction to tkinter library, use of TK & mainloop methods, use of widgets like Button, Canvas, Checkbutton, Entry, Frame, MenuButton, Listbox, Menu, Scrollbar, Text, Message, Pack, Grid, place etc. for GUI design.	**5**
Unit 6	**SORTING AND SEARCHING** Searching: Linear search, binary search and hash search. Sorting: Insertion sort, selection sort, bubble sort, quick sort, merge sort, heap sort, and Bucket sort. Time and space complexity of algorithms, comparing algorithms	**9**
Unit 7	**Problem Solving** Real-world programming problems	**3**

Total No. of Turns: 14

List of Experiments		**Number of Turns**
1	Implement programs to input/output various data types	**2**
2	Implement programs to use command line arguments and operators	**2**
3	Implement programs making use of conditional statements and loops	**2**
4	Implement programs making use of iterable containers	**2**
5	Implement programs making use of functions and recursion	**2**
6	Implement various searching and sorting algorithms	**2**
7	Project work including GUI design using tkinter	**2**

Course Outcomes: At the end of the course, students will be able to:	
1	Develop understanding of the fundamental concepts essential for programming.
2	Make efficient use of iterables, function and classes to programming problems
3	Develop simple GUI applications
4	Learn to compare algorithms and improve efficiency of algorithms

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1.	Python Programming: An Introduction to Computer Science by John M. Zelle, Franklin, Beedle& Associates Inc	Latest Edition
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1.	Think Python, How to Think Like a Computer Scientist, Version 2.0.17, Allen Downey Green Tea Press Needham, Massachusetts	Latest Edition
2.	Core python programming, Dr. R. Nageswara Rao, 2nd edition,	Latest

	Dreamtech press	Edition

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1.	Programming, Data Structures and Algorithms using Python, https://nptel.ac.in/courses/106106145	NPTEL
2.	Programming in Python, https://onlinecourses.swayam2.ac.in/cec22_cs20/preview	Swayam

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	3	1	-	1	-	1	-	1	2	-	-
CO2	3	2	2	2	3	1	-	1	-	1	-	1	2	-	-
CO3	3	2	3	1	3	1	-	1	1	1	1	-	1	-	-
CO4	3	2	2	3	2	1	-	1	-	-	-	1	1	-	-

1: Low, 2: Medium, 3: High

Course Name	**Strength of Materials**
Course Code	**ES2306**
Credits	**4**
L T P	**3-0-2**

Course Objectives:
At the end of this course, the student should be able to understand the basic concept regarding the strength of material. The course will prepare the students to apply these concepts to engineering and applied sciences problems.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
1	**INTRODUCTION:** Equations of static equilibrium, Concept of various forces/loads, stresses and strains developed due to these forces/loads, Uniaxial tensile test, Stress-strain diagrams for various types of ferrous and non-ferrous materials, isotropic and anisotropic materials, Compression test, impact test, fatigue test, hardness test, torsion and bending test as per ASTM standards	**4**
2	**SIMPLE STRESS & STRAIN:** Hooke's law, stress and elongation produced in various types of bars due to its own weight and applied axial force, Poisson's ratio, and relationship between elastic constants,stresses and elongation produced in simple & composite bars due to axial, thermal and combined loading.	**6**
3	**2-D STATE OF STRESS ANALYSIS:** Generalized 2-D state of stress accompanied by shear stress, stresses on an arbitrary plane under this state of stress, sign conventions for normal and shear stresses, complementary shear stress, principal stresses and principal planes, Different stresses determination through Mohr's stress circle approach in 2-D generalized state of stress.	**6**
4	**SHEAR FORCE AND BENDING MOMENT IN BEAMS:** Classification of beams, supports and loads, Shear force (SF) & Bending moment (BM) in beams and their sign conventions, Relation between rate of loading (w) with SF and BM. SF and BM diagrams of cantilevers, simply sported beams with or without overhang under different types of loading e.g. concentrate loads, uniformly distributed load, uniformly varying load, moment or its combinations, the point of contra-flexure	**6**
5	**BENDING & SHEAR STRESSES IN BEAMS**: Theory of pure bending, position of neutral axis, Bending equation, practical application of bending equation, review of moment of area concepts, variation of bending stress in various cross-sectional beams, shear stresses in beams, variation of shear stresses for different cross-sectional beams	**6**
6	**TORSION OF CIRCULAR SHAFTS:** Torsional equation of circular shafts, shear stress distribution, torsional rigidity, power transmitted by the shaft, comparisons of hollow & solid circular shafts, analysis of shafts in series and parallel mode, Equivalent bending moment and equivalent torque for a shaft subjected to bending moment and torque simultaneously	**5**
7	**COLUMN AND STRUTS**: Definitions, Euler's theory of columns buckling, Euler's equation for various end restraints, Rankine and other empirical formulae.	**4**
8	**DEFLECTION OF BEAMS**: Relationship between bending moment, slope and deflection, moment area method, method of integration, Macaulay's method, Use of these methods to determine slope and deflection for statically determinate and statically indeterminate beams under various loading conditions.	**5**

Sr. No.	List of Experiments	No. of Turns
1	To perform uni-axial Tensile Test on a given material and to determine its various mechanical properties under the uni-axial tensile loading.	2
2	To perform uni-axial compressive test on a given material and to determine its various mechanical properties under the uni-axial compression loading.	2
3	To perform shear test on a given material and to determine its shear stress of the material.	2
4	To perform torsion test on a given material and to determine its various mechanical properties under torsional load.	2
5	To perform Column test of a given material and to determine its Euler's buckling load and Young's modulus of elasticity of the material.	2
6	To perform Impact test on a given material and to determine its resilience.	2
7	To perform a test on close and open coil springs under axial loading on spring tester and determine its various mechanical properties.	2
8	To study and perform Fatigue test on a given material and to determine endurance strength and limit of the material.	2
9	To determine various Rockwell hardness of the given materials	2
10	To perform the Three point bending test on a given material and determine its Young's modulus of elasticity and bending strength.	2
11	To study the concepts of various strain gauges along with their areas of applications	2
12	To study the Creep test on the given material specimen and determine its creep strength.	2
13	To perform the various tests on the given wooden specimens by wood UTM and determineits various strengths.	2
14	To perform test on strain hardened specimen and to determine its effect on the Young'smodulus of elasticity.	2

Course Outcomes: By the end of this course, the student will be able to:	
1	Understand the concept of stresses & strains, various types of materials, its properties & testing processes as per ASTM standards.
2	Understand elastic constants and also be able to determine stresses & elongations in simple and composite bars under various types of loads.
3	Determine stresses on an arbitrary plane for a generalized 2-D state of stress accompanied by shear stressthrough analytical and graphical methods
4	Understand and be able draw shear force and bending moment diagrams for different types of beams under various types of loading.
5	Understand bending and shear stress equations and its application in determination of bending & shear stresses in different cross-sectional beams at any point across its length.
6	Understand the torsional stresses for solid, hollow and composite circular shafts and its importance inpower transmission.
7	Understand the Column and struts and determine the buckling load under various axial loadings.
8	Determine the deflections of various beams subjected to different loading by various methods.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Strength of Material - G. H. Ryder (MacMillan)	1969
2	An Introduction to the Mechanics of Solids – Crandall & Dahl (Mc-Graw Hill)	2012
3	Engg. Mechanics of Solids - E. P. Popav (Pearson Education)	2003
4	Strength of Material - D S Bedi, Fifth Ed.	2010
5	Strength of Material - R K Rajput, Fifth Ed.	2012

Course Name	**Engineering Drawing with CAD Software**
Course Code	**ES2302**
Credits	**3**
L TP	**2-0-2**

Course Objectives:

At the end of this course, the student should be able to understand the basic concepts of Engineering Drawing. The student should be able to visualize and draw the two- and three-dimensional objects. The student should also be able to understand the features associated with operations of the computer-aided design (CAD) software.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	Introduction to Engineering Graphics, Concept of points and lines, System of Projections, Orthographic projections, Dimensioning.	**4**
2	Introduction to different types of CAD Softwares e.g. SolidWorks/AutoCAD/ CATIA etc., 2D-Sketching, Sketching Entities & Relation, 3D-Sketching, Editing and its Features, Dimensions, Sketch Tools, File handling.	**7**
3	Projections of planes / lamina on reference planes, classification of primary and secondary planes, use of auxiliary planes, Exercises using CAD software.	**5**
4	Classification of solids, Projections of solids on the basis of positions of the axis of various solids on reference planes and Sectioning of solids, Exercises using CAD software.	**6**
5	Introduction to Perspective projection, isometric views, Isometric lines & Axes, conversion of orthographic views to isometric views and vice-versa, Exercises using CAD software.	**6**

List of Experiments:		**Number of Turns**
Exercises to be done using CAD software		
1	2D & 3D Sketching using various sketching tools.	2
2	Projection of planes.	2
3	Developments of 3D-parts.	2
4	Projection of solids.	2
5	Projection of Sectioning of solids.	2
6	Isometric and orthographic views.	2
7	Generating drawings of 3D-parts.	2

Sr. No.	**Course outcome** By the end of this course, the students will be able to:	**Knowledge Level (Blooms Level)**
1	Understand the basic concepts of Engineering Graphics, drawing standards, conventions and symbols that are in common usage.	**L2**
2	Apply the concepts of engineering drawing to create orthographic projections of points, lines, planes, solids with conventional and CAD software.	**L3 & L6**
3	Visualize the actual objects and convert them in to readable drawings with conventional and CAD software.	**L6**
4	Create new designs/engineering models with conventional and CAD software.	**L6**

CO-PO & PSO Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	-	1	2	1
CO2	3	2	3	3	3	-	-	-	1	-	-	1	3	2
CO3	3	2	3	3	3	-	-	-	1	-	-	1	3	2
CO4	3	2	3	3	3	-	-	-	1	-	-	1	3	2

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Engineering Drawing, P. S. Gill, S.K. Kataria& Sons.	2012
2	Engineering Drawing, D.A. Jolhe, Tata McGraw Hill	2010
3	Engineering Graphics with SOLIDWORKS, David C. Plan chard, SDC Publications	2020

Course Name	**:**	**Introduction to Mechatronics**
Course Code	**:**	**ES 2304**
Credits	**:**	**04**
L T P	**:**	**3-0-2**
Course Objectives:		
The objective of the course content is to: 1.Impart knowledge and information about mechatronics system. 2. Understand the concepts of signal conditioning and data acquisition for intelligent systems. 3.Develop the basics for mechatronic product design		

Total No. of Lectures-42

Introduction to Mechatronics : Introduction, Elements of Mechatronics system, Classificationof Mechatronics system,Mechatronic system intelligence, Components involved in intelligent system designand development,measurementsand control system as a part of mechatronics system,Application of Mechatronic systems(6)

Sensors and transducers : Introduction,Performance characteristics of transducers, Transducer for displacement (Potentiometer, strain-gauge, Optical encoder, LVDT, Hall effect sensor); velocity(Tachogenerator), force (load cell), pressure (Piezoelectric sensors, Tactile sensor), liquid level (Floats, Differential pressure), Temperature (Bimetallic strips, RTDs, Thermistors, Thermocouples) and light sensor (Photovoltaic- transducer, LDR, Photodiode, Photo Transistor). (8)

Signal conditioning: Operational amplifier (Inverting, Non-inverting, Summing, Integrating, Differential amplifiers, comparator), protection, filtering, digital signals (R-2R ladder DAC and Successive Approximation ADC), Concepts of multiplexers(7)

Controllers: Basics of number system, binary, octal and hexadecimal systems with their conversion from one system to other. Boolean algebra, logic gates, ICs, flip-flops& counters.Microprocessor, Microcontroller, PLC & their Architectures, Working Principle, Software Programs (Assembly/High Level), Interfacing Aspects (7)

Actuators and mechanisms:
Pneumatic and hydraulic actuation systems: Directional control valves, Pressure control valves, cylindersMechanical actuation systems: Kinematic chain, cam, gear, clutches, ratchet and pawl, belt and chain drive, bearings
Electrical actuation systems:Relays, Solid-state Switches (Diode, Thyristor, Triac, BJT, FET), DC and AC motors, brushless dc motor, stepper motors, servomotors (8)

Robotics: Types of motions, Function, Governing Laws, Classification, Features and Components of Robots, System Automation(6)

Topics to be thought through Flipped Learning (NPTEL MOOCs) -
***https://nptel.ac.in/courses/112107298*)**
Mechanical actuation systems: Kinematic chain, cam, gear, ratchet and pawl, belt and chain drive, bearings (Unit 3 Lecture 11)
Pneumatic and hydraulic actuation systems: Directional control valves, Pressure control valves, cylinders (Unit 3 Lecture 12)
Basics of number, binary, octal and hexadecimal systems with their conversion from one system to other. Boolean algebra, logic gates, ICs, flip-flops. (Unit 5 Lecture 21&22)
PLC Controller (Unit 7 Lecture 33)

LIST OF EXPERIMENTS		
1	**Experiment on Sensors & Transducers**	**Number of Turns**
(i)	To study the characteristics of LVDT using linear displacement trainer kit & compare with ideal characteristics.	01
(ii)	To measure the strain of the metal strip using strain gauge trainer kit & compare with ideal characteristics.	01
(iii)	To measure the angular displacement of resistive & capacitive transducer using angular displacement trainer kit & compare with ideal characteristics.	01
(iv)	To obtain the characteristics of RTD, thermistor, thermocouple with hot and cold junction thermal trainer kit & compare with ideal characteristics.	01
2.	**Experiments on Signal Conditioning**.	
(a)	Experiments on Analog Devices	
(i)	PN Junction Diode	01
(ii)	Zener Diode	01
(iii)	Half wave rectifier	01
(iv)	Full wave rectifier	01
(b)	**Experiments on Digital devices**	
(i)	Logic Gates (AND, OR, NAND, NOR etc)	01
(ii)	Flip Flop - RS Flip Flop, JK Flip Flop, T Flip Flop and D Flip Flop.	01
3	**Experiments on Controller**	
(i)	To perform the basic sequence programming using PLC.	01
4.	**Experiments on Actuators**	
(i)	To perform AND and OR logic using pneumatic actuators.	01
5.	**Project using Arduino**	
(i)	To build a line follower robot using Arduino.	02

Course Outcomes:

By the end of this course, the student will be able:
CO1: To understand the basic concepts, applications and components of mechatronic system.
CO2: To analyze sensing, signal conditioning and data acquisition circuits.
CO3: To design product and systems theoretically as well as practically with Intelligence.
CO4: To apply the knowledge of mechatronic system for industrial applications.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Mechatronics by W Bolton , 6thedition, Pearson Education	2019
2	Mechatronics by Tilak Thakur 1st edition, Oxford University Press	2016
3	Mechatronics by Dan Necsulescu, Pearson Education	2001
4	Mechatronics by H M T Limited,TMH	2017
5	Mechatronics Principles, Concepts & Applications by Nitaigour P Mahalik, TMH	2017

Course Name	**Introduction To Electronics & Electrical Engineering**
Course Code	**ES 2305**
Credits	**4**
L T P	**3-0-2**

Course Objectives:
To introduce to the students, the fundamental concepts of electronic devices, circuits and electrical systems for engineering applications.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
1	**Semiconductor Devices and applications**: Introduction to different semiconductor materials, familiarization with active and passive components, operation of p-n junction diode, applications of diodes, introduction to BJT and MOSFET, transistor as an amplifier, transistor as a switch, functional operation of OpAmp, concept of Oscillators, filters and their types	10
2	**Digital Electronics**: Number system, Binary arithmetic, Binary codes, introduction to logic gates, combinational circuits: adder, subtractor, multiplexer, demultiplexer, sequential circuit: flipflops.	9
3	**Communication Systems:** Basics of signals and systems, time and frequency domain analysis, various frequency bands used for communication, block diagram of Analog and Digital communication, need of modulation, Introduction to wired and wireless communication.	10
4	**Fundamentals of Electrical Engineering:** Introduction to circuit laws, amplitude, phase, phase difference, RMS value and average value of an AC signal, introduction and types of motors, Transformer: construction, working principle and applications	7
5	**Microprocessor and Microcontroller:** Introduction to microprocessor and microcontroller, architecture of 8086, functional diagram, register organization, memory segmentation	6

List of Experiments

S. No.	**Name of the experiment**	**No. of turns**
1	To familiarise with basic electronic components, oscilloscopes, power supply, multimeter etc.	2
2	To simulate and analyse the IV characteristics of PN junction diode	1
3	To simulate and analyse the functionality of opamp	2
4	To simulate and verify the truth tables of various logic gates	1
5	To simulate and analyse various combinational circuits	2
6	To simulate and verify the truth tables of various flip-flops	2
7	To familiarise with microprocessor and microcontroller kits	2
8	Write a MATLAB program for the generation of standard signals	1
9	To implement amplitude modulation and demodulation by using MATLAB	1

Course Outcomes: By the end of this course, the students will be able to	
1	Express the understanding of semiconductor devices (p-n Diode, BJT, MOSFET etc), and their applications.
2	Demonstrate the functional operation of various analog and digital electronic circuits.
3	Solve basic electronic circuits using circuit laws.
4	Describe various signals, systems and fundamentals of communication systems.

5	Describe the basic principle and working of fundamental electrical systems, ac dc motors and transformer etc.
6	Explain the fundamentals of microprocessors and microcontrollers.

Suggested Books:		
S. No.	**Name of Book/ Authors/ Publishers**	**Year of Publication/ Reprint**
1	Electronics Devices & Circuit Theory, RL Boylestead & L Nashelsky (PHI)	2009
2	Circuits and Networks: Analysis and Synthesis, Sudhakar and Shyam Mohan, TMH	2009
3	Electronic Communication Systems by G. Kennedy, Mc Graw Hill, 4th Edition	2008
4	Digital Principles and Applications, 7th Edition, A. Malvino and D. Leach	2011
5	Alexander, Charles K., and Sadiku, Matthew N. O., Fundamentals of Electric Circuits, 5th Ed, McGraw Hill	2013
6	A course in Electrical and Electronic Measurements and Instrumentation, A K. Sawhney, 18th Edition, Dhanpat Rai & Sons	2001
7	Microprocessors and Microcontrollers Architecture, Programming and Interfacing Using 8085, 8086 and 8051, Soumitra Mandal, Tata McGraw-Hill	2017

Course Name	**:**	**Introduction to Product Design**
Course Code	**:**	**ES -2307**
Credits	**:**	**2**
LTP	**:**	**0-0-4**

Course Objectives:
To demonstrate the concepts Product Design and Development skills through: Additive Manufacturing, Reverse Engineering, CNC machining, Laser engraving and Robotic

Course Outcomes:	
1	Apply the fundamental concepts and principles of reverse engineering in product design and development.
2	Understand the processand applications of Additive Manufacturing for Product development
3	Understand the concepts and applications of CNC machines&Robot and its interface.

Practical's **Total: 56 hours**

Sr. No.	Name	No of turns
1	Prepare a CAD model of given Product using NX Software	4X2
2	Reverse Engineering (3D Scanning, Repair and measurement) of given product for development of CAD model	4X2
3	Converting CT/MRI scan data using MIMICS Software to Develop the CAD model	4X1
4	Tessellation of various CAD models into STL file and Simulation of process parameters using software and its validation	4X1
5	Fabrication of CAD model using polymers based 3D Printer for Product development	4X1
6	To study various CNC machine codes and addresses and write a programme for a given profile	4X1
7	To execute the part program on CNC trainer kit followed by product fabrication on CNC machine tool	4X1
8	Demonstrate the various components of industrial robots andprogramming the Robot for pick and place application	4X1
9	To design a circuit using the PLC concept for automated devices	4X1
10	To sketching given design using CorelDRAW and fabricate the product using Laser engraving	4X1
11	To measure the surface integrity of given Product using advance measurement techniques	4X2

Course Name	**:**	**Introduction to Environmental Sciences**
Course Code	**:**	**GS 2301 (Common to all branches)**
Credits	**:**	**1**
L T P	**:**	**1 0 0**

Course Objectives:
This course aims to (i) acquaint the students with the basics of Environmental Science (ii) make them aware of the importance of Environmental Science

Total No. of Lectures – 14

Lecture-wise breakup		**No. of Lectures**
Unit 1	Multi-disciplinary Nature of Environmental Studies; Environmental Problems and their Causes, Concept of Sustainability; Sustainable Development, Sustainable Development Goals (SDG).	2
Unit 2	Types of Ecosystems - System Dynamics - Understanding Ecosystems, Ecosystem Degradation, Ecosystem Delivery, Habitat Classification.	2
Unit 3	Natural Resources and Associated Problems, Non Renewable Resources, Renewable Resources, Resource Utilization.	2
Unit 4	Energy and Environment – Fossil Fuel, Geothermal, Tidal, Nuclear, Solar, Wind, Hydropower and Biomass.	2
Unit 5	Environmental Pollution – Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear Hazards ; Global Environmental Issues ; Solutions to Pollution Problems.	2
Unit 6	Cleaner Production and Life Cycle Analysis - LCA Methodology, Steps and Tools; EIA and Environment Audit.	2
Unit 7	Environment, Development and Society- Emerging Technologies for Sustainable Development and Environmental Management; Policies and Practices, Legislation; Disaster Management.	2

Course Outcomes (COs): At the end of the course, the students will be able to:	
1	Relate the importance of environmental science for sustainable development of society.
2	Apply the principles of environmental science and the concept of sustainable development in real life engineering problems.

Test Books		**Year of Publication/ Reprint**
S.No.	**Name of Book**	
1	"Environmental Science", Miller G.T. and Spool, Ceonage Learning Publications.	2021
2	"Environmental Studies", Banny Joseph, Tata Mcgraw Hill Publication.	2021
3	"Text book of Environmental Studies for U.G. Courses", Erach Bharucna , University Press.	2021
4	"Environmental Studies – from criteria to cure", R. Raogopalan, Oxford Univ. Press.	2022
5	"Principles of Environmental Science – Inquiry and applications", Mary Ann Cunningham, William P. Cunningham, TMH Edition.	2020

Course Name	**Universal Human Values**
Couse Code	**GS2302**
Credits	**1**
L T P	**1-0-0**

Objectives:
The course has the following objectives- CO1-To equip students with foundation in ethical decision-making, teamwork, and social responsibility. CO2-To emphasize the integration of technical skills with ethical principles to prepare students for responsible and ethical professional practices. CO3-To shape students into well-rounded individuals with strong ethical foundation that guides their actions, decision and interactions with world around them.

Total Number of Lectures: 14

Lecture wise Breakup	**Number of Lectures**
Course Introduction: Need, Basic Guidelines, Content & Process for Value Education Understanding ethics, morals, and values Ethical theories and their application in engineering and technology	2
Ethical Decision-Making Steps in ethical decision-making Identifying and analysing ethical dilemmas in real-world scenarios	3
Teamwork and Collaboration Characteristics of effective teams Conflict resolution and managing differences Collaboration tools and techniques for virtual teams	3
Social Responsibility and Sustainability Role of engineers in promoting social good Environmental ethics and sustainable development Corporate social responsibility and ethical considerations in technology choices	3
Ethical analysis of Technological Innovations Engineering Ethics Balancing short-term gains with long-term consequences	3

Course Outcomes:
Some of the key outcomes that students can expect after completing this course: CO1-Increased awareness of ethical issues in both personal and professional contexts. CO2-Encourages critical thinking skills, allowing students to analyse complex situations from multiple angles and evaluate the ethical implications of different actions. CO3-Promotes an understanding of diverse cultures, beliefs, and backgrounds, fostering an inclusive mindset. CO4-Engage in self-reflection and introspection, leading to personal growth and a better understanding of their own values, strengths, and areas for improvement.

Suggested Books:

S.No.	***Name of Book/ Authors/ Publisher***	***Year of Publication/ Reprint***
1	"Engineering Ethics" (Includes Human Values), Govindarajan M, Pearson Education Inc.	2017
2	"Professional Ethics and Human Values", Govindarajan M, Learning India Private Limited.	2020
3	"Professional Ethics and Human Values (JNTU-Kakinada)", B Raghavan, McGraw Hill.	2021
4	"The Moral Status of Technical Artefacts (Philosophy of Engineering and Technology)", Peter Kroes and Peter-Paul Verbeek	2020
5	"Ethics and Professionalism in Engineering (Broadview Guides to Business and Professional Ethics)" by Richard H McCuen and Kristin L Gilroy., Pubs: W.W. Norton & Company.	2020
6	"Engineering Ethics: Challenges and Opportunities" by W Richard Bowen, Cengage Learning	2019

Additional Reading-

S.No.	***Name of Book/ Authors/ Publisher***	***Year of Publication/ Reprint***
1	A Casebook in Interprofessional Ethics: A Succinct Introduction to Ethics for the Health Professions (SpringerBriefs in Ethics)", Jeffrey P Spike and Rebecca Lunstroth,2 Pearson Education Inc	2020
2	"Fundamentals of Ethics for Scientists and Engineers", Edmund G Seebauer and Robert L Barry,2020, Pearson Education Inc. .	2020

SYLLABUS

Course Name	**:**	**Communication Skills**
Course Code	**:**	**HS2351**
Credits	**:**	**3**
L T P	**:**	**2-0-2**

Course Objectives
The objective of the course content is: CO1: To explain different aspects of communication process and enable the students to develop a strong theoretical base to handle various real-life communication tasks. CO2: To provide opportunities to the students to acquire and practice their LSRW skills in English for effective communication in professional life. CO3: To enable the students to articulate their ideas and perspectives using appropriate communication strategies and tools. CO4: To develop critical thinking and creative writing skills among the students and equip them with necessary analytical tools to achieve success in personal and professional domains.

Total No. of Lectures – 28

Lecture-wise Breakup		**No. of Lectures**
1	**Introduction to Communication** Concept, Process, Modes – verbal (oral and written) and non-verbal (kinesics, proxemics, chronemics), Types (formal, semi-formal, and informal), Channels (downward, upward, horizontal, diagonal), and Levels (extrapersonal, interpersonal, intrapersonal, organizational, and mass) of Communication, Barriers to Effective Communication with Solutions, Significance and Tools of Effective Communication.	**(4)**
2	**Developing Effective Listening and Speaking Skills** Hearing versus Listening, Listening Process (hearing, understanding, remembering, evaluating and responding), Note-taking, Barriers to Listening, and Strategies for Effective Listening. Tools and Techniques (linguisticand paralinguistic) of Effective Speaking at Various Levels (interpersonal, group, organization and society), Art of Conversation, Dialogue, Discussion, Public Speaking, Presentation, Negotiation, and Persuasion.	**(7)**
3	**Developing Reading and Technical Writing Skills** Concept, Strategies and Techniques (skimming, scanning, inferring, close reading) for Effective Reading and Comprehension, Understanding and Summarizing the Gist. Tips for Effective Technical Writing**,** Formal Letter Writing, Notice, E-mail Writing, Precis Writing, Statement of Purpose, and IMRD-Based Report.	**(8)**

4	**Critical and Creative Thinking Skills** Descriptive, Referential, Inferential, Discursive, Analytical, Evaluative, Creative and Lateral Using Texts and Various Media Forms like Books, Newspaper Articles, Films, and Social Visuals.	**(4)**
5	**Job Preparation** Sensitization to Building Portfolio, Job/Cover Letter and Resume, Interview Skills	**(3)**
6	**Digital Media for Effective Communication** Introduction, Current Trends in e-learning, Online Meetings, Digital Media Tools and Apps for Enhancing Communication Skills	**(2)**

Total No. of Practical Sessions: 14

Practical Session Wise Breakup		**No. of Practical Sessions**
1	**Organizational Communication** Verbal, Vocal and Non-Verbal Communication in Practice, Greetings and Self-Introduction, Speech, and JAM.	**(2)**
2	**Speaking Techniques at Different Forums** Group Discussion, Role-play, Making and Presenting Power Point Presentations.	**(3)**
3	**Practice on Reading and Technical Writing** Reading Comprehension, Formal Letter Writing, Précis Writing, Notice, Email Writing, Report Writing, and Statement of Purpose	**(3)**
4	**Applying Critical Thinking Skills** Book Review, Film Review, Social Visuals -Interpretation and Critical Analysis.	**(3)**
5	**Towards Job Preparation** Sensitization to Building Portfolio, Job/Cover Letter, Resume, Interview	**(2)**
6	**Use of Digital Media for Effective Communication** Training the students to use digital tools	**(1)**

OBJECTIVES OF THE COURSE

The objective of the course content is:

CO1: To explain different aspects of communication process and enable the students to develop a strong theoretical base to handle various real-life communication tasks.

CO2: To provide opportunities to the students to acquire and practice their LSRW skills in English for effective communication in professional life.

CO3: To enable the students to articulate their ideas and perspectives using appropriate communication strategies and tools.

CO4: To develop critical thinking and creative writing skills among the students and equip them with necessary analytical tools to achieve success in personal and professional domains.

OUTCOMES OF THE COURSE

By the end of this course, the students will be able to:

1. Understand the basic concepts of effective communication and learn the importance of communication skills for professional purposes.
2. Apply the four skills of language effectively by using latest learning strategies and digital tools to create and produce original pieces of technical writing and speech.
3. Analyse and evaluate critically what they listen, read and write to respond appropriately in different contexts of their personal and professional life.

Course Name	**:**	**CALCULUS**
Course Code	**:**	**MA2301**
Credits	**:**	**4**
L T P	**:**	**3-0-2**
Total No. of Lectures	**:**	**42**

Course Objectives:
At the end of the semester, the students should be able to

1	Understand the behavior of infinite series and their use.
2	Learn the concepts related to differential calculus of functions of several variables and their applications.
3	Learn the concept and methods of evaluating multiple integrals and their applications to various problems.

	Lecture wise breakup	**No. of Lectures**
1	**INFINITE SERIES** Limits of sequences of numbers, Theorems of calculating limits of sequences, Infinite series and convergence, alternating series, power series and convergence. Taylor's and Maclaurin's Series. (Scope as in Chapter 8, Sections 8.1 – 8.9 of Text Book 1).	12
2	**DIFFERENTIAL CALCULUS** Functions of several variables, Limits and continuity, Partial Derivatives, Euler's Theorem for Homogeneous functions; Differentiability, Linearization and Differentials; Chain rule; Extreme values and Saddle Points; Lagrange multipliers; Taylor's Formula**.** **(**Scope as in Chapter 12, Sections 12.1 – 12.6, 12.8 – 12.10 of Text Book 1).	14
3	**INTEGRAL CALCULUS** Parametrization of plane curves, Polar coordinates, Graphing in Polar coordinates, Cylinders and Quadric surfaces, Double integrals in Rectangular and Polar form, Triple integrals in Rectangular, Cylindrical and Spherical Coordinates, Substitutions in Multiple integrals. Applications to practical problems. (Scope as in Chapter 9, Sections 9.4, 9.6 and 9.7 ,Chapter10, Sections10.6 and 10.7 and Chapter 13, Sections 13.1, 13.3, 13.4,13.6 and 13.7 of Text Book 1).	16

Course Outcomes:
At the end of the semester, the students are able to

1	Test the behavior of infinite series.
2	Apply the concepts of differential calculus of functions of several variables.
3	Evaluate multiple integrals and apply them to practical problems.

Text Books:

1	Calculus and Analytic Geometry, Thomas and Finney, 9th edition, Pearson Education Asia.	2006

Reference Books:

1	Advanced Engineering Mathematics, Wylie and Barrett, 6th edition, Mc Graw Hill.	2003

Practical / Lab work to be performed using Mathematica/ Matlab

1. Study the convergence of sequences through plotting.
2. Analyze the convergence of infinite series by plotting their sequences of partial sums.
3. Study the convergence of infinite series using Cauchy's root test and Ratio test
4. Taylor and Maclaurin series of trigonometric, logarithmic, hyperbolic functions.
5. Plotting 2D curves in rectangular and polar coordinates.
6. Plotting 3D surfaces.
7. Find critical points and identify local maxima, local minima or saddle points
8. Draw the surfaces and analyze the existence of limits as they approach the specified points.
9. Check the continuity of functions
10. Draw the surfaces and find level curves at the given heights

Course Name	**:**	**LINEAR ALGEBRA, DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS**
Course Code	**:**	**MA2302**
Credits	**:**	**4**
L T P	**:**	**3-0-2**
Total No. of Lectures	**:**	**42**

Course Objectives:
At the end of the semester, the students should be able to

1	Learn the various concepts associated with real vector spaces and theory of matrices
2	Learn the methods to solve ordinary differential equations of various types.
3	Learn the various concepts of vector calculus and their applications to problems.

	Lecture wise breakup	**No. of Lectures**
1	**ALGEBRA** Vector spaces over reals, Linear dependence, Basis, Dimension, Co-ordinates with respect to a basis, Change of basis, Subspace, Linear transformation $R^n \rightarrow R^m$, Range space and Rank, Null space and Nullity, Rank and Nullity relation, Matrix representation of a linear transformation, Similar matrices, Invertible linear transformation, Eigenvalues and eigenvectors, Cayley Hamilton theorem, Diagonalization of a matrix.	16
2	**ORDINARY DIFFERENTIAL EQUATIONS** First order exact differential equations, Integrating factor, Orthogonal trajectories, Second and Higher order Linear Differential Equations with constant coefficients, Differential Operators, Methods of Variation of Parameters and Undetermined Coefficients, Euler Cauchy Equation, Wronskian. .	12
3	**VECTOR CALCULUS** Gradient, Divergence and Curl – their physical interpretation, Line, Surface and Volume integrals, Green's theorem in the plane, Stoke's theorem, Divergence theorem, Applications to Science and Engineering.	14

Course Outcomes:
At the end of the semester, the students are able to

1	Solve the various problems related to real vector spaces and theory of matrices
2	Solve ordinary differential equations of various types
3	Apply various concepts of vector calculus to problems.

Text Books:

1	Introductory Linear Algebra with Applications, Kolman, B. and Hill,D.R., 7th edition, Pearson Education	2001
2	Advanced Engineering Mathematics, Kreyszig, 8th edition, John Wiley and Sons.	2005

Reference Books:

1	Differential Equations, S. L. Ross, John Wiley and Sons, India	2004
2	Advanced Engineering Mathematics, Wylie and Barrett, 6th edition, Mc Graw Hill.	2003
3	Differential Equations, Frank Ayers, SI edition, Mc Graw Hill.	1972

Practical / Lab work to be performed using Mathematica/ Matlab

1. Perform basic Matrix operations.
2. Find rank, eigenvalues and eigenspace of matrices.
3. Check diagonalizability of matrices.
4. Solve ordinary differential equation.
5. Plotting of second order solution family of differential equation.
6. Plotting of third order solution family of differential equation.
7. Plotting of vector fields.
8. Find Gradient, Divergence and Curl.
9. Computation of line integrals and surface integrals.
10. Verify Green's theorem in the plane, Stoke's theorem, Divergence theorem.

Course Name	**:**	**Electromagnetic Theory and Quantum Physics**
Course Code	**:**	**PY2301**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

1. To familiarize the students with the concepts of electrostatics and boundary value problems.
2. To make the students able to understand the magnetostatics and their boundary value problems.
3. To make the students able to understand and apply the concepts of electromagnetic wave propagation.
4. To familiarize the students with the concepts and principles of Quantum Mechanics.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**VECTORS, FIELDS AND ELECTROSTATICS:** Cartesian coordinate System, Cylindrical and Spherical coordinate Systems, Gradient, Divergence of a Vector and Divergence Theorem, Curl of a vector and Stoke's theorem, Gauss's law & its applications, Maxwell's 1st eqn. (Electrostatics), Electric Energy and potential, Potential gradient, the dipole fields, Energy density in an electrostatic field. Current and current density, Continuity of current, Metallic conductors, Dielectric materials, Electrostatic boundary-value problems, Introduction to Laplace's and Poisson's equations.	12
2	**MAGNETOSTATICS:** Biot-Savart's law, Ampere's circuital law, Magnetic flux and magnetic flux density, Scalar and vector magnetic potentials. Magnetic dipole, Force due to Magnetic field on a differential current element, force between two differential current elements, Force and torque on a closed circuit, magnetic materials, Magnetic boundary conditions, Inductors and inductances.	10
3	**MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVE PROPAGATION:** Faraday's law, Displacement current, Maxwell's equations in point form, Maxwell's equations in integral form, EM waves in general, EM wave propagation in Lossy Dielectrics, Wave propagation in lossless dielectrics, Plane waves in free space, Plane waves in Good conductors, Power & Poynting Vector, Reflection of a plane wave at normal incidence.	10
4	**QUANTUM PHYSICS:** Need of Quantum theory, Photoelectric effect, The Compton effect; matter waves, group and phase velocities; Uncertainty principle and its application; time independent and time dependent Schrödinger wave equation; Eigen values and Eigen functions, Born's interpretation and normalization of wave function, applications of Schrödinger wave equation for particle in one dimensional infinite potential well. Introduction to nanoscience, Quantum materials, and Superconductivity.	10

List of Experiments:		**Number of Turns**
1	To study dielectric constant and Curie temperature of Ferroelectric ceramic BaTiO3.	1
2	To determine coercivity of magnetic material using hysteresis loop tracer.	1
3	To study the Hall effect and to determine Hall Voltage (V_H) and Hall coefficient (R_H)	1
4	To determine the energy band gap of semiconductor (Ge) using Four Probe Method.	1
5	To design a method to draw equipotential lines with various geometries of electrodes kept at different potentials.	1
6	To determine the flashing and Quenching Potential of neon/Argon and also to find the capacitance of unknown capacitor.	1
7	To study the variation of magnetic field with distance along the axis of current carrying circular coil using Stewart and Gee's apparatus.	1

8	To plot I-V Characteristics of Solar cell.	1

Course Outcomes: By the end of the course	
1	Students will be equipped with the tools of electromagnetic theory.
2	Students will be able to solve numerical problems based on electrostatics, magnetostatics, electromagnetic wave propagation.
3	Students will be able to understand and apply the basic concepts of Quantum Mechanics.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Engineering Electromagnetics, William H Hyat, Jr., and John A. Buck, Tata McGraw Hill	2013 / 5th edition
2	Elements of Engineering Electromagnetics, Matthew N.O. Sadiku, Oxford University Press	2012 / 4th edition
3	Concepts of Modern Physics, Arthur Beiser, McGraw Hill Education (India) Pvt. Ltd., New Delhi.	2013
4	Modern Physics, J. Bernstein, P.M. Fishbane and S.G. Gasiorowicz, Pearson, Education India Pvt. Ltd., New Delhi	2009

Course Name	**:**	**Mechanics and Optics**
Course Code	**:**	**PY2302**
Credits	**:**	**4**
L T P	**:**	**3-0-2**

Course Objectives:
1. To inculcate the application of Mechanics concepts in engineering
2. To familiarize students with Statics, Kinematics, and Kinetics of rigid body.
3. To familiarize the students with Ultrasonics and their applications.
4. To familiarize students the basic concepts of LASER and Nanotechnology for possible industrial applications.

Total No. of Lectures – 42

	Lecture wise breakup	**Number of Lectures**
1	**STATICS AND DYNAMICS:**Analysis of system of forces, Equation of equilibrium in space and its applications, Center of gravity, Centroid, mass, area and Polar moment of inertia of simple and compound bodies. Kinematics of a Particle: Introduction, Motion of a projectile, Kinetics of a particle: Force and acceleration, Work and energy, Impulse and momentum.	10
2	**PLANAR KINEMATICS AND KINETICS OF A RIGID BODY:** Rigid-body motion, Translation, Rotation about a fixed axis, Absolute general Plane Motion analysis. Relative-Motion Analysis: Velocity, Instantaneous center of zero velocity, Acceleration. Moment of Inertia, Planar Kinetic equations of motion, Equations of motion: Translation, Rotation about a fixed axis and General Plane motion, Kinetic Energy, Work of a Force, Work of a Couple, Principle of Work and Energy, Conservation of Energy, Linear and Angular Momentum, Principle of Impulse and Momentum, Conservation of Momentum, Eccentric Impact.	12
3	**LASERS, OPTICAL FIBRES AND ULTRASONICS:** Basics of Interference, Diffraction and Polarization, Michelson–Morley Interferometer, Raman effect, Laser and its characteristics, He-Ne laser, Ruby laser, Semiconductor lasers, Ultra-fast lasers, Applications of Lasers, Optical fibres; Numerical aperture, Classification of optical fibres, fibre Losses, fibre manufacturing, Applications of optical fibres. Production of ultrasonics, detection and uses of ultrasonics, reverberation.	12
4	**NANOTECHNOLOGY:** Introduction, Length Scale, Size Dependence, Synthesis of Nanoparticles: Mechanical Method, Sol-gel Technique, Physical Vapour Deposition, Chemical Vapour Deposition, Overview of Carbon-based nanostructures, X-ray Diffraction for nano-materials analysis, Applications of Nanotechnology, Introduction to Quantum Materials and Superconductors.	8

	List of Experiments	**No.of Turns**
1.	Familiarization of students with basic instruments Vernier Calipers, Screw Gauge and Spectrometer.	1
2.	(i)To determine the wavelength of He-Ne laser using transmissiongrating. (ii) To determine the slit width using the diffraction pattern.	1
3.	To find the specific rotation of sugar solution using a Bi-quartz Polarimeter.	
4.	To determine the acceleration of gravity using Kater's pendulum	1
5.	To determine the Moment of Inertia of a Flywheel.	1
6.	To determine the range of the projectile as a function of angle ofinclination and initial velocity.	1
7.	To determine the velocity of ultrasonic waves in a given liquid.	1
8.	To measure the centripetal force, F_c, and compare to $F_c = mv^2/r = m\omega^2 r$.	1

Course Outcomes:	
1	Students will be able to understand and implement the concepts of Mechanics, types of motions and characteristics of rigid body.
2	Students will learn about lasers and fibre optics which have important applications for societal needs.
3	Students are expected to develop capability to tackle problems in general and in the various areas covered in the course.

Suggested Books:	
Sr. No.	**Name of Book/ Authors/ Publisher/Edition**
1	Statics, R.C. Hibbeler, Pearson (11th Edition).
	Dynamics, R.C. Hibbeler, Pearson (11th Edition).
2	Dynamics, F.P. Beer et al.,McGraw Hill (8th Edition).
3	Dynamics, Merriam and Kraige, Wiley and Sons (5th Edition).
4	Engineering Mechanics, G. Ramamurthy, R. S. Walia and Rajesh Kumar,I K International (3rd Edition).
5	Optics, AjoyGhatak, McGraw-Hill (3rd Edition).
6	Physics for Engineers, N.K. Verma, Prentice Hall India (3rdEdition).
7	Engineering Physics, Satya Prakash, PragatiPrakashan (9th Edition)

Course Name	**:**	**CONDENSED MATTER PHYSICS**
Course Code	**:**	**PY2303**
Credits	**:**	**4**
L T P	**:**	**3 - 2/2**

Total No. of Lectures – 42

Course Objectives:	
1.	To familiarize the students with basic concepts of the condensed phase of matter especially solids.
2.	To make the students able to understand the crystal structure, lattice vibrations, electronic properties, dielectric and the magnetic properties etc. in relation to engineering applications.
3.	To make the students able to understand the basics concepts of semiconductors, superconductivity, and their applications in various fields.
4.	To familiarize students the basic concepts of LASER and Nanotechnology for possible industrial applications.

Lecture wise breakup	**No. of Lectures**

1	**Crystal structure and Band Theory of Solids: -**Space lattices crystal structures (cubic and hexagonal cells), close packed morphology (Hexagonal and cubic close packing), single and polycrystalline structures, crystal Structure analysis, X-ray diffraction and Bragg's law, Classical and Quantum Theory of free electrons, Fermi-Dirac Distribution Function, Density of States, Motion of electrons in magnetic field (Hall effect), Energy bands in solids. Introduction of Phonons, Vibrations of one dimensional monoatomic and diatomic lattices, Momentum of Phonons. Electron in a Periodic Potential (Qualitative idea of Kronig Penney Model), Energy versus wave vector,	(14)
2	**Dielectric and Magnetic Materials:** Fundamental of dielectrics, active and passive dielectrics, various polarization mechanisms, Frequency and temperature dependence on polarization of dielectrics, Internal field, Dielectric Loss Tangent, Dielectric Breakdown. Review of basic formulas, magnetic susceptibility, classification of materials, anti-ferromagnetism and ferrimagnetism, ferromagnetism in metals, ferromagnetic domains, hysteresis,antiferromagnetism.	(7)
3	**Semiconductors and Superconductivity:** Introduction, Pure or Intrinsic Semiconductors, impurity or Extrinsic semiconductors, Drift velocity, mobility and Conductivity of Intrisic Semiconductors, carrier concentration and Fermi level for Intrinsic and Extrinsic Semiconductors, Applications: P-N Junction diode, Zener diode and Tunnel diode.Introduction to superconductivity, Mechanism of superconductivity, Meissner Effect, Effect of current and magnetic field, Type1 and Type II superconductors, Thermal properties, Isotope effect, London Equations, Qualitative idea of BCS theory, Applications of superconductivity.	(14)
4	**Nanotechnology:** Introduction, Length Scale, Size Dependence, Synthesis of Nanoparticles: Mechanical Method, Sol-gel Technique, Physical Vapour Deposition, Chemical Vapour Deposition, Overview of Carbon-based nanostructures, X-ray Diffraction for nano-materials analysis, Applications of Nanotechnology, Introduction to Quantum Materials.	(7)

S.No	**List of Experiments**	**No. of**

		turns
1.	To study dielectric constant and Curie temperature of Ferroelectric ceramic BaTiO3.	1
2.	To determine coercivity of magnetic material using hysteresis loop tracer.	1
3.	To study the Hall effect and to determine Hall Voltage (V_H) and Hall coefficient (R_H)	1
4.	To determine the energy band gap of semiconductor (Ge) using Four Probe Method.	1
5.	To design a method to draw equipotential lines with various geometries of electrodes kept at different potentials.	1
6.	To determine the flashing and Quenching Potential of neon/Argon and also to find the capacitance of unknown capacitor.	1
7.	To study the variation of magnetic field with distance along the axis of current carrying circular coil using Stewart and Gee's apparatus.	1

Course Outcomes: By the end of the course	
1	Students will be able to understand the physics behind structural properties of the solids.
2	Students will be aware of latest developments in certain areas of condensed matter physics, which have important applications for societal needs.
3	Students are expected to develop capability to tackle problems in general and in various areas covered in the course.

Suggested Books:	
Sr. No	**Name of Book/ Authors/ Publisher**
1.	Introduction to Solid State Physics, Charles Kittel, Wiley India Pvt. Ltd., New Delhi (8^{th} Edition)
2.	Solid State Physics, S.O. Pillai, New Age International, Pvt. Ltd., New Delhi (5^{th} Edition)
3.	Solid State Physics, M. A. Wahab, Narosa Publishing House, Pvt. Ltd. New Delhi (3^{rd} Edition).
4.	Solid State Physics R.K. Puri, V.K.Babbar, S. Chand & Company, Pvt. Ltd. New Delhi (3^{rd} Edition).

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Semester-III

Course Code	Course Name	L	T	P	Credits
	HSM-II				3
DSN 3001	Data Structures	3	0	2	4
DSN 3002	Python for Data Science	3	0	2	4
DSN 3003	Operating Systems	3	0	2	4
DSN 3004	Computer Networks	3	0	2	4
Total					**19**

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Data Structures**
Course Code	**:**	**DSN 3001**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able - • To learn and understand efficient storage mechanisms of data for an easy access. • To design and implement various basic and advanced data structures. • To get familiar with basic data structures and their use in fundamental algorithms • To improve the efficiency of algorithm by using suitable data structure.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Review:** Classes, Pointers, Recursion, Time and Space Complexity of Algorithms, Recurrence relations, solving recurrence relations using Substitution Method	**5**
Unit 2	**Linked Lists:** Introduction to linked list, Insertion-Deletion-Search in linked list, Doubly Linked List and Circular Linked List, **Applications of linked list:** Sparse Matrix Storage, Polynomial operations etc.	**5**
Unit 3	**Stacks:** Introduction to Stacks, implementation of stack using arrays and linked list **Applications of Stacks:** Balanced brackets, Infix to postfix conversion, postfix evaluation etc.	**5**
Unit 4	**Queues:** Introduction to queues, implementation of queue using arrays and linked list **Application of queues:** Job scheduling in CPU etc.	**5**
Unit 5	**Trees:** Introduction to trees and related terminologies, representations and implementations of trees in a program, Binary Tree, Traversals in binary tree, BFS-DFS in binary tree	**5**
Unit 6	**Binary Search Tree (BST):** Insertion-Deletion-Search in BST, AVL and B-Tree	**5**
Unit 7	**Graphs:** Introduction to graphs & related terminologies, representations and implementations of graphs in a program, Graph traversals, Dijkstra's Algorithm for Single Source Shortest Path, Minimum Spanning Tree using Prim's and Kruskal's Algorithms, Union-Find Data Structure	**6**
Unit 8	**Advanced Data Structures:** Heaps, implementations of priority queue using heaps; Hashing; Indexing	**6**

List of Experiments:		Number of Turns
1.	Write programs implementing pointers	**1**
2.	Write programs implementing recursion	**1**
3.	Write programs implementing singly linked list	**1**
4.	Write programs implementing doubly and circular linked list	**1**
5.	Write programs implementing stacks	**1**
6.	Write programs implementing applications of stacks	**1**
7.	Write programs implementing queues	**1**
8.	Write programs implementing applications of queues	**1**
9.	Write programs implementing binary trees	**1**
10.	Write programs implementing different traversals in binary tree	**1**
11.	Write programs implementing insertion-deletion-search in BST	**1**
12.	Write programs implementing insertion-deletion-search in AVL	**1**
13.	Write programs implementing different representations of graphs	**1**
14.	Write programs implementing Prim's and Kruskal's Algorithms	**1**

Course Outcomes: At the end of the course, students will be able to	
1.	Understand and compare different data structures for solving a programming problem
2.	Implement various data structures in programs to solve computational problems
3.	Compute time and space requirements of a solution and compare different solutions
4.	Modify data structures to design solutions for programming problems

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1.	Fundamentals of Data Structures in C++ by Ellis Horowitz, Sartaj Sahni, and Dinesh Mehta, W. H. Freeman	2nd edition, 2006
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1.	An introduction to data structures with applications, By J.P. Tremblay and P.G. Sorensen, TMH.	2nd edition, 2007
2.	Data Structures and Algorithm Analysis in C++ by M.A.Weiss, Pearson Education	3rd edition, 2007
3.	Data Structures and Algorithms, by A.V. Aho, J.E. Hopcroft and J.D. Ullman	1st edition, 1982

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1.	https://onlinecourses.swayam2.ac.in/cec23_cs09/preview	Swayam
2.	https://www.coursera.org/learn/data-structures	Coursera
3.	https://www.udemy.com/course/datastructurescncpp/	Udemy

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO2	1	-	1	-	-	-	-	-	-	-	-	-	1	1	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO4	2	1	3	1	1	-	-	-	-	-	-	1	-	1	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Python for Data Science**
Course Code	**:**	**DSN 3002**
Credit	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
• Basic process of data science. • Understanding of how to manipulate and analyze uncurated datasets. • Basic statistical analysis and machine learning methods. • Visualize results effectively.

Total No. of Lecture - 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**INTRODUCTION:** Introduction to data science, Data acquisition, data pre-processing and preparation, data quality, Tools for data science, significance of python for data science.	**10**
Unit 2	**PYTHON PROGRAMMING:** Python Basics, Setting up python, Python Data Structures: lists and tuples, dictionaries, sets; Jupyter, Spyder.	**08**
Unit 3	**PYTHON PROGRAMMING FUNDAMENTALS:** Conditions and Branching, Loops, Functions, Objects and Classes, reading files with open, writing files with open.	**10**
Unit 4	**PYTHON LIBRARIES FOR DATA SCIENCE:** Numpy, loading data with Pandas, working with and Saving data with Pandas, MatplotLib, Seaborn, Scikit-Learn.	**10**
Unit 5	**CASE STUDIES:** Regression, Classification.	**04**

List of Experiments:		**No. of Turns**
1.	Installing SPYDER (TOOL), Setting working Directory, Creating and saving a script file, File execution, clearing console, removing variables from environment, clearing environment, Commenting script files, Variable creation, Arithmetic and logical operators.	**1**
2.	Basics of Python, Loops, Functions, String, Exception Handling.	**1**
3.	Data Structures in Python (List, Dictionary, Tuples and Sets)	**1**
4.	File Handling by performing File manipulations- open, close, read, write, append and copy from one file to another and other related programs.	**1**
5.	Implement OOP concepts like Data hiding and Data Abstraction	**2**

6.	Create NumPy arrays from Python Data Structures, Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting. Import a CSV file and perform various Statistical and Comparison operations on rows/columns. Load an image file and do crop and flip operation using NumPy Indexing.	**2**
7.	Data Manipulation using Pandas: Pandas dataframe and dataframe related operations on Toyota Corolla dataset for Reading files, Exploratory data analysis , Data preparation and preprocessing.	**2**
8.	Data visualization on Toyoto Corolla dataset using matplotlib and seaborn libraries	**2**
9.	Case Studies on Regression: Predicting price of pre-owned cars and Case Studies on Classification: Classifying personal income	**2**

Course Outcomes:	
1	Understanding various process of data science and fundamental building blocks of python programing.
2	Developing robust applications using the features of Python programming.
3	Understanding the usage of standard and advanced Python libraries and data analysis using python tools.
4	Designing platform-independent and GUI based python applications for business problems.

Text Book:		**Year of Publication / Reprint**
1	Python Data Science Handbook: Essential Tools for Working with by Jake VanderPlas, O'Reilly Media, Inc.	Latest edition
Reference Books:		
1	Python for Data Science For Dummies, Book by John Mueller and Luca Massaron, John Wiley & Sons	Latest edition
2	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, Wes McKinney, Shroff/O'Reilly.	Latest edition
3	Mastering Python for Data Science By Samir Madhavan	Latest edition

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1.	https://www.edx.org/course/python-for-data-science-2	Engineering services company
2.	https://courses.mooc.fi/org/uh-cs/courses/data-analysis-with-python-2023-2024	MOOC.fi

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-
CO 2	2	2	2	2	3	2	-	-	-	-	-	-	-	-	-
CO 3	3	3	2	2	3	2	-	-	-	-	-	-	2	-	-
CO 4	2	3	1	3	2	-	-	-	-	-	-	-	-	-	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Operating Systems**
Course Code	**:**	**DSN 3003**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
• Describe the purpose, structure and functions of operating system. • Understand system calls • Understand the file system, processes synchronization, process scheduling • Understand memory management techniques used in an operating system.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
Unit 1	**CONCEPTS OF OPERATING SYSTEMS:** Computer system overview, concept of an operating system, multiprogramming, multiprocessing, multi user, time sharing, Multitasking, personal system, parallel system, real time system, general system architecture, System components, operating system services, system calls, system programs, system structure, Approaches to OS design and implementation	**10**
Unit 2	**PROCESSES MANAGEMENT:** Concept of process, process states, process state transitions, process control block, operations on processes, Process scheduling , scheduling criteria, Inter process Communication, Concurrent processes	**4**
Unit 3	**MEMORY MANAGEMENT:** Logical and physical address space, storage allocation and management techniques, swapping concepts of multi programming, paging, segmentation, virtual Memory, demand paging,	**4**
Unit 4	**INPUT/OUTPUT AND DATA MANAGEMENT:** Directory structure and implementation, protection file system structure, allocation methods, free space management, Storage management, buffering, swap space management, RAID Technologies.	**4**
Unit 5	**NETWORKS OPERATING SYSTEM**	**8**
	Network operating system, distributed operating system, access control, Client server computing, Tiny Operating System for low-power wireless devices,	

Unit 6	**OS SECURITY THREATS:** Types of Threats in Operating System, Malware, Viruses, Worms, Rootkits and Defense against Security threat, Logging, Auditing, and Recovery	**6**
Unit 7	**CASE STUDIES:** Linux/Unix/Windows/Android OS design and architecture, Unix shell, Unix operating systemservices, user Interfaces, representation of files in Unix system processesand their structure, input-output system, memory management in Unix.	**6**

List of Experiments:		**No. ofTurns**
1	Execution of various scripts using shell programming	**4**
2	Application development in Android	**4**
3	Use the system calls of UNIX/Linux operating system: mkdir, rmdir, link, unlink, mount, chown, chmod, getuid, setuid, fork, wait, exec, exit, kill, getpid, brk, nice, sleep, trace, open, close,read, write, lseek, stat, sync	**4**
4	Use the following system calls of UNIX operating system: signals, pipe, socket, accept, snd, recv, connect	**2**

Course Outcomes:	
1	Understanding of design issues associated with operating systems
2	Analyze the working of an operating system and its components.
3	Analyze the synchronization in processes
4	Identify the working methodology of various subcomponents of the operating system.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1.	Operating system, Galvin & Silberschatz, JohnWilley	Latest edition
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1.	Operating Systems-A Concept Based Approach ByDhamdhare, TMH	Latest edition
2.	Operating systems Internals and design principles By William Stallings, Pearson Education	Latest edition

3.	Operating Systems –A Design Oriented approach ByCrowley, TMH	Latest edition
4.	Operating systems Design and Implementation By Andrew S. Tanenbaum, Pearson Education	Latest edition

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1.	https://onlinecourses.nptel.ac.in/noc20_cs04/preview	NPTEL
2.	https://www.udacity.com/course/introduction-to-operating-systems--ud923	UDACITY

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	3	3	2	2	2	3	-	-	-	-	-	-	1	-	-
CO 2	2	1	1	3	3	-	-	-	-	-	-	-	2	-	-
CO 3	2	3	2	2	2	-	-	-	-	-	-	-	-	-	-
CO 4	2	2	3	2	-	-	-	-	-	-	-	-	2	-	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Computer Networks**
Course Code	**:**	**DSN 3004**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able - • To understand the basic concepts of computer networks • To explore various applications and their protocols • To design and implement various transport layer protocols and algorithms • To analyze and develop various network layer protocols and algorithms • To evaluate the performance of various data link control protocols and algorithms

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**COMPUTER NETWORKS AND THE INTERNET** What is the Internet; network edge; network core; Delay, Loss and throughput in Packet-Switched Networks; Protocol Layers and their Service Models.	**6**
Unit 2	**APPLICATION LAYER** Principles of Network Applications; The Web and HTTP; File Transfer: FTP; Electronic Mail in the Internet; DNS - The Internet's Directory Service	**8**
Unit 3	**TRANSPORT LAYER** Introduction and Transport-Layer Services; Multiplexing and Demultiplexing; Connectionless Transport: UDP; Connection-Oriented Transport: TCP; TCP Congestion Control.	**10**
Unit 4	**NETWORK LAYER** Introduction; Virtual circuit and datagram networks; What is inside a router; Internet Protocol (IP): Forwarding and Addressing in the Internet; Routing Algorithms; Routing in the Internet	**10**
Unit 5	**DATA LINK LAYER** Introduction to the link layer; Error Detection and Correction Techniques; Multiple Access links and Protocols; Switched local area networks.	**8**

List of Experiments:		**Number of Turns**
1	Understanding and using of commands like ping, ipconfig, hostname,	**2**

	getmac, arp, nslookup, netstat, tracert, route,pathping	
2	Socket Programming – Installing and learning Linux operating system, Understanding the syntax, purpose and use of various functions used in sockets programming – connect(), send(), recv(), bind(), listen(), accept(), sendto(), recvfrom() etc. functions, TCP/IP based echo client server and UDP/IP based echo client server	**3**
3	Practicals based on Wireshark – getting started, HTTP, DNS, TCP, IP, ICMP, Ethernet & ARP, DHCP etc.	**9**

Course Outcomes: At the end of the course, students will be able to:	
1	Understand and explain various components of computer networks
2	Illustrate the various applications and protocols
3	Analyze and develop various transport layer protocols and algorithms
4	Explore and apply network layer protocols and algorithms to design and analyze the networks
5	To evaluate and compare various data link control protocols and algorithms

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	James F. Kurose and Keith W. Ross, "Computer Networking: A top down approach", Pearson Education, 6th edition.	2017
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	A.S. Tanenbaum, "Computer Networks", 5th Edition, PHI	2010
2	G. Keiser, "Local Area Networks", 2nd Edition, TMH	2002
3	D. Bertesekas and R. Gallager, "Data Networks", 2nd Edition, PHI	2010
4	William Stallings, "Data & Computer Communication", PHI, 6th Edition	2002
5	B.A. Forouzan, "Data communications and networking", TMH, 1st ed	2000
6	B.A. Forouzan, "Local Area Networks", TMH.	2001
7	B.A. Forouzan, "TCP/IP Protocol Suite", TMH	2005

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	Computer Networks, https://onlinecourses.swayam2.ac.in/cec19_cs07/preview	Swayam
2	Computer Networks and Internet Protocol,	NPTEL

	https://onlinecourses.nptel.ac.in/noc20_cs23/preview	

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	-	2	2	1	1	1	1	2	3	3	2	2
CO 2	2	2	1	2	3	3	2	1	1	2	-	3	3	2	2
CO 3	2	3	3	3	3	2	2	1	1	2	1	3	3	3	3
CO 4	3	3	3	3	3	2	2	1	2	2	1	3	3	2	2
CO 5	3	3	2	2	3	2	1	1	2	2	1	3	3	2	3

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Semester-IV

Course Code	Course Name	L	T	P	Credits
DSN 4001	Statistical Thinking for Data Science	3	0	2	4
DSN 4002	Discrete Structures for Computer Science	3	1	0	4
DSN 4003	Artificial Intelligence	3	0	2	4
DSN 4004	Data Base Management System	3	0	2	4
DSN 4005	Data Science and Machine Learning	3	0	2	4
DSN 4006	Data Analytics and Visualization	3	0	2	4
Total					**24**

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Statistical Thinking for Data Science**
Course Code	**:**	**DSN 4001**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

Students should be able –

- To analyze tools and techniques for performing data sampling and distribution.
- To explore the techniques for predicting future trends from data using regression and classification.
- To apply the knowledge and skill to adopt strategies to derive insights while visualizing data.
- To develop statistical thinking in designing data collection.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	DATA EXPLORATION AND ANALYSIS Elements of Structured, Estimates of Location - Mean, Median, Mode, Outliers, Estimates of Variability- Standard Deviation, Z-Score, Frequency Table and Histograms, Correlation	**8**
Unit 2	DATA SAMPLING AND DISTRIBUTION Normalization, Sampling Data-Simple Random sampling, Stratified, Cluster Sampling, Sampling Error/Bias. Bootstraping, Central Limit Theorem, Confidence intervals, Normal distribution, Binomial distribution, Poisson distribution	**9**
Unit 3	HYPOTHESIS TESTING A/B Testing, Hypothesis Tests- null, one-way, two-way, P-value, Type 1 & 2 errors, t-tests, multiple testing, degrees of freedom, ANOVA, Chi-Square Tests, Power and Sample Size	**9**
Unit 4	REGRESSION Simple Linear Regression, Multiple Linear Regression, Confidence and Prediction Intervals, Categorical Variables, Multicollinearity, Polynomial Regression	**8**
Unit 5	CLASSIFICATION Naive Bayes, Discriminant Analysis, Logistic Regression, Evaluating Classification Models.	**8**

Total no. of turns: 14

List of Experiments:		**Number of Turns**
1	Draw correlation between the features of various datasets.	**2**
2	For a given dataset, display a chosen feature using different mean values and display the confidence interval of a chosen feature based on a sample.	**2**
3	Perform t-test on selected feature in a dataset .	**2**
4	For a given dataset create Boxplots for different groups of a feature.	**2**
5	Construct Linear Regression model for a dataset and display the error measures.	**2**
6	Apply classification algorithms such as Naive Bayes, Logistic Regression algorithm on a dataset to estimate the accuracy.	**2**
7	Apply classification algorithms on various datasets and analyse performance metrices.	**2**

Course Outcomes: At the end of the course, students will be able to:	
1	Understand various data sampling and distribution techniques.
2	Perform Hypothesis testing on datasets
3	Apply statistical tests for Regression and classification tasks.
4	Analyze the data from real world applications with statistical techniques.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Bruce, Peter, and Andrew Bruce. Practical statistics for data scientists: 50 essential concepts. " O'Reilly Media, Inc.".	2017
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Ismay, Chester, and Albert Y. Kim. Statistical Inference via Data Science: A Modern Dive into R and the Tidyverse. CRC Press.	2019
2	The Elements of Statistical Learning, by Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, Springer Series in Statistics.	2009

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	https://www.coursera.org/learn/statistical-inference	Coursera

2	https://www.datacamp.com/community/open-courses/statistical-inference-and-data-analysis	DataCamp

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	-	2	2	2	2	-	-	-	-	1	2	2	-
CO2	-	-	1	1	1	-	-	-	-	-	-	2	2	2	1
CO3	-	2	-	2	1	-	-	-	-	-	1	1	1	1	-
CO4	2	2	3	2	2	2	2	1	1	1	-	1	2	3	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Discrete Structures for Computer Science**
Course Code	**:**	**DSN 4002**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:

- To develop logical thinking and its application to computer science, vital for data analysis.
- To reason mathematically about basic data types and structures (such as numbers, sets, graphs, and trees) used in computer algorithms and systems; synthesize elementary proofs, especially proofs by induction to establish the mathematical foundations of data manipulation and algorithms.
- To model and analyze computational processes using analytic and combinatorial methods.
- To apply principles of discrete probability to calculate probabilities and expectations of simple random processes.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
Unit 1	**MATHEMATICAL REASONING** Mathematical reasoning, Propositions, Negation, disjunction and conjunction, Implication and Equivalence, Truth tables, Predicates, Quantifiers, Natural deduction, Rules of Inference, Methods of proofs, Resolution principle, Application to PROLOG.	**7**
Unit 2	**SET THEORY** Paradoxes in set theory, Inductive definition of sets and proof by induction, Peano postulates, Relations, Properties of relations, Equivalence Relations and partitions, Partial orderings, POSETs, Linear and well-ordered sets.	**8**
Unit 3	**FUNCTIONS** Functions; mappings, Injection and Surjections, Composition of functions, Inverse functions, Special functions, Recursive function theory.	**6**
Unit 4	**COMBINATORICS** Elementary combinatorics, Pigeonhole principle, Permutations and Combinations, Counting techniques, Recurrence relations, Solving Linear Recurrence relations, Generating functions, Combinatorial Optimization techniques	**8**

Unit 5	**GRAPH THEORY** Elements of graph theory, Graph Isomorphism, Euler graph, Hamiltonian path, trees, Tree traversals, Huffman coding, Spanning trees Graph Analytics for data visualization **GROUPS, RINGS, FIELDS** Definition and elementary properties of groups, Semigroups, Monoids, Rings, Fields, Vector spaces, lattices, matrices and linear transformations	**8**
Unit 6	**DISCRETE PROBABILITY** Introduction, Probability Theory, Bayes' Theorem, Expected Value and Variance, Discrete random variables, Markov chains, Entropy and Information theory	**5**

Course Outcomes: At the end of the course, students will be able to:	
1	Utilize logical notations to define and reason about fundamental mathematical concepts like sets, relations, functions, and integers, which are essential for data analysis and problem-solving.
2	Synthesize induction hypotheses and perform simple induction proofs to reason about data patterns and structures, especially in recursive algorithms and data modeling.
3	Calculate the number of possible outcomes in elementary combinatorial processes, such as permutations and combinations, which are essential for data sampling and data-driven decision-making.
4	Apply graph theory models of data structures and state machines to solve problems of connectivity and constraint satisfaction, for example, scheduling.
5	Calculate probabilities and discrete distributions for simple combinatorial processes; calculate expectations for data driven decision making

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	K. H. Rosen, Discrete Mathematics and applications, 7th Edition, McGraw Hill	2012

Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Seymour Lipschutz and Marc Lipson, Schaum's Outline of Discrete Mathematics, 3rd Edition	2010
2	J. L. Mott, A. Kandel, T. P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians, 2nd Edition, Pearson India	2015

3	C. L. Liu and D. P. Mohapatra, Elements of Discrete Mathematics, 4th Edition., McGraw-Hill	2012
4	C. Stein, R. L. Drysdale, K. Bogart, Discrete Mathematics for Computer Scientists, Second edition, Pearson Education Inc.	2011
5	W. K. Grassmann and J. P. Trembnlay, Logic and Discrete Mathematics, A Computer Science Perspective, Prentice Hall Inc	2007
6	M. Litvin and G. Litvin, Coding in Python and Elements of Discrete mathematics, Skylight Publishing	2019
7	A. M. Stavely, Programming and Mathematical Thinking, The New Mexico Tech Press	2014

Equivalent MOOCs Courses:		
Sr. No.	**Course Link**	**Offered by**
1	https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/video_galleries/video-lectures/	MIT Open Courseware
2	https://onlinecourses.nptel.ac.in/noc20_cs82/preview	NPTEL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	1	1	-	-	-	-	2	1	-	1	-	-
CO2	3	1	3	-	1	-	-	-	1	2	-	1	1	2	-
CO3	1	2	1	3	1	2	1	1	-	1	-	2	2	1	1
CO4	2	1	3	1	1	-	-	-	-	-	1	-	2	-	-
CO5	3	2	1	1	2	-	-	-	1	1	-	-	2	1	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Artificial Intelligence**
Course Code	**:**	**DSN 4003**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able - • To learn the basic concepts and techniques of Artificial Intelligence • To develop AI algorithms for solving practical problems • To represent the knowledge in logical form for further processing by algorithms • To develop reasoning and planning models by using the data presented

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Introduction:** Artificial Intelligence and its applications, criteria of success, Intelligent Agents, Nature of Agents, Learning Agents, advantages & limitations of AI	**6**
Unit 2	**Uninformed Search:** State space search, BFS, DFS, Iterative Deepening, Bidirectional Search **Informed Search:** Best first search, greedy best first search, A* search,	**6**
Unit 3	**Local Search:** Hill climbing, variants of hill climbing, Simulated Annealing **Adversarial Search:** Min-Max Search, Alpha-Beta Pruning, Markov Decision Processes **Constraint Satisfaction problems, backtracking**	**9**
Unit 4	**Logic:** Propositional logic, predicate logic, Resolution and Refutation, Clause form, unification algorithm	**6**
Unit 5	**Reasoning:** Bayesian Networks, Fuzzy Logic, Knowledge Representation And Reasoning through fuzzy logic and Bayesian Network	**8**
Unit 6	**Planning:** The Planning problem, planning with state space search, partial order planning, planning graphs, planning with propositional logic, planning algorithms	**7**

List of Experiments:		**No. of Turns**
1.	Write programmers to conduct uninformed and informed search, local search, adversarial search, constraint satisfaction, backtracking	**6**
2.	Mini project work based on AI problems	**8**

Course Outcomes: At the end of the course, students will be able to	
1.	Solve problems by applying suitable AI techniques
2.	Apply knowledge representation schemes for designing knowledge base
3.	Apply reasoning and planning approaches to derive conclusions using the knowledge base
4.	Design end-to-end solutions for real world problems

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1.	Artificial Intelligence: A Modern Approach by Stuart Russell & Peter Norvig, Prentice-Hall	4th edition, 2021
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1.	Artificial Intelligence: A New Synthesis by Nils J. Nilsson, Morgan-Kaufmann	1st edition, 1998
2.	Artificial Intelligence: Foundations for Computational Agents by David Poole and Alan Mackworth, Cambridge Univ. Press	2010
3.	Knowledge Representation and Reasoning by Ronald Brachman, Morgan Kaufmann	2004

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1.	https://onlinecourses.nptel.ac.in/noc22_cs56/preview	Swayam
2.	https://onlinecourses.nptel.ac.in/noc22_cs02/preview	NPTEL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	1	1	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	1	2	3	1	-	1	-	-	-	-	-	1	1	2	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Data Base Management System**
Course Code	**:**	**DSN 4004**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able - • To analyze the components/ requirements of DBMS • To explore the role of storage and file structure in database management. • To apply their knowledge of normalization theory to the normalization of a database • To develop various SQL queries related to any given situation. • To enable them think for transactions and concurrency in database applications in various scenarios

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**INTRODUCTION** Introduction and application of DBMS, Data Independence, Database System Architecture – levels, Mapping, Database users and DBA, Database Languages: DDL, DML. **DATABASE MODELS:** Entity – Relationship model, constraints, keys, Design issues, E-R Diagram, Weak and Strong entity types, Extended E-R features- Generalization, Specialization, Aggregation, Translating E-R model into Relational model. hierarchical and network models	**8**
Unit 2	**RELATIONAL MODE**L: Introduction to relational model, basic structure, Types, Keys,views in a relational database. **SQL:** Fundamentals, basic structure, set operations, aggregate operations, DDL, DML, DCL, nested queries, complex queries, Integrity Constraints, PL/SQL Concepts, triggers	**8**
Unit 3	**RELATIONAL ALGEBRA AND RELATIONAL CALCULUS** Relational Algebra: Fundamental operations, Additional Operations Relational calculus: Tuple Relational calculus, Domain Relational calculus **STORAGE AND FILE STRUCTURE** Overview of physical storage media, magnetic disks, RAID, file organization, organizationof records in files, indexing and hashing	**6**
Unit 4	**RELATIONAL DATABASE DESIGN:** Functional Dependencies, Non-loss Decomposition, First, Second, Third Normal Forms, Dependency Preservation, Boyce/Codd Normal Form, Multi-valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form, 6th Normal Form.	**8**

Unit 5	**TRANSACTION MANAGEMENT** Transaction concept, transaction state, ACID properties, serializability, Recoverability, Implementation of Isolation, Testing for serializability, **CONCURRENCY CONTROL** Basic Concept, Lock based concurrency control, Time stamping methods, Dealing with Deadlocks, Recovery techniques based on deferred update and recovery techniques based on Immediate Update. Introduction to Checkpoints and Shadow Paging, Introduction to Database Security, Discretionary access control based on granting and revoking privileges	**7**
Unit 6	**DISTRIBUTED DATABASES** Introduction, data mining, Big Data, NoSQL, New SQL, Modern databases based on these concepts.Object oriented databases	**5**

List of Experiments:		**Number of Turns**
1	For a given scenario of database application, Create the required tables using SQL Commands	**1**
2	Write Sql queries to apply the constraints i.e. Primary Key, Foreign key, UNIQUE to the tables.	**2**
3	SQL queries for Null values and different clauses	**2**
4	Usage of SELECT, rename, tuple operations, DELETE etc.	**2**
5	SQL queries for implementing various String operations, Set operations	**2**
6	SQL queries for implementing JOINs and types of joins with conditions.	**2**
7	SQL nested queries for a particular scenario.	**1**
8	SQL queries to create the views ,triggers	**1**
9	SQL queries to create indexes and apply on a database.	**1**

Course Outcomes:	
1	Describe DBMS architecture, physical and logical database designs, database modeling, relational, hierarchical and network models
2	explain basic database storage structures and access techniques such as file organizations, indexing methods, Understand the normalization of databases
3	Analyse /contrast the realtional algebra, calculus , other latest modern databases like data mining, no sql, etc
4	Design , implement, test and debug using Sql ,transaction proceesing, concurrency control mechanism
5	Design a database and Sql queries , triggers etc in various environments.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	"Database System Concepts", Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Tata	2006

	McGraw Hill,	
	"Fundamentals of Database Systems", Elmsari and Navathe, Pearson Education	2013
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Database Management Systems , Ramakrishnan and Gehrke, McGrawHill	2003
2	"An Introduction to Database Systems", C.J.Date, A.Kannan, S.Swamynathan, Pearson Education	2006
3	J. D. Ullman, "Principles of Database Systems", 2nd Ed., Galgotia Publications	1999

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	Database Management Essentials https://www.coursera.org/learn/database-management	coursera
2	Data Base Management System By Prof. Partha Pratim Das https://archive.nptel.ac.in/courses/106/105/106105175/	NPTEL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	-	1	1	1	2	1	2	1	1	1	1	2
CO2	1	1	1	-	1	1	1	2	1	2	1	1	1	1	2
CO3	1	2	1	1	2	1	1	2	1	2	1	1	2	1	2
CO4	2	1	2	1	2	1	1	2	1	2	2	2	2	2	2
CO5	2	1	3	1	3	2	1	3	1	2	2	3	2	2	3

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Data Science and Machine Learning**
Course Code	**:**	**DSN 4005**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives :
Students should be able - • To analyze and apply mathematical concepts in the context of data science and machine learning. • To explore various data acquisition, cleaning, and preprocessing techniques. • To develop skills in applying machine learning algorithms and predictive modeling on various datasets. • To prepare students for lifelong learning in the rapidly evolving field of data science and machine learning.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Introduction to Data Science:** Basics of python for data science and machine learning, Types of data: structured data, unstructured data, other data types, the data science process, Explore and visualize data, features, Linear algebra, correlation	**6**
Unit 2	**Data Acquisition and Preprocessing:** Data sources and collection, Data storage and management, Data Preparation: handling missing data, feature encoding, feature scaling, Data Cleaning, Dataset division: train, test and validation sets	**7**
Unit 3	**Machine Learning Fundamentals:** Applications of Machine Learning, Introduction to Machine Learning Techniques: Supervised Learning, Unsupervised Learning and Reinforcement Learning, bias-variance tradeoff, overfitting-underfitting, Evaluation Measures: SSE, R2, confusion matrix, precision, recall, F-Score, ROC-Curve, cross-validation.	**7**
Unit 4	**Regression and Classification:** Simple Linear Regression, Multiple Linear Regression, Logistic Regression, gradient descent algorithm, K-Nearest Neighbor, Support Vector Machine (SVM), Naïve Bayes, Decision Trees.	**12**
Unit 5	**Dimensionality Reduction and Clustering:** Feature selection, Principle Component Analysis, K-means clustering, Hierarchical clustering, Density based clustering.	**10**

List of Experiments:	**Number of**

		Turns
1	Explore various python libraries used for data handling and machine learning techniques: numpy, pandas, matplotlib, scikit-learn etc.	2
2	Implementation of data handling and preprocessing techniques	2
3	Implementation of various classification and regression algorithms – Linear and logistic regression, KNN, SVM, Naïve Bayes, Decision Trees	6
4	Implementation of Dimensionality Reduction and Clustering techniques: PCA, K-means clustering, Density based clustering algorithms	4

Course Outcomes: After completion of course, students would be able to:	
1	Explore and apply mathematical and engineering knowledge to analyze complex data science problems.
2	Apply modern tools and techniques to solve data science problems.
3	Apply different machine learning models on various datasets.
4	Analyze the trade-off of various machine learning models for real-life applications.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	"Introduction to Data Science" by Jeffrey Stanton, SAGE Publications	2017
2	"Introduction to Machine Learning with Python: A Guide for Data Scientists", Andreas Müller, Sarah Guido, O'Reilly Media	2016
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	"The Machine Learning Yearning" by Andrew NG, Deeplearning.ai	2021
2	"Python for Data Analysis" by Wes McKinney, O'Reilly Media	2022
3	"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", by Aurélien Géron, 3rd Edition, O'Reilly	2022

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	Machine Learning Specialization - Stanford University https://www.coursera.org/specializations/machine-learning-introduction	Coursera
2	Data Science Specialization - Johns Hopkins University https://www.coursera.org/specializations/jhu-data-science	Coursera

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	-	-	2	-	-	2	-	-	-	3	1	1
CO2	1	1	1	-	3	-	-	-	1	-	-	-	3	3	1
CO3	1	3	1	-	-	-	-	-	-	-	-	-	3	3	1
CO4	-	-	-	-	-	2	1	-	2	-	-	-	-	-	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Data Analytics and Visualization**
Course Code	**:**	**DSN 4006**
Credits	**:**	**4**
LTP	**:**	**3 0 2**

Course Objectives:
Students should be able – • To explore various statistical tools that are most commonly used to process, analyse, and visualize data. • To develop skills in students for independent research and study in data analytics. • To enable students learn various fundamental algorithms and techniques that will help them to solve complex real-world problems for decision support. • To describe the data analysis process involving collecting, wrangling, mining, and visualizing data.

Total No. of Lectures- 42

Lecture Wise Breakup		**Number of Lectures**
Unit 1	**INTRODUCTION TO THE SCIENCE OF STATICS:** Fundamental Elements of Statistics, Qualitative and Quantitative Data Summaries, Normal distribution, Sampling, The Central Limit Theorem	**4**
Unit 2	**CONFIDENCE INTERVALS AND HYPOTHESIS TESTS:** Statistical Inference, Stating Hypotheses, Test Statistics and p-Values, Evaluating Hypotheses, Significance Test "Recipe", Significance Tests and Confidence Intervals, Inference about a Population Mean, Two-Sample Problems	**8**
Unit 3	**UNDERSTANDING THE ASSOCIATION BETWEEN TWO CONTINOUS OR QUANTITATIVE FACTORS:** Scatterplots, Correlation, Simple Linear Regression, F-test for Simple Linear Regression, t-test for Simple Linear Regression	**4**
Unit 4	**REGRESSION DIAGNOSTICS AND MULTIPLE LINEAR REGRESSION:** Residual Plots, Outliers and Influence Points, Assumptions of least-square regression, Equation of multiple linear regression, Interpretation of multiple linear regression, F-test for Multiple Linear Regression, t-tests in Multiple Linear Regression, Cautions about Regression	**8**
Unit 5	**ANALYSIS OF VARIANCE (ANOVA):**	**10**

	One-Way Analysis of Variance, F-test for ANOVA, Evaluating Group Differences, Type I and Type II Errors, Issues with Multiple Comparisons, Assumptions of Analysis of Variance, Relationship between One-Way Analysis of Variance and Regression, One-Way Analysis of Covariance, Two-Way Analysis of Variance, Two-Way Analysis of Covariance	
Unit 6	**DATA VISUALIZATION** Principles for data visualization, Data literacy, Multivariate visualization, Geospatial visualization, Interactive visualization, Critiques in data visualization, Data visualization with ethics, Designing dashboards.	**8**

List of Experiments		**Number of Turns**
1.	Downloading and installing data visualization tools R. Understanding the fundamentals of R.	**1**
2.	Creating basic visualizations in R	**1**
3.	Hypothesis testing and ANOVA in R to guide decision making	**1**
4.	To perform predictive analytics in R such as Linear regression, logistic regression, etc.	**2**
5.	Installing and understanding the fundamental concepts of Tableau	**1**
6.	Connecting to Data and preparing data for visualization in Tableau	**1**
7.	Data Aggregation and Statistical functions in Tableau	**1**
8.	Creating different Data Visualizations like Multivariate, Geospatial, and Interactive visualization in Tableau	**4**
9.	Creating and formatting basic Dashboards in Tableau	**2**

Course Outcomes:

1. Select the appropriate statistical analysis depending on the research question at hand.
2. Form testable hypotheses that can be evaluated using common statistical analyses.
3. Conduct, present, and interpret common statistical analyses using R
4. Become an expert on visualization techniques such as heat map, treemap, waterfall, Pareto, Gantt chart, and market basket analysis, and build interactive dashboards

Text Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1.	Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani. An Introduction to Statistical Learning with Applications in R. Springer.	2013

2.	Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press.	2014

Reference Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1.	Andy Field, Jeremy Miles and Zoe Field. Discovering Statistics Using R. Publisher: SAGE Publications Ltd. ISBN-13: 978-1446200469	2012
2.	Scott Murray, Interactive Data Visualization for the Web. O'Reilly.	2013
3.	Nathan Yau, Visualize This: The FlowingData Guide to Design, Visualization and Statistics, John Wiley & Sons.	2011

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1.	https://www.coursera.org/learn/data-analyze-visualize	coursera
2.	https://nptel.ac.in/courses/106107220	NPTEL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	3	1	1	3	-	-	-	-	-	-	-	3	1	2
CO2	3	2	3	3	1	2	1	-	-	-	-	-	2	3	2
CO3	1	1	2	3	3	3	-	-	1	-	-	1	1	3	3
CO4	1	1	1	3	2	-	2	-	-	-	-	-	1	1	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Semester-V

Course Code	Course Name	L	T	P	Credits
DSN 5001	Data Acquisition and Information Retrieval	3	0	2	4
DSN 5002	Analytical Tools for Data Science	3	0	2	4
DSN 5003	Software Engineering	3	0	2	4
DSN 5004	Internet of Things	3	0	2	4
DSP 5101	Minor Project	0	0	8	4
Total					**20**

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Data Acquisition and Information Retrieval**
Course Code	**:**	**DSN 5001**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able - • Recognize and classify various data structures and types for effective information retrieval. • Apply basic query languages and normalization techniques to optimize data for retrieval. • Understand web data acquisition fundamentals such as web crawling and indexing for information retrieval. • Acquire skills in data preprocessing and attribute modification for information extraction. • Assess information retrieval models and metrics to enhance data retrieval effectiveness.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Introduction to Data and Information:** Concepts and distinctions between data and information. **Data Types and Structures:** Overview of various data types (bits, strings, dates) and simple structures **Basics of Data Abstraction:** Understanding data abstraction and its role in information handling. **Data Models Overview:** Brief explanation of Entity-relationship, network, and other basic data models applicable to information retrieval. **Data Integrity and Manipulation:** Introduction to maintaining data integrity and essential data manipulation operations.	**8**
Unit 2	**Query Languages and Normalization Techniques:** Querying Data: Introduction to basic query languages and their application in information retrieval. **Normalization Concepts**: Understanding the principles and significance of normalization in data management for information retrieval systems. **Query Optimization Basics:** Simplified strategies for basic query optimization. **Operations for IR** : Basic understanding of joins and their role in combining data sets for retrieval.	**8**
Unit 3	**Data Acquisition from the Web:** Basics of Web Data Acquisition, Exploring the basics of web data, search fundamentals, and web crawling.	**8**

	Web Characterization: Understanding the fundamental characteristics of the web environment and different web types. **Web Indexing and Link Analysis:** Introduction to web indexing, link analysis, and their relevance to data retrieval.	
Unit 4	**Information Extraction and Data Preparation:** Data Preprocessing: Fundamentals of data cleaning, handling missing data, and outlier detection in preparation for retrieval. **Attribute Modification and Conversion:** Basics of modifying attributes and converting data for information retrieval. **Introduction to Information Extraction:** Basics of extracting relevant information from various data sources.	**10**
Unit 5	**Retrieval Models and Application:** Introduction to Information Retrieval Models: Basics of different retrieval models and their application in practical contexts. **Evaluation in Information Retrieval:** Basics of assessing retrieval systems using metrics like precision, recall, accuracy, and F-measure.	**8**

List of Experiments:		**Number of Turns**
1	Explore and classify different data types like strings, numbers, and dates to understand their characteristics and usage	**2**
2	Use SQL queries to retrieve and organize data, practicing SELECT formatting and various query options.	**2**
3	Simulate web crawling and indexing, analyzing page characteristics and exploring surface, deep, and dark web components.	**2**
4	Apply cleaning methods, handle missing values, and convert data types to prepare datasets for analysis.	**2**
5	Evaluate retrieval models using Precision, Recall, and F-measure metrics to assess their performance.	**2**
6	Employ techniques like tokenization and stemming to extract and process information from web content.	**2**
7	Implement the Vector Space Model and compute TF-IDF weights to understand their role in information retrieval.	**2**

Course Outcomes:	
1	Recognize data types, query languages, and web data fundamentals in information retrieval systems.
2	Comprehend data models, extraction methods, and retrieval principles.
3	Implement data preprocessing, query optimization, and indexing strategies in retrieval simulations.
4	Assess model advantages, evaluate system metrics, and compare retrieval techniques.

5	Critically review web impact on data, analyze retrieval models, and propose system enhancements.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Book Title: "Information Retrieval: Implementing and Evaluating Search Engines" Author: Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormack Publisher: The MIT Press Publication Date: 2016	2016
2	Book Title: "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)" Author: Bing Liu Publisher: Springer Publication Date: 2006	2006
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Book Title: "Introduction to Information Retrieval" Author: Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze Publisher: Cambridge University Press Publication Date: 2008	2008
2	Book Title: "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)" Author: Bing Liu Publisher: Springer Publication Date: 2006	2006
3	Book Title: "Data Mining: Practical Machine Learning Tools and Techniques"Author: Ian H. Witten, Eibe Frank, Mark A. Hall Publisher: Morgan Kaufmann Publication Date: 2016	2016

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	Course: Professional Certificate Course in Data Analytics Link: https://ifacet.iitk.ac.in/professional-certificate-course-in-data-analytics/ By IIT Kanpur	IIT Kanpur

2	Course: Information Retrieval and Mining Massive Data Sets Link: https://www.udemy.com/course/information-retrieval-and-mining-massive-data-sets/	Udemy

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	1	2	1	-	-	1	1	1	2	2	3
CO2	3	2	2	1	2	1	-	-	-	-	-	-	2	3	1
CO3	2	2	3	2	2	-	-	-	-	-	-	-	3	2	1
CO4	3	2	2	2	3	-	-	-	1	-	-	-	1	2	1
CO5	2	1	2	3	3	-	-	1	-	-	-	-	1	2	1

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Analytical Tools for Data Science**
Course Code	**:**	**DSN 5002**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

Students should be able –

- To analyze tools and techniques for generating useful information out of the data.
- To explore the techniques of data science to structure and obtain insights from complex data.
- To apply the knowledge and skill to visualize and adopt strategies for better decision making.
- To develop queries and dashboard for different real-world problems for managing data.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	INTRODUCTION TO DATA ANALYTICS Introduction to analytics process, Types of Analytical Techniques: Descriptive, Predictive, Perspective, Social Media Analytics	**3**
Unit 2	MS EXCEL Conditional Formatting, Sparklines and Number Formats, macros, drop down lists, charting techniques, Create an Interactive Dashboard	**7**
Unit 3	POWER BI Introduction to Power BI, Power BI Desktop, Data Analysis Expressions, Data Visualization, QlikView Workbench	**8**
Unit 4	TABLEAU Introduction to Tableau, Common charts, Transformations and calculations, Interactions, Data storytelling	**8**
Unit 5	MySQL Introduction to database, SQL and MySQL, basic DDL and DML statements, joins and views, Importing-exporting and querying data, creating and manipulating documents, CRUD operation, indexing.	**8**
Unit 6	R Studio Introduction to R, Importing data, data inputting, data visualization, manipulating and managing data, statistical modeling, R and database.	**8**

Total no. of turns: 14

List of Experiments:		Number of Turns
1	Create table and perform operations with formula and functions, create charts through Excel.	2
2	Analyze the data from a real world application through PowerBI.	2
3	Perform data blending, data collaboration through Tableau on social media data.	2
4	Create MySQL database and apply CRUD operations.	2
5	Manage and handle MySQL database and apply CRUD operations	2
6	Perform data manipulation using R.	2
7	Perform visualization and statistical modelling using R.	2

Course Outcomes: At the end of the course, students will be able to:	
1	Understand and handle data through various analytical data science tools.
2	Analyze various techniques to perform data analytics.
3	Prepare queries to retrieve data, create and manipulate documents and perform indexing.
4	Develop dashboard for different real-world problems for managing data.

Text Book:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication / Reprint
1	Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer.	2007
Reference Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication / Reprint
1	EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analysing, Visualizing and Presenting Data", Wiley publishers.	2015
2	Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization, O’Reilly.	2016
3	Communicating Data with Tableau: Designing, Developing, and Delivering Data Visualizations, Jones, O′Reilly publisher	2014

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	Introduction to Data Analytics, https://nptel.ac.in/courses/110/106/110106072/	NPTEL

2	https://www.coursera.org/learn/data-visualization	Coursera

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	2	3	2	2	-	-	-	-	1	3	1	-
CO2	2	2	2	3	2	-	-	-	-	-	-	1	2	2	-
CO3	1	-	-	1	1	-	-	-	-	1	-	1	2	1	1
CO4	2	2	2	2	-	2	2	1	1	-	-	2	3	2	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Software Engineering**
Course Code	**:**	**DSN 5003**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

- To understand the fundamental principles and concepts of software engineering, including the software development lifecycle, requirements engineering, and software project management.
- To learn and apply various software development methodologies and processes, such as Agile, Waterfall, and DevOps, in real-world software projects.
- To gain proficiency in software design and architecture, including the creation of well-structured and maintainable software systems.
- To explore software testing and quality assurance techniques, including unit testing, integration testing, and software verification and validation.
- To progress skills in developing team software, and the importance of continuous improvement and testable software.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Introduction to Software Engineering:** Overview of Software Engineering, Importance of Software Engineering, Software Development Lifecycle (SDLC), Software Process Models (Waterfall, Agile, etc.), Role of Requirements Engineering, Project Management in Software Development	**8**
Unit 2	**Software Development Methodologies:** Agile Methodologies (Scrum, Kanban), DevOps and Continuous Integration/Continuous Deployment (CI/CD), Technical Debit, XP, TSP, MSS, Comparison of Software Development Methodologies, Selecting the Right Methodology for a Project, Software Teams	**8**
Unit 3	**Software Design and Architecture:** Software Design Principles, Object-Oriented Design (OOD), Design Patterns Architectural Patterns, Component-Based Development, Modeling and Documentation (UML)	**8**
Unit 4	**Software Testing and Quality Assurance:** Introduction to Software Testing, Types of Software Testing (Unit Testing, Integration Testing, System Testing, etc.), Test Planning and Test Cases, Test Automation, Software Verification and Validation, Quality Assurance and Quality Control	**8**
Unit 5	**Software Maintenance and Evolution:** Software Maintenance Concepts, Challenges in Legacy Systems,	**5**

	Software Refactoring, Code Smells and Anti-patterns, Software Evolution and Continuous Improvement, Software Updates and Version Control	
Unit 6	**Software Standards and Metrics:** IEEE/ISO standards, Metrics for SRS, design, coding and testing Modern trends in software engineering	**5**

List of Experiments:		**Number of Turns**
1	Requirements Elicitation and Analysis: To practice gathering and analyzing software requirements for a sample project using various techniques, such as interviews, surveys, and use cases.	**2**
2	Agile Software Development with Scrum: To simulate an Agile development environment using Scrum methodology, including sprint planning, daily stand-ups, and sprint reviews.	**2**
3	Software Design and UML Modeling: To design a small software system using UML diagrams, including class diagrams, sequence diagrams, and state diagrams etc, and to document the design.	**2**
4	Unit Testing and Test Automation: To write unit tests for a software module and automate the testing process using a testing framework (e.g., JUnit, pytest).	**2**
5	Software Version Control with Git: To learn version control concepts and use Git to manage a software project, including creating branches, merging changes, and resolving conflicts.	**2**
6	Software Maintenance and Bug Fixing: To work on a sample legacy codebase, fix bugs, and make enhancements, understanding the challenges and importance of maintenance.	**2**
7	Team software project Development	**2**

Course Outcomes:	
1	Students will demonstrate knowledge of fundamental software engineering concepts, methodologies, and principles, as well as comprehension of the different software development lifecycle models, testing strategies, and project management techniques.
2	Students will apply software development methodologies to real-world scenarios, analyze and design software systems using UML modeling, and apply design patterns to improve software architecture.
3	Students will evaluate software testing strategies, assess software quality through quality assurance and verification techniques.
4	Students will demonstrate problem-solving skills by identifying and fixing software bugs and issues, critically analyzing code for improvements, and making informed decisions in choosing appropriate methodologies for various project scenarios.
5	Students will apply their knowledge and skills to create a working software project, and

	execute experiments that involve actual software development, testing, and maintenance.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Software Engineering: A Practitioner's Approach | 9th Edition by Roger Pressman and Bruce Maxim	2023
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Software Engineering, 10/e Paperback – 24 May 2017 by Ian Sommerville	2017
2	FUNDAMENTALS OF SOFTWARE ENGINEERING, 5TH ED by Rajib Mall	2018
3	Software Testing Paperback – 8 August 2012 by Yogesh Singh	2012
4	Software Engineering Body of Knowledge (SWEBOK), IEEE	Online

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	Course Name: "IBM DevOps and Software Engineering Professional Certificate" Online Platform: Coursera Course Link: https://www.coursera.org/professional-certificates/devops-and-software-engineering Details: Develop a DevOps mindset, practice Agile philosophy & Scrum methodology - essential to succeed in the era of Cloud Native Software Engineering,	Coursera
2	Course Name: Software Engineering 101: Plan and Execute Better Software Online Platform: Udemy Course Link: https://www.udemy.com/course/software-engineering-101/	Udemy

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1	1	1	-	-	-	2	2	3
CO2	2	3	2	2	2	1	2	1	1	-	-	-	2	2	3
CO3	3	2	2	2	1	2	1	1	1	-	-	-	2	2	1
CO4	2	3	3	1	2	3	1	1	1	-	-	-	2	2	2
CO5	3	3	3	2	1	1	1	2	1	1	-	-	3	3	1

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Internet of Things**
Course Code	**:**	**DSN 5004**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

The main objectives of this course are:

- Understanding of core technology, applications, sensors used and IOT architecture along with the industry perspective.
- Design and implement real time solutions using IOT.
- To Understand Advanced concept like SDN, NFV, CPS and Industry 4.0
- To understand and Practice Integration of cloud services with IoT application

Total No. of Lecture – 42

Sr. No.	Course contents	No. of Lectures
Unit 1	**Introduction to IOT** Understanding Internet of Things, Internet of People and Services, Enabling Building blocks and Technologies, Embedded and I OT device, IoT Ecosystem (from thinking things to Distributed collective Wisdom), IoT Decision Framework, IoT Solution Architecture Models, IoT data management Framework. Challenges and Issues for IoT	**6**
Unit 2	**Setting IoT Raspberry Pi/Arduino and Introduction to Sensors** Major IoT Boards in Market, Exploring Raspberry Pi, Secure Shell (SSH) Client and Team Viewer, understanding Sensing, Actuators actions and Micro-electromechanical Systems (MEMS). **Sensors:** Types of sensors**,** Calibration, - noise modelling and characterization, noise filtering and sensor data processing. Google Maps, Waze, WhatsApp, Ola Positioning sensors: encoders and accelerometers, Image sensors: cameras Global positioning sensors: Global Positioning System (GPS), Global Navigation Satellite System (GLONASS), Indian Regional Navigation Satellite System (IRNSS), Galileo and indoor localization systems, Motion & Orientation Sensors: Accelerometer, Magnetometer, Proximity Sensor, Gyroscope	**6**
Unit 3	**IoT Networking** **IoT Network architecture and Sublayers**: Access Network, Backhaul network, Transport network and Network Management Sublayer. **Short range Communication Technologies and Protocols:** Bluetooth (Smart and Ready), 802.15.4, ZigBee, Zwave, (6LoWPAN) and Mac layer protocol	**10**

	Long Rang Communication Technologies and Protocols: WiFi 802.11 ah, Thread Low-Power Wide-Area Network (LPWAN), Cellular IoT Networks (SigFox, LoRa, LTE-M) **IoT Messaging Protocols:** Incompatibility of HTTP in IoT, Publisher Subscriber Model, MQTT and CoAP	
Unit 4	**Modern Networking for IoT and Advanced Industrial Evolution** Issues with traditional networks for IoT, Software Defined Networks (SDN) for IoT, Introduction to Network Function Virtualization (NFV) **Industrial IoT:** Cyber Physical Systems, Industrial Evolutions and Industry 4.0, Smart Factories (PLC, SCADA, MES), Web 3.0, Social Implication and Society 5.0.	**8**
Unit 5	**Cloud Computing and Security issues in IoT** Introduction to GCP, AWS, Microsoft Azure, IoT Integration of IoT services with the cloud, IoT Data Analytics, SDN based Claud Computing. Security Issues: Security Requirement analysis for IoT network, devices and applications, Security services for IoT communication, Issue of Privacy, User and Location privacy preservation, Privacy Vs Personalization.	**6**
Unit 6	**Futuristic IoT Application** Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Agriculture, Smart Homes, Wearables, Smart Grids, Connected Car, Connected digital health, Telemedicine), smart retail etc.	**6**

List of Experiments		**No. of Hours**
1.	Project based lab work: Design and build systems that will use sensors, communication protocols and actuators	**16**
2.	To learn Connecting Raspberry Pi with remote desktop using VNC client	**2**
3.	To basics of learn Microsoft Azure platform	**2**
4.	To Create IoT hub, cloud data store and stream analytical function on Azure	**4**
5	Connecting and passing data to azure IoT hub from raspberry pi client	**4**

Course Outcomes:

At the end of the course, students will be able to:	
1.	Understand the concept of IoT
2.	Study IoT architecture and Networking fundamentals

3.	Study the Cloud application and security/privacy issues in IoT.
4.	Understand various applications of sensor in Industrial, healthcare, commercial, andbuilding automation.

Text Book:

Sr. No.	Book Detail	Year of Publication
1.	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", VPT, 1st Edition-	2014 (Text Book

Reference Books:

Sr. No.	Book Detail	Year of Publication
1.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, 1st Edition	2013 (reference Book)
2.	CunoPfister, "Getting Started with the Internet of Things", OReilly Media	2011(reference Book)
3.	Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing	2015 (reference Book)

Equivalent MOOCs Courses:

Sr No	Course Link	Offered by
1	https://www.coursera.org/specializations/iot	Coursera
2	https://www.edx.org/course/introduction-to-the-internet-of-things-iot	EDX

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	1	-	-	-	-	-	1	3	2	1
CO2	2	1	1	-	1	1	-	-	-	-	-	1	3	2	1
CO3	2	1	1	1	1	2	1	-	1	-	-	1	3	3	2
CO4	2	2	1	1	1	2	2	-	1	1	-	2	2	3	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Semester-VI

Course Code	Course Name	L	T	P	Credits
DSN 6001	Internship Part – I	0	0	12	6
DSN 6002	Internship Part – II	0	0	4	2
DSN 6003	Internship Part – III	0	0	8	4
	Internship Training (Optional) – Total Credits	0	0	24	12
Or					
Optional Course Work					
DSE 1001 – DSE 1005	Deptt. Elective Course-V	3	0/1	2/0	4
DSO 1001	Open Elective*	3	0	2	4
DSP 6001	Project Work	0	0	8	4
Total					**12**

*Open Elective course will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

Deptt. Elective Course-V:

Course Code	Course Name	L	T	P	Credits
DSE 1001	Web Technologies	3	0	2	4
DSE 1002	Mobile Computing and Sensor Networks	3	0	2	4
DSE 1003	Principles of Programming Languages	3	0	2	4
DSE 1004	Generative Artificial Intelligence	3	0	2	4
DSE 1005	Artificial Intelligence for Social Good	3	1	0	4

***Open Elective:**

Course Code	Course Name	L	T	P	Credits
DSO 1001	Web Technologies*	3	0	2	4

*Open Elective course will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Web Technologies**
Course Code	**:**	**DSE 1001**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
• Students should understand fundamentals of programming in Java. • Students should be able to design and develop Java programs using JDK environment. • Students should learn the basics about Client side scripts and Server side scripts. • Students should understand fundamentals of PHP.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	INTRODUCTION TO JAVA Creation of Java, importance to Internet, Java applets and applications, security, portability, Java's Byte code. Understanding the java programs, compiling the program, control statements, lexical issues, Data types in Java, Java literals, variables, scope and lifetime of variables, type conversion, declaring and using arrays	**6**
Unit 2	OPERATORS IN JAVA Arithmetic, Modulus, Assignment, Bitwise, Relational, Assignment, ternary operator, Operator precedence. Control statements, classes, garbage Collection, overloading methods, overloading constructors, using objects as parameters. Argument passing by value and by reference, returning objects, static and final keywords. Inheritance in Java using super keyword, abstract classes.	**6**
Unit 3	EXCEPTION HANDLING IN JAVA Exception types, using try and catch, multiple catch classes, nested try statement, using throw, Java Built in Exceptions, creating user defined exceptions.	**6**
Unit 4	MULTITHREADED PROGRAMMING IN JAVA Java thread model, Thread priorities, synchronization, creating thread using thread class and runnable interface, creating multiple threads, deadlocks.	**6**
Unit 5	USING AWT CONTROLS Menus, using Labels, buttons, checkboxes, Checkbox group, choice controls, using Lists, managing scrollbars, using a textField, textArea. 4 Layout manager FlowLayout, borderLayout, gridLayout, menubars, menus.	**8**
Unit 6	SCRIPTING Client side scripting -Java script, Server side scripting- Java server pages JSP application development: generating dynamic content, using scripting elements implicit JSP objects, conditional processing –	**7**

	displaying values using an expression to set an attribute, declaring variables and methods error handling and debugging sharing data between JSP pages, requests, and users passing control and date between pages – sharing session and application data, Introduction to PHP and database connectivity.	
Unit 7	CONTENT MANAGEMENT SYSTEM HTML5,CSS, Wordpress, druppal, Joomla	**3**

List of Experiments:		**Number of Turns**
1	Java program based on operators, loop, decision making statement and type casting.	**2**
2	Java program to define class, constructors and method overloading.	**2**
3	Java programs based on different types of inheritance.	**2**
4	Java programs based on interface and packages.	**2**
5	Java programs based on exception handling.	**2**
6	Java programs based on multithreading.	**2**
7	Web based project using client side scripting, server side scripting concepts and database connectivity.	**2**

Course Outcomes: At the end of the course, students will be able to:	
1	Demonstrate object-oriented design principles including encapsulation and information hiding, inheritance.
2	Write, compile and execute Java programs to solve problems.
3	Design and develop programs using client side scripting.
4	Design and develop programs using server side scripting and database connectivity.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Chris Bates,"Web Programming, building internet applications", 3rd Ed., WILEY Dreamtech.	2007
2	Patrick Naughton and Herbert Schildt, "The complete Reference Java 2" 5th Ed., TMH.	2002
Reference Books:		
Sr.	**Name of Book/ Authors/ Publisher**	**Year of Publication/**

No.		Reprint
1	Hans Bergsten , "Java Server Pages", 2nd Ed., O'Reilly.	2002
2	Dietel, Nieto, "Internet and World Wide Web – How to program", 2nd Ed., PHI.	2001
3	Joel Sklar, "Web Warrier guide to web design technologies", 3rd Ed. Cengage Learning.	2005
4	JOOMLA BIBLE,1st Edition, by RIC SHREVES, Wiley	2010
5	BEGINNING DRUPAL, 1st Edition, by Jacob Redding, Wiley	2010
6	JavaScript the complete reference, 3rd Edition, by Thomas A Powell, Fritz Schneider, McGraw-Hill	2012

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	https://www.coursera.org/specializations/java-programming	Coursera
2	https://www.coursera.org/learn/programming-with-javascript	Coursera
3	https://www.coursera.org/learn/web-applications-php	Coursera

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	1	-	-	-	-	-	1	1	1	-	-
CO2	3	2	3	3	2	-	-	-	-	-	3	1	3	2	-
CO3	3	2	3	1	2	-	-	-	-	-	3	1	3	2	-
CO4	3	2	3	3	2	-	-	-	2	-	3	1	3	2	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Mobile Computing and Sensor Networks**
Course Code	**:**	**DSE 1002**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

Students should be able -

- To Identify the key components and technologies involved in mobile computing and sensor networks.
- To Explain the principles behind wireless LAN, PAN and WAN technologies
- To Analyze and Apply mobile network and transport layer protocols
- To Evaluate the trade-offs between different sensor network architectures and protocols.
- To Assess the security measures in mobile and sensor network applications.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Wireless and Mobile Computing Fundamentals** Wireless transmission and networking, Multiple Access Technologies- CDMA, FDMA, TDMA, Cellular architecture, Frequency reuse, Channel assignment strategies, Spread spectrum Technologies	**8**
Unit 2	**Wireless LAN, PAN, WAN** Wireless LANs - IEEE 802.11 standards, Architecture & protocols, Infrastructure vs. Adhoc Modes, Hidden Node Problems, Wireless PANs - Bluetooth and Zigbee, Introduction to Wireless Sensors, Introduction to Vehicular Adhoc Networks Wireless WANs – 2G, 3G, 4G, 5G, 6G, Protocols for digital cellular systems such as GSM, EDGE, GPRS, UMTS	**10**
Unit 3	**Mobile Network and Transport Layer** Mobile IP, DHCP, traditional TCP, classical TCP improvements, support for mobility	**8**
Unit 4	**Ad hoc & Sensor Networks** Adhoc network routing protocols - Destination sequenced distance vector algorithm, Cluster based gateway switch routing, Ad hoc on-demand routing, Location aided routing, Zonal routing algorithm. Sensor networks - fundamentals, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS	**10**
Unit 5	**Security in Wireless and Mobile Networks** Vulnerabilities, Security techniques, Wi-Fi Security, IEEE 802.11x and IEEE 802.11i standards, DoS in wireless communication	**6**

List of Experiments:	**Number**

		of Turns
1	netsh WLAN Commands for Windows 10	**3**
2	Wireshark Lab: Getting Started, Investigating the 802.11 wireless network protocol, Examining and investigating the DHCP packets, analyzing a trace of the TCP segments	**4**
3	Downloading, Installing and learning Linux operating system	**1**
4	Downloading, Installing and Learning ns3.36.1	**1**
5	Study and Run networking scripts in ns3.36.1	**5**

Course Outcomes: At the end of the course, students will be able to:	
1	Recall and Describe the core concepts and terminologies related to mobile computing and sensor networks
2	Explain the principles and components of wireless LAN, PAN and WAN technologies
3	Demonstrate and examine the ability of mobile network and transport layer protocols
4	Evaluate and compare various sensor network architectures and protocols
5	Assess the security measures in mobile and sensor network applications.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Jochen Schiller "Mobile Communications", Addison Wesley, Pearson Education, 2nd edition.	2003
2	Behrouz A. Forouzan, "Data Communication and Networking", McGraw Hill, 5th edition	2013
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Theodore S. Rappaport, "Wireless communications – principles and practice" PHI, 2nd	2010
2	Willian Stallings, "Wireless communications and networks", pearson, 2nd ed	2009
3	R. Price, "Fundamentals of Wireless networking", TMH	2012
4	T.L. Singal, "Wireless communications", MGH	2013
5	CK. Toh, "Adhoc mobile wireless networks-protocols and systems", Pearson	2015
6	Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc	2014

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	Wireless Adhoc and Sensor Networks https://archive.nptel.ac.in/courses/106/105/106105160/	NPTEL
2	Sensor Networks https://www.coursera.org/lecture/internet-of-things-history/sensor-networks-n-to-1	Coursera

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	1	1	1	2	2	1	3	3	2	3
CO2	3	1	1	1	3	1	1	1	2	2	1	3	2	3	3
CO3	3	3	3	3	3	1	1	1	2	2	1	3	3	2	2
CO4	3	3	3	3	3	1	1	1	2	2	1	3	3	2	3
CO5	3	2	2	2	3	1	1	1	2	2	1	3	2	3	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Principles of Programming Languages**
Course Code	**:**	**DSE 1003**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

- To understand the various ways to describe syntax and semantics of programming languages
- To understand data, data types, and basic statements of programming languages
- To understand parameter passing and function call mechanisms
- To understand object-orientation, concurrency, and event handling in programming languages
- To acquire knowledge about functional and logic programming paradigms

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Syntax and Semantics and Basic Statements:-**Evolution of programming languages - describing syntax & semantics - lexical analysis - parsing - recursive-decent bottom up parsing - primitive data types – strings - array types - associative arrays - record types - union types - pointers and references - Arithmetic expressions - relational and Boolean expressions - assignment statements - mixed-mode assignments - control structures - selection - iterations - branching - guarded statements.	**10**
Unit 2	**Subprograms and Implementations:-**Subprograms - design issues - local referencing - parameter passing - overloaded methods - generic methods - design issues for functions - semantics of call and return - implementing simple subprograms - stack - dynamic local variables - nested subprograms - blocks - dynamic scoping.	**8**
Unit 3	**Object-Orientation, Concurrent, and Event Driven Programming:-** Object-orientation design issues for OOP languages - implementation of object-oriented constructs - concurrency - semaphores - monitors - message passing - threads - statement level concurrency - exception handling - Event driven control - Event Handling	**8**

Unit 4	**Functional Programming**:-Introduction to lambda calculus - fundamentals of functional programming languages - Programming with Scheme -Introduction to LISP - Lists - Storage allocation for lists - Some useful functions - Error handling.	**8**
Unit 5	**Logic Programming:-**Introduction to logic and logic programming - Computing with relations - Programming with Prolog - Data structures in Prolog - Programming techniques - Control in Prolog - Cuts - multi-paradigm languages.	**8**

List of Experiments:		**Number of Turns**
1	-Simple test programs to determine type compatibility rules of a C compiler. -Simple test program to determine the scope of variables having the same name and different names declared within a while / for loop. -Program that behaves differently if name equivalence is used against structural equivalence. -Write a program to convert one form of comments in C to alternate comments form.	**4**
2	-Write a program to determine the ratio of the time required to pass a large array by reference and the time required to pass the same array by value. -Write a program that determines whether it is legal to call a function that has been passed by passing a pointer to it to another function. -Devise a subprogram and calling code in which pass-by-reference and pass-by-value-result of one or more parameters produces different results. -Design a skeletal program and a calling sequence that results in an activation record instance in which the static and dynamic links point to different activation recorded instances in the run-time stack.	**4**
3	-Chess / checkers game using object oriented programming – C++/Smalltalk / Python / Java. - Design a Tic-tac-toe game that uses even driven programming concepts.	**2**
4	-Scheme functions to compute mathematical formula, roots of a quadratic equation, count of characters in a string, set computation like,	**2**

	Union, Intersection, complementation, etc. -Lisp recursive function to return 'nth' item from a list, diagonal of a matrix, sum of the diagonal of matrix, a sub-string from a string, etc.	
5	Prolog program to find the factorial of a number, simplification of arithmetic expression involving additive, multiplicative identity, solve Sudoku puzzle, etc.	**2**

Course Outcomes: Upon completion of this course, the students will be able to:	
1	Define data types, functions, syntax and semantics of all programming languages
2	Use the various styles of programming languages for any given problem
3	Compare and use appropriate parameter passing technique for solving problems
4	Distinguish between the usage of all programming languages
5	Apply the appropriate programming language to solve real-world problems

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Robert W. Sebesta, "Concepts of Programming Languages", Tenth Edition, Addison Wesley,.	2012
2	Michael L. Scott, "Programming Language Pragmatics", Third Edition, Morgan Kaufmann.	2009
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Allen B Tucker, and Robert E Noonan, "Programming Language Principles and Paradigms", Second Edition, Tata McGraw Hill	2007
2	R. Kent Dybvig, "The Scheme Programming Language", Fourth Edition, MIT Press	2009
3	Jeffrey D. Ullman, "Elements of ML Programming", Second Edition, Prentice Hall, 1998.	1998

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	http://nptel.ac.in/course/106102067 by Prof. S. Arun Kumar "Principles of	NPTEL

	Programming Languages"IITDelhi	
2	https://www.coursera.org/learn/programming-language by Dan Grassman university of Washington	Coursera

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	0	0	0	0	0	0	0	0	0	0	1	0	0
CO2	0	0	1	1	0	2	0	0	0	0	0	0	0	2	0
CO3	0	2	0	0	3	0	0	0	2	0	0	0	2	0	0
CO4	3	0	0	0	0	0	0	0	0	1	0	1	2	0	0
CO5	1	0	3	2	0	3	0	0	0	0	0	0	0	0	0

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Generative Artificial Intelligence**
Course Code	**:**	**DSE 1004**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

Students should be able -

- To understand the fundamental concepts and techniques of Generative AI.
- To analyze and compare various generative AI models.
- To apply generative AI tools and techniques to real-world applications.
- To critically evaluate the ethical and societal implications of Generative AI.
- To develop practical skills in implementing and working with generative AI models using popular libraries and frameworks.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Foundations of Generative AI** Introduction to AI, Machine Learning, and Deep Learning; Overview of Generative AI: Concepts, applications, and challenges; Probability and Statistics for Generative AI; Backpropagation and Optimization Techniques for Generative Models	**8**
Unit 2	**Generative Modeling Techniques** Generative Adversarial Networks (GANs): Theory, architectures, and training strategies; Variational Autoencoders (VAEs): Latent space exploration, loss functions, and applications; Autoregressive Models: Recurrent Neural Networks (RNNs), Transformers, and their applications in text generation; Other Generative Models: PixelCNN, StyleGAN, VQ-VAE, and their unique capabilities	**10**
Unit 3	**Applications of Generative AI** Image generation and editing: Deepfakes, photorealistic images, and artistic style transfer; Text generation and manipulation: Machine translation, creative writing, and dialogue systems; Music generation and composition: Neural networks for creating new musical pieces and styles; Other Applications: Drug discovery, materials science, and personalized learning	**10**
Unit 4	**Ethical and Societal Implications** Bias and fairness in Generative Models; Deepfakes and misinformation; Explainability and transparency of Generative Models; Intellectual property and ownership of AI-generated content	**8**
Unit 5	**Projects on Generative AI** Introduction to popular libraries and frameworks (TensorFlow,	**6**

	PyTorch); Implementing a simple GAN for image generation; Text generation with LSTMs and Transformers; Project presentations and discussion	

List of Experiments:		**Number of Turns**
1	Explore python libraries and frameworks for implementing generative AI models.	**2**
2	Visualize how a linear regression model makes decisions by exploring its decision boundary.	**1**
3	Generate and analyze realistic MNIST digits using a basic Generative Adversarial Network (GAN).	**2**
4	Train a Variational Autoencoder (VAE) on MNIST images and explore its latent space. Manipulate the latent space to generate new and exciting variations of MNIST digits.	**2**
5	Fill in the gaps of a partially occluded image using AI magic (image inpainting).	**2**
6	Transform a photograph into a painting with AI-powered style transfer.	**1**
7	Analyze the bias of a pre-trained image classification model using fairness metrics.	**2**
8	Use a pre-trained language model like GPT-3 to generate poems, code, or scripts based on your prompts.	**2**

Course Outcomes: After completion of course, students would be able to:	
1	Apply fundamental concepts of Generative AI to analyze and compare different generative models.
2	Design and implement generative models for specific applications like image generation and text synthesis.
3	Evaluate the ethical and societal implications of Generative AI and propose mitigation strategies.
4	Independently explore and learn new advancements in the field of Generative AI.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning" (Adaptive Computation and Machine Learning series). MIT Press.	2016
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/**

		Reprint
1	David Foster, "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play". O'Reilly Media.	2023
2	Kim-Hui Yap, "Deep Learning with Generative Adversarial Networks", Apress.	2019
3	Carl Berg-Lund and Thomas Lee, "Deep Learning for Computational Physics", CRC Press.	2023

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	"Generative AI Fundamentals Specialization" https://www.coursera.org/specializations/generative-ai-for-everyone	Coursera (IBM)
2	"Generative AI for Everyone" https://www.coursera.org/learn/generative-ai-for-everyone	Coursera (Google Cloud & DeepMind)
3	"Generative AI with LLMs" https://www.deeplearning.ai/courses/generative-ai-with-llms/	DeepLearning.AI
4	"Generative AI Fundamentals with Google Cloud", https://www.udacity.com/course/generative-ai-fundamentals-for-google-cloud--cd13291	Udacity

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	2	-	2	-	-	-	-	1	-	1	3	2	1
CO2	2	-	3	-	2	-	-	-	-	1	-	1	2	2	-
CO3	1	-	1	-	-	2	-	3	-	1	-	1	1	1	2
CO4	1	-	1	-	1	1	-	2	-	1	1	2	1	2	1

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Artificial Intelligence for Social Good**
Course Code	**:**	**DSE 1005**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
Students should be able - • To identify societal challenges that can potentially be tackled by AI methods, and determine which AI methods can be applied. • To describe the AI methods covered in the course, including the basic concepts, the key algorithms, and the commonly-used implementation of the methods. • To model the societal challenges as mathematical problems. • To become familiar with successful applications of AI techniques to real-world social good problems.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**BASICS** Introduction and History of AI, Applications of AI, AI and Ethics, AI and Humans, AI and Social Work, Security and Privacy	**3**
Unit 2	**OPTIMIZATION** Convex optimization, Linear Programming (LP), Mixed Integer Linear Programming (MILP), Stochastic Optimization, Conservation Planning: Wildlife Corridor Design, Duality, Branch and Price, Maximin Model, Minimax Regret, Prevent Illegal Fishing, Influence Propagation Models, Submodular Function Optimization	**8**
Unit 3	**GAME THEORY** Minimax Theory, Nash Equilibrium, Stackelberg Equilibrium, Security Games:- Ferry Protection, Ranger Patrol Planning; Human Behavior Modeling:- Prospect Theory, Quantal Response, Cognitive Hierarchy; Mechanism Design with Money:- Auction, Truthfulness, Price-of-Anarchy; Spatio-Temporal Pricing in Ridesharing Platforms:- Scheduling and Pricing, Market equilibrium; Citizen Science	**10**
Unit 4	**MACHINE LEARNING AND DEEP LEARNING** Classification and Clustering:- Decision Trees, kmeans, Gaussian Mixture Models (GMMs); Probabilistic Graphical Models:- Dynamic Bayesian Networks (DBNs), Markov Random Fields (MRFs); Predicting Illegal Activities:- Predict	**15**

	Poaching Threat, Predict Urban Crime; Regression:- Linear Regression, Regularization, Support Vector Machines (SVMs),; Neural Networks (NNs), Convolutional NN, Faster RCNN, Deep Learning for Developing Countries	
Unit 5	**SEQUENTIAL DECISION MAKING** Sequential Decision Making Markov Decision Processes (MDPs), Partially Observable MDPs:- Online Planning, MonteCarlo Tree Search (MCTS); Online Planning, Reinforcement Learning, Invasive Species Management	**6**

Course Outcomes:	
1	Solve problems by applying AI techniques to societal challenges.
2	Describe evaluation criteria and methodologies of applying AI methods for social good
3	Propose solutions and learn to adjust and modify the AI techniques to fit the real-world social good problems.
4	Apply set of advanced AI methods to promote social good:

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Christopher Bishop, "Pattern Recognition and Machine Learning", Springer.	2006
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Noam Nisan, Tim Roughgarden, Eva Tardos, Vijay V. Vazirani, "Algorithmic Game Theory", Cambridge University Press.	2007
2	Bradley, Hax, and Magnanti, "Applied Mathematical Programming", Addison-Wesley.	1977
3	Stephen Boyd and Lieven Vandenberghe, "Convex Optimization", Cambridge University Press.	2004

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	https://www.coursera.org/specializations/ai-for-good	Coursera
2	https://onlinecourses.nptel.ac.in/noc19_ge32/preview	NPTEL

3	https://onlinecourses.nptel.ac.in/noc23_ee87/preview	NPTEL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	-	-	-	-	3	-	-	-	-	2	-	-
CO2	2	3	2	2	-	-	-	2	-	-	-	-	1	1	-
CO3	2	-	-	-	-	-	-	1	-	-	-	-	1	-	-
CO4	1	2	3	1	-	1	-	-	-	-	-	1	1	2	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Web Technologies**
Course Code	**:**	**DSO 1001**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

- Students should understand fundamentals of programming in Java.
- Students should be able to design and develop Java programs using JDK environment.
- Students should learn the basics about Client side scripts and Server side scripts.
- Students should understand fundamentals of PHP.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	INTRODUCTION TO JAVA Creation of Java, importance to Internet, Java applets and applications, security, portability, Java's Byte code. Understanding the java programs, compiling the program, control statements, lexical issues, Data types in Java, Java literals, variables, scope and lifetime of variables, type conversion, declaring and using arrays	**6**
Unit 2	OPERATORS IN JAVA Arithmetic, Modulus, Assignment, Bitwise, Relational, Assignment, ternary operator, Operator precedence. Control statements, classes, garbage Collection, overloading methods, overloading constructors, using objects as parameters. Argument passing by value and by reference, returning objects, static and final keywords. Inheritance in Java using super keyword, abstract classes.	**6**
Unit 3	EXCEPTION HANDLING IN JAVA Exception types, using try and catch, multiple catch classes, nested try statement, using throw, Java Built in Exceptions, creating user defined exceptions.	**6**
Unit 4	MULTITHREADED PROGRAMMING IN JAVA Java thread model, Thread priorities, synchronization, creating thread using thread class and runnable interface, creating multiple threads, deadlocks.	**6**
Unit 5	USING AWT CONTROLS Menus, using Labels, buttons, checkboxes, Checkbox group, choice controls, using Lists, managing scrollbars, using a textField, textArea. 4 Layout manager FlowLayout, borderLayout, gridLayout, menubars, menus.	**8**
Unit 6	SCRIPTING Client side scripting -Java script, Server side scripting- Java server pages JSP application development: generating dynamic content, using scripting elements implicit JSP objects, conditional processing – displaying values using an expression to set an attribute, declaring	**7**

	variables and methods error handling and debugging sharing data between JSP pages, requests, and users passing control and date between pages – sharing session and application data, Introduction to PHP and database connectivity.	
Unit 7	CONTENT MANAGEMENT SYSTEM HTML5,CSS, Wordpress, druppal, Joomla	**3**

List of Experiments:		**Number of Turns**
1	Java program based on operators, loop, decision making statement and type casting.	**2**
2	Java program to define class, constructors and method overloading.	**2**
3	Java programs based on different types of inheritance.	**2**
4	Java programs based on interface and packages.	**2**
5	Java programs based on exception handling.	**2**
6	Java programs based on multithreading.	**2**
7	Web based project using client side scripting, server side scripting concepts and database connectivity.	**2**

Course Outcomes: At the end of the course, students will be able to:	
1	Demonstrate object-oriented design principles including encapsulation and information hiding, inheritance.
2	Write, compile and execute Java programs to solve problems.
3	Design and develop programs using client side scripting.
4	Design and develop programs using server side scripting and database connectivity.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Chris Bates,"Web Programming, building internet applications", 3rd Ed., WILEY Dreamtech.	2007
2	Patrick Naughton and Herbert Schildt, "The complete Reference Java 2" 5th Ed., TMH.	2002
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**

1	Hans Bergsten , "Java Server Pages", 2nd Ed., O'Reilly.	2002
2	Dietel, Nieto, "Internet and World Wide Web – How to program", 2nd Ed., PHI.	2001
3	Joel Sklar, "Web Warrier guide to web design technologies", 3rd Ed. Cengage Learning.	2005
4	JOOMLA BIBLE,1st Edition, by RIC SHREVES, Wiley	2010
5	BEGINNING DRUPAL, 1st Edition, by Jacob Redding, Wiley	2010
6	JavaScript the complete reference, 3rd Edition, by Thomas A Powell, Fritz Schneider, McGraw-Hill	2012

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	https://www.coursera.org/specializations/java-programming	Coursera
2	https://www.coursera.org/learn/programming-with-javascript	Coursera
3	https://www.coursera.org/learn/web-applications-php	Coursera

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	3	1	-	-	-	-	-	1	1	1	-	-
CO2	3	2	3	3	2	-	-	-	-	-	3	1	3	2	-
CO3	3	2	3	1	2	-	-	-	-	-	3	1	3	2	-
CO4	3	2	3	3	2	-	-	-	2	-	3	1	3	2	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Semester-VII

Course Code	Course Name	L	T	P	Credits
	HSM-III/ HSM-IV				3
DSE 1006 – DSE 1013	Deptt. Elective Course-I	3	0/1	2/0	4
	Deptt. Elective Course-II	3	0/1	2/0	4
DSO 1002	Open Elective -I	3	0	2	4
DSO 1003	Open Elective-II	3	0	2	4
DSP 7001	Major Project-I	0	0	8	4
Total					**23**

Deptt. Elective Course-I / Deptt. Elective Course-II

Course Code	Course Name	L	T	P	Credits
DSE 1006	Big Data Analytics	3	0	2	4
DSE 1007	High Performance Computing	3	0	2	4
DSE 1008	Soft Computing	3	0	2	4
DSE 1009	Wireless and Mobile Networks	3	0	2	4
DSE 1010	Advances of Intelligent and Learning Agents	3	0	2	4
DSE 1011	Data and Internet Security	3	0	2	4
DSE 1012	Theory of Computation	3	1	0	4
DSE 1013	Digital Image Processing	3	0	2	4

***Open Elective-I**

Course Code	Course Name	L	T	P	Credits
DSO 1002	Computer Networks*	3	0	2	4

*Open Elective-I course will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

***Open Elective-II**

Course Code	Course Name	L	T	P	Credits
DSO 1003	Data Acquisition and Information Retrieval*	3	0	2	4

*Open Elective-II course will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Big Data Analytics**
Course Code	**:**	**DSE 1006**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives :

Students should be able –

- To analyze the data analytics life cycle, data flow and characteristics of big data.
- To explore tools and techniques required in handling large amount of datasets.
- To apply the appropriate techniques and tools to solve big data problems.
- To develop skills in students for independent research and study in big data analytics.
- To enable practice on platforms through implementation of big data problems.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Introduction to Big Data**- Traits of Big data, Challenges of Conventional Systems, Evolution of Big Data and Analytic Scalability, Statistical Concepts: Sampling Distribution, Re-Sampling, Statistical Inference, Prediction Error. **Understanding Big Data Storage**- General overview of HDFS, MapReduce and YARN, MapReduce Programming Model. **Data Analytics methods with Clustering and Classification**- Overview of *k*-means clustering, Regression Modelling, Decision Tree, Naïve Bayes Classifier, Time-series Analysis, Introduction to R.	**10**
Unit 2	**Frequent Itemsets and Mining Data Streams-** Mining Frequent Itemsets- Market Based Model, Apriori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm, Counting Frequent Itemsets in a Stream, Hierarchical and Frequent Pattern based Clustering. **Introduction to Streams Concepts-** Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream- Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real-Time Analytics Platform (RTAP) Applications, Case Studies, Real Time Sentiment Analysis,	**12**

	Stock Market Predictions. Using Graph Analytics for Big Data: Graph Analytics. **Recommendation System:** Collaborative Recommendation, Content Based, Recommendation, Knowledge Based Recommendation, Hybrid Recommendation.	
Unit 3	**NoSQL Data Management for Big Data-** NoSQL Databases, Schema-less Models, Increasing Flexibility for Data Manipulation-Key Value Stores, Document Stores, Tabular Stores, Object Data Stores, Graph Databases, Hive. Sharding, Hbase, Sharding, Review of Data Analytic Methods using R.	**10**
Unit 4	**Framework, Technologies, Tools and Visualization-** MapReduce Framework, Combiner and Partitioner, Characteristics of MapReduce, Real Time use of MapReduce, MapR, Hadoop, History and Milestones of Hadoop, Hadoop Architecture, Hadoop Cluster using commodity hardware Hive, Brief History of Hive, Data Types in Hive, Hive query writing and execution modes, NoSQL Databases- S3, Hadoop Distributed File Systems, **Big Data Visualizations-** Visual Data Analysis Techniques, Interaction Techniques, Systems and Analytics Applications, Analytics using Statistical packages, Industry, challenges and application of Analytics. **Case Studies-** Analyzing big data with twitter, Big data for E-Commerce, Big data for blogs	**10**

List of Experiments:		**Number of Turns**
1	Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.	**1**
2	Hadoop Implementation of file management tasks, such as Adding files and directories, Retrieving files and Deleting files	**1**
3	Implement of Matrix Multiplication with Hadoop Map Reduce	**1**
4	Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm	**1**
5	Implementation of K-means clustering using Map Reduce	**1**
6	Installation of Hive along with practice examples.	**1**
7	Installation of HBase, Installing thrift along with Practice examples	**2**
8	Practice importing and exporting data from various data bases .	**2**

9	Hands-on with NoSQL Databases: S3, Hadoop Distributed File System(HDFS)	**2**
10	Hands-on with Statistical Packages and Hands-on with Visual Data Analysis tools	**2**

Course Outcomes:	
1	Identify and explain the appropriate tools, techniques and methods used for big data analytics.
2	Apply and experiment statistical methods, clustering and classification algorithms, mining algorithms and recommendations system for large volumes of data.
3	Set-up and evaluate performance of analytics on data streams, NoSQL databases for societal application development.
4	Justify the role of big data platforms, frameworks and data visualization tools for analysis of large volumes of data.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press.	2012
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers	2015
2	Bart Baesens, “Analytics in a Big Data World: The Essential Guide to data Science and its Applications”, Wiley publications.	2014
3	Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons	2012

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	“Big Data Computing” by Rajiv Misra, IIT Patna Link: https://onlinecourses.nptel.ac.in/noc20_cs92/preview	NPTEL
2	“Learn Big Data: The Hadoop Ecosystem Masterclass” Link: https://www.udemy.com/course/learn-big-data-the-hadoop-ecosystem-masterclass/	UDEMY

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1	1	3	-	-	-	-	-	-	-	3	1	2
CO2	3	2	3	3	1	2	1	-	-	-	-	-	2	3	2
CO3	1	1	2	3	3	3	-	-	1	-	-	1	1	3	3
CO4	1	1	1	3	2	-	2	-	-	-	-	-	1	1	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**High Performance Computing**
Course Code	**:**	**DSE 1007**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able – • Understand High Performance Computing (HPC) system architectures and various computational models. • Learn basics of CUDA programming. • Apply parallel execution models and methodologies for parallel programming and parallel applications development. • Design and implement compute intensive applications on HPC platform.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Parallel Programming & Computing – Introduction** Modern processors, Parallel Computing, Multiprocessors and Multicomputer Architectures, Scalar VS Vector Processing, Multivector and Superscalar Machines, Pipelined Processors, SIMD Computers, Conditions of parallelism, Program flow mechanisms, Types of Parallelism – ILP, PLP, LLP, Program Partitioning and scheduling.	**8**
Unit 2	**Introduction to High Performance Computing** Scalable Parallel Computer Architectures, low-cost computing, Cluster Computing Architecture, Cluster Middleware and SSI, Need of Resource Management and Scheduling, Programming Environments.	**5**
Unit 3	**Cluster Computing AND ITS ARCHITECTURE:** Clustering Models, Clustering Architectures, Clustering Architectures key factors, types of clusters, Mission critical Vs Business Critical Applications, Fault Detection and Masking Algorithms, Check pointing, Heartbeats, Watchdog Timers, Fault recovery through Failover and Failback Concepts.	**7**
Unit 4	**High Speed Networks & Message Passing** Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing over Networks – Algorithms and Applications, Job Scheduling approaches and Resource Management in Cluster.	**7**

Unit 5	**CUDA Programming:** Introduction to CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of Shared Memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, memory management, CUDA C on multiple GPUs, Hashing and Natural Parallelism, Scheduling and Work Distribution, Atomics, Barriers and Progress, Transactional Memory	**10**
Unit 6	**Open CL Programming** Introduction to OpenCL, OpenCL Setup, Basic OpenCL, Advanced OpenCL	**3**
Unit 7	**Shared-memory programming** OpenMP: Introduction to OpenMP, Parallel Programming using OpenMP	**2**

List of Practical: **Total No. of lab turns 14**

List of Experiments		**Number of Turns**
1.	To study the basic commands of linux.	**1**
2.	To establish Beowulf Cluster using MPI (Message Passing Interface) Library.	**2**
3.	Installation and configuration of Alchemi Grid.	**1**
4.	Running a sample application on Alchemi Grid and analysing it.	**1**
5.	To study a Grid Simulation Toolkit.	**1**
6.	To run two sample programs using GridSim Toolkit.	**2**
7.	To study a Cloud Simulation Toolkit.	**1**
8.	To setup Cloud.	**1**
9.	Implement programs related to HA cluster, HP cluster, Job Scheduler.	**4**

Course Outcomes:	
1	Understand High Performance Computing (HPC) system architectures and various computational models.
2	Learn basics of CUDA programming
3	Apply parallel execution models and methodologies for parallel programming and parallel applications development.
4	Design and implement compute intensive applications on HPC platform.

Text Book:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press	2010
2	Rajkumar Buyya, High Performance Cluster Computing: Architectures and Systems, Vol. 1 Pearson Education	1999
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill International Editions	2003
2	John L. Hennessy and David A. Patterson. Computer Architecture: A Quantitative Approach (5th ed.). Elsevier India Pvt. Ltd.	**2011**
3	Vipin Kumar , Ananth Grama , Anshul Gupta , George Karypis. Introduction to Parallel Computing (2nd ed.). Pearson India.	**2003**

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1.	https://nptel.ac.in/courses/106/108/106108055/	IISC Banglore
2.	https://nptel.ac.in/courses/106105033	IIT Kharagpur
3.	https://nptel.ac.in/courses/128/106/128106014/	IIT Kanpur

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	2	2	1	2	3	2	3	-	-	-
CO2	2	2	3	2	2	2	3	2	3	2	2	2	-	-	-
CO3	2	3	3	3	2	2	3	2	2	2	2	2	-	-	-
CO4	3	3	2	2	2	3	3	2	3	3	3	3	-	-	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Soft Computing**
Course Code	**:**	**DSE 1008**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

- To understand and analyze various soft computing techniques.
- To explore and analyze how to design, train, and fine-tune different soft computing techniques using practical programming languages and tools.
- To annotate the synergy of combining different soft computing paradigms and learn how to create hybrid models to solve multidisciplinary challenges
- To evaluate the performance of different soft computing techniques.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**INTRODUCTION TO SOFT COMPUTING** Evolution of Soft computing, Soft and Hard Computing, Characteristics and Application of Soft Computing, Soft Computing Constituents	**5**
Unit 2	**NEURAL NETWORKS** Structure and working of Biological Neural Network, Fundamentals of Artificial Neural Networks & Applications, Characteristics of Artificial Neural Networks, History of neural network research, Learning Methods, Perceptron, Multilayer Neural Networks, Recurrent and Non-Recurrent Neural Networks, Advances in Neural Networks, Applications of ANN in Solving Engineering Problems	**8**
Unit 3	**INTRODUCTION TO FUZZY LOGIC** Fuzzy Logic, Fuzzy Sets, Operations on Fuzzy Sets, Membership Functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Defuzzification, Fuzzy Decision Making, Fuzzy Logic Controller Design and Applications	**8**
Unit 4	**GENETIC ALGORITHMS(GA)** Introduction to GA, GA Operators: Encoding, Crossover, Selection, Mutation, Phases of GA, Solving of Single Objective Problems, Solving of Multi Objective Optimization Problems, Applications of GA	**8**
Unit 5	**HYBRID SYSTEMS** Introduction, Architecture of a Hybrid system and its	**7**

	applications	
Unit 6	**MACHINE LEARNING** Introduction to Machine Learning, Types of Machine Learning, Machine Learning Techniques: Supervised, Unsupervised and Reinforcement learning	**6**

List of Experiments:		**Number of Turns**
1	Implement OR, AND Using Perceptron	**2**
2	Implement OR, AND, X-OR gate, Using back propagation algorithm	**2**
3	Solve a given problem-1 (Operations) using Fuzzy Logic	**2**
4	Solve a given problem-1 (Max-Min Composition) using Fuzzy Logic	**2**
5	To find the solution of the function Maximize, given the constraints using GA approach.	**2**
6	Design a hybrid system for any real-world problem	**4**

Course Outcomes:	
1	Identify and describe soft computing techniques and their roles in building intelligent machines
2	Recognize the feasibility of applying a soft computing methodology for a particular problem
3	Effectively use existing software tools to solve real problems using a soft computing approach
4	Evaluate and compare solutions by various soft computing approaches for a given problem.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Neuro fuzzy and soft computing by Jang, Pearson Education	1996
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Learning and Soft Computing by Kecman, Pearson Education	2001
2	With Case Studies and Applications from the Industry, Apress	2020
3	Neural Network in computer Intelligence by Fu, TMH	2003
4	Bio-Inspired Artificial Intelligence – Dario Floreano, PHI	2008

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	NOC:Evolutionary Computation for Single and Multi-Objective Optimization, IIT Guwahati https://nptel.ac.in/courses/112103301	Swayam
2	Neural Networks and Applications, IIT Kharagpur Prof. Somnath Sengupta	Swayam

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1	3	1	1	1	1	1	3	1	3	3	1	1
CO2	3	3	2	2	3	1	1	1	2	2	2	3	3	2	2
CO3	3	3	3	3	3	2	3	2	3	3	3	3	3	3	3
CO4	1	3	1	3	1	3	3	3	1	1	1	1	3	1	1

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Wireless and Mobile Networks**
Course Code	**:**	**DSE 1009**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

Students should be able -

- To understand the basic concepts of wireless and mobile networking
- To explore various multiple access protocols
- To analyze and compare wireless LAN and PAN
- To evaluate the performance of various wireless network generations
- To explain and compare various wireless network devices

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**INTRODUCTION** Wireless transmission – frequencies for radio transmission, regulations, signals, signal propagation – path loss of radio signals, additional signal propagation effects, multipath propagation, multiplexing and modulation, spread spectrum, mobile radio communication, cellular systems	**8**
Unit 2	**MEDIUM ACCESS CONTROL** Motivations for a specialized MAC, Hidden and exposed terminals, near and far terminals, SDMA, FDMA, TDMA – fixed TDM, classical aloha, slotted aloha, CSMA, DAMA, PRMA, reservation TDMA, MACA, polling, ISMA, CDMA	**8**
Unit 3	**WIRELESS NETWORKING** Introduction to wireless networks, overview of wireless networks, Wireless LANs – introduction, architectural comparison, characteristics, access control, IEEE 802.11 – architecture, MAC sublayer, frame format, frame types, addressing mechanism, physical layer; Bluetooth and Wireless PAN – architecture, layers, frame format.	**10**
Unit 4	**WIRELESS SYSTEMS & STANDARDS** Development of wireless networks- 1G, 2G, 3G, 4G, 5G, 6G, WiMax, IEEE 802.16, Cellular Telephony, AMPS, D-AMPS, GSM, IS-95, Satellite networks	**8**
Unit 5	**WIRELESS NETWORK DEVICES** WLAN radio components, wireless network adaptors, wireless network access points, wireless repeaters, bridges, wireless LAN switch, wireless routers and gateways, wireless LAN Antennas,	**8**

	wireless LAN planning and design, wireless network security	

List of Experiments:		**Number of Turns**
1	netsh WLAN Commands for Windows 10	**3**
2	Wireshark Lab: Getting Started; Investigating the 802.11 wireless network protocol	**3**
3	Downloading, Installing and learning Linux operating system	**1**
4	Downloading, Installing and Learning ns3.36.1	**1**
5	Study and Run various networking script in ns3.36.1	**6**

Course Outcomes: At the end of the course, students will be able to:	
1	Understand and explain various wireless transmission fundamentals
2	Develop and compare various multiple access protocols
3	Analyze and understand various wireless networking architectures
4	Evaluate and compare various wireless systems and standards
5	Discuss the working principles of various wireless networking devices

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Jochen Schiller "Mobile Communications", Addison Wesley, Pearson Education, 2nd edition.	2003
2	Behrouz A. Forouzan, "Data Communication and Networking", McGraw Hill, 5th edition	2013
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Theodore S. Rappaport, "Wireless communications – principles and practice" PHI, 2nd	2010
2	Willian Stallings, "Wireless communications and networks", pearson, 2nd ed	2009
3	R. Price, "Fundamentals of Wireless networking", TMH	2012
4	T.L. Singal, "Wireless communications", MGH	2013
5	I.S. Misra, "Wireless Communications and networks", MGH	2015

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	Introduction to Wireless and Cellular Communications, https://onlinecourses.nptel.ac.in/noc22_ee85/preview	NPTEL
2	Wireless Communications for everybody, https://www.coursera.org/learn/wireless-communications	Coursera

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	1	3	1	1	1	2	2	1	3	3	2	3
CO2	3	2	3	3	3	2	1	1	2	2	2	3	2	3	3
CO3	3	2	2	3	3	2	1	1	2	2	1	3	3	2	3
CO4	3	3	3	3	3	2	1	1	2	1	1	3	2	3	3
CO5	3	1	1	2	3	2	2	1	2	1	2	3	3	2	3

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Advances of Intelligent and Learning Agents**
Course Code	**:**	**DSE 1010**
Credits	**:**	**4**
LTP	**:**	**3 0 2**

Course Objectives:

1. This course aims to familiarize students with advanced techniques for designing and deploying intelligent and learning agents while actively involving them in research and hands-on system-building projects.
2. Students will learn how agents make decisions with rational, goal-oriented behavior using reactive agents, reinforcement learning, and AI planning methods.
3. Students will learn about the concepts of Markov Decision Problems and Temporal Difference Learning.
4. Students will learn to apply the concepts, models and algorithms in practical applications and case studies.

Total No. of Lectures- 42

Lecture Wise Breakup		**Number of Lectures**
Unit 1	**INTRODUCTION:** Models and algorithms for rational, Goal-oriented behavior in agents: Reactive agents, Reinforcement learning, Exploration-exploitation tradeoff, AI planning methods,	**6**
Unit 2	**MULTI-AGENT SYSTEMS:** Multi-agent planning, Coordination techniques for multi-agent systems, Distributed algorithms for constraint satisfaction, Models of competitive behaviour: Game theory mechanism and design	**7**
Unit 3	**MULTI-ARMED BANDITS:** Coin-tossing game; Definition of stochastic multi-armed bandit, Contextual bandits, ε-first and ε-greedy algorithms, Definition of regret, Achieving sublinear regret with GLIE sampling, Lai and Robbins's lower bound on regret, UCB, KL-UCB	**8**
Unit 4	**MARKOV DECISION PROBLEM:** Definition of Markov Decision Problem, policy and value function, Types of Markov decision process, Existence of optimal policy, MDP planning problem, Applications of MDPs, Bellman's equations, Action value function, Banach's Fixed-point Theorem, Bellman optimality operator, Proof of contraction under max norm, Temporal Difference Learning, N-step temporal difference methods	**8**
Unit 5	**EVOLUTIONARY COMPUTATION:** The Reinforcement Learning problem, applications, Coding the Double Q Learning Agent and Analyzing Performance, Prediction and control problems; Ergodic MDPs; Model-based algorithm for	**8**

	acting optimally in the limit; Monte Carlo methods for prediction, Maximum likelihood estimates and least squares estimates, PyTorch Lightning	
Unit 6	**CASE STUDIES:** Humanoid robot soccer	**5**

List of Experiments		**Number of Turns**
1.	Implement coordination techniques for multi-agent systems	**2**
2.	Implement distributed algorithms for constraint satisfaction	**2**
3.	Implement ε-first and ε-greedy algorithms	**2**
4.	Implement Markov decision process	**2**
5.	Implement Reinforcement Learning on prediction problems	**4**
6.	Implement Monte Carlo methods for prediction	**2**

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

1. Understand basic concepts, methods, techniques, and tools for the use of intelligent agents in computer-based systems.
2. Apply the principles and methods of intelligent agents to a small-scale practical problem within the framework of a term project.
3. Critically evaluate current trends in intelligent agents and their manifestation in business and industry.
4. Demonstrate proficiency in applying advanced concepts and integrating models and algorithms to solve complex problems in intelligent agent systems.

Text Book(s):

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Michael Wooldridge: An Introduction to MultiAgent Systems (2nd ed.). Wiley	2009

Reference Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Stuart Russell and Peter Norvig: Artificial Intelligence: A Modern Approach (3rd ed.)	2009
2	Regret Analysis of Stochastic and Nonstochastic Multi-armed Bandit Problems, Sébastien Bubeck and Nicolò Cesa-Bianchi, Foundations and Trends in Machine Learning, Volume 5, Number 1 (Online version)	2012
3	Algorithms for Reinforcement Learning, Csaba Szepesvári, Morgan &	2009

	Claypool	
4	Reinforcement Learning: An Introduction, Richard S. Sutton and Andrew G. Barto, 2nd edition, MIT Press,	2018
5	Artificial Intelligence: Foundations of Computational Agents: David L. Poole and Alan K. Mackworth, 2nd edition, Cambridge University Press	2017

Equivalent MOOCs courses:		
Sr. No.	**Course link**	**Offered by**
1	https://onlinecourses.nptel.ac.in/noc22_cs77/preview	NPTEL
2	https://nptel.ac.in/courses/106105237	NPTEL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	1	2	-	-	1	1	1	1	2	3	1	1
CO2	3	3	2	2	2	2	1	1	2	1	3	1	3	2	-
CO3	1	2	1	3	1	2	1	1	-	1	-	2	2	1	1
CO4	3	3	3	3	2	2	1	1	1	1	2	3	3	3	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Data and Internet Security**
Course Code	**:**	**DSE 1011**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able - • Understanding of core technology, applications, sensors used and IOT architecture along with the industry perspective. • Design and implement real time solutions using IOT. • To Understand Advanced concept like SDN, NFV, CPS and Industry 4.0 • To understand and Practice Integration of cloud services with IoT application

Course Contents **Total No. of Lectures- 42**

Lecture wise breakup		**Number of Lectures**
Unit 1	**Introduction to IOT** Understanding Internet of Things, Internet of People and Services, Enabling Building blocks and Technologies, Embedded and IOT device, IoT Ecosystem (from thinking things to Distributed collective Wisdom), IoT Decision Framework, IoT Solution Architecture Models, IoT data management Framework. Challenges and Issues for IoT	**6**
Unit 2	**Setting IoT Raspberry Pi/Arduino and Introduction to Sensors** Major IoT Boards in Market, Exploring Raspberry Pi, Secure Shell (SSH) Client and Team Viewer, understanding Sensing, Actuators actions and Micro-electromechanical Systems (MEMS). **Sensors:** Types of sensors**,** Calibration, - noise modelling and characterization, noise filtering and sensor data processing. Google Maps, Waze, WhatsApp, Ola Positioning sensors: encoders and accelerometers, Image sensors: camerasGlobal positioning sensors: Global Positioning System (GPS), Global Navigation Satellite System (GLONASS), Indian Regional Navigation Satellite System (IRNSS), Galileo and indoor localization systems, Motion & Orientation Sensors: Accelerometer, Magnetometer, ProximitySensor, Gyroscope	**6**
Unit 3	**IoT Networking** **IoT Network architecture and Sublayers**: Access Network, Backhaul network, Transport network and Network Management Sublayer. **Short range Communication Technologies and Protocols:** Bluetooth (Smart and Ready), 802.15.4, ZigBee, Zwave, (6LoWPAN) and Mac layer protocol	**10**

	Long Rang Communication Technologies and Protocols: WiFi 802.11 ah, Thread Low-Power Wide-Area Network (LPWAN), Cellular IoT Networks (SigFox, LoRa, LTE-M) **IoT Messaging Protocols:** Incompatibility of HTTP in IoT, Publisher Subscriber Model, MQTT and CoAP	
Unit 4	**Modern Networking for IoT and Advanced Industrial Evolution** Issues with traditional networks for IoT, Software Defined Networks (SDN) for IoT, Introduction to Network Function Virtualization (NFV) **Industrial IoT:** Cyber Physical Systems, Industrial Evolutions and Industry 4.0, Smart Factories (PLC, SCADA, MES), Web 3.0, Social Implication and Society 5.0.	**8**
Unit 5	**Cloud Computing and Security issues in IoT** Introduction to GCP, AWS, Microsoft Azure, IoT Integration of IoT services with the cloud, IoT Data Analytics, SDN based Claud Computing. Security Issues: Security Requirement analysis for IoT network, devices and applications, Security services for IoT communication, Issue of Privacy, User and Location privacy preservation, Privacy Vs Personalization.	**6**
Unit 6	**Futuristic IoT Application** Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Agriculture, Smart Homes, Wearables, Smart Grids, Connected Car, Connected digital health, Telemedicine), smart retail etc.	**6**

List of Expreiments		**No. of Hours**
1.	Project based lab work: Design and build systems that will use sensors, communication protocols and actuators	**16**
2.	To learn Connecting Raspberry Pi with remote desktop using VNC client	**2**
3.	To basics of learn Microsoft Azure platform	**2**
4.	To Create IoT hub, cloud data store and stream analytical function on Azure	**4**
5	Connecting and passing data to azure IoT hub from raspberry pi client	**4**

Course Outcomes: -

At the end of the course, students will be able to:	
1.	Understand the concept of IoT
2.	Study IoT architecture and Networking fundamentals
3.	Study the Cloud application and security/privacy issues in IoT.

4.	Understand various applications of sensor in Industrial, healthcare, commercial, andbuilding automation.

Text Book:

Sr. No.	Book Detail	Year of Publication
1.	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", VPT, 1st Edition-	2014 (Text Book

Reference Books:

Sr. No.	Book Detail	Year of Publication
1.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, 1st Edition	2013 (reference Book)
2.	CunoPfister, "Getting Started with the Internet of Things", OReilly Media	2011(referenc e Book)
3.	Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing	2015 (reference Book)

Equivalent MOOC Courses:

Sr No	Course Link	Offered by
1	https://www.coursera.org/specializations/iot	Coursera
2	https://www.edx.org/course/introduction-to-the-internet-of-things-iot	EDX

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	1	-	-	-	-	-	1	3	2	1
CO2	2	1	1	-	1	1	-	-	-	-	-	1	3	2	1
CO3	2	1	1	1	1	2	1	-	1	-	-	1	3	3	2
CO4	2	2	1	1	1	2	2	-	1	1	-	2	2	3	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Theory of Computation**
Course Code	**:**	**DSE 1012**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
Students should be able - • To understand fundamental mathematical and computational principles that are foundations of computer science. • To learn about abstract models of computation, finite representations for languages. • Distinguish different computing languages and classify their respective types. • To gain formal understanding of algorithms and procedures.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**AUTOMATA AND LANGUAGE THEORY** Introduction to formal proofs, Finite Automata (FA), Deterministic Finite Automata (DFA), Non-deterministic Finite Automata (NFA), Finite Automata with Epsilon transitions	**8**
Unit 2	**REGULAR EXPRESSIONS AND LANGUAGES** Regular Expression, FA and Regular Expressions, Proving languages not to be regular, Closure properties of regular languages, Equivalence and minimization of Automata	**9**
Unit 3	**CONTEXT-FREE GRAMMARS AND LANGUAGES** Context-Free Grammar (CFG), Parse Trees, Ambiguity in grammars and languages, Definition of the Pushdown automata, Languages of a Pushdown Automata, Equivalence of Pushdown automata and CFG Deterministic Pushdown Automata, Normal forms for CFG, Pumping Lemma for CFL, Closure Properties of CFL	**10**
Unit 4	**COMPUTABILITY THEORY** Turing Machines, Programming Techniques for TM, Variations of TM, Non-Universal TM, Universal TM, decidability, halting problem, reducibility.	**8**
Unit 5	**UNDECIDABALITY** Complexity classes P, NP, L, NL, PSPACE, BPP and IP, A language that is not Recursively Enumerable (RE), An undecidable problem that is RE, Undecidable problems about Turing Machine, Post's Correspondence Problem	**7**

Course Outcomes:	
1	Recognise and comprehend formal reasoning about languages
2	Express computer science problems as mathematical statements
3	Distinguish different computing languages and classify their respective types
4	Develop a competent understanding of the basic concepts of complexity theory

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computations", second Edition, Pearson Education	2007
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	H.R. Lewis and C.H. Papadimitriou,"Elements of the theory of Computation", Second Edition, Pearson Education	2003
2	Thomas A. Sudkamp," An Introduction to the Theory of Computer Science, Languages and Machines", Third Edition, Pearson Education.	2007
3	J. Martin, "Introduction to Languages and the Theory of computation" Third Edition, Tata Mc Graw Hill.	2007

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	Theory of Computation https://onlinecourses.nptel.ac.in/noc19_cs79/preview	Swayam+ IIT Kanpur
2	The complete theory of computation https://www.udemy.com/course/the-complete-theory-of-computation/	Udemy

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	1	3	1	1	-	-	-	1	3	2	1
CO2	3	3	2	2	-	2	2	1	1	-	-	-	3	3	3
CO3	3	2	3	3	1	1	1	-	-	-	-	1	2	3	1
CO4	1	2	2	3	2	2	-	-	-	-	-	-	2	3	1

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Digital Image Processing**
Course Code	**:**	**DSE 1013**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able - • To analyze the basic theory and the methods that are widely used in digital image procesing • To explore variuos methods to enhance the image in different domains using image processing • To apply the techniques of noise removal, edges detection etc • To develop hands on experience to process images in many domains.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**INTRODUCTION AND FUNDAMENTAL TO DIGITAL IMAGE PROCESSING** Origin of Digital Image Processing, Fundamental steps in Digital Image Processing, Components of Digital Image Processing System, Image sensing and acquisition, Image sampling, quantization and representation, Basic relationship between pixels.	**7**
Unit 2	**IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN & FREQUENCY DOMAIN** Basic grey level transformation, Histogram processing, Basics of Spatial filtering, Smoothing and Sharpening spatial filters, Introduction to Fourier Transform and the Frequency Domain, Discrete Fourier Transform, Smoothing and Sharpening Frequency – Domain filters.	**8**
Unit 3	**IMAGE RESTORATION** Image Degradation/Restoration Process, Noise models, restoration in presence of noise, Inverse filtering, Minimum Mean Square Filtering, Geometric menu filter, Geometric transformations.	**5**
Unit 4	**COLOR IMAGE PROCESSING** Color Fundamentals, Color models, Basis of full color image processing, Colortransformations.	**3**
Unit 5	**IMAGE COMPRESSION** Fundamentals, Image compression models, Error free	**5**

	compression, Lossy compression.	
Unit 6	**MORPHOLOGICAL IMAGE PROCESSING and IMAGE SEGMENTATION** Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.	**5**
Unit 7	**REPRESENTATION, DESCRIPTION AND RECOGNITION** Representation-chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers, Regional descriptors, topological descriptors.	**3**
Unit 8	**PATTERN RECOGNITION** Pattern and pattern classes, Recognition Based on Decision-Theoretic Methods, Structural methods	**6**

List of Experiments:		**Number of Turns**
1	Implement the basic commands/ functions of an image processing tool.	**1**
2	Take an input image and plot its histogram with various ways as imhist, bar, stem, plot and histogram processing can be used for image enhancement.	**1**
3	Various operations like scaling, Arithmatic operators etc on image . Filtering using MATLAB package	**2**
4	Filtering for Blurring and Sharpening the image in spatial and frequency domain	**2**
5	Implement various Nonlinear Spatial Filters.	**2**
6	Implement various types of filters to remove the noise in an image.	**2**
7	Implement image compression algorithms.	**2**
8	Design problems related to image segmentation	**1**
9	Design problems related to image recognition, pattern recognition	**1**

Course Outcomes:	
1	Understand the concepts of Digital image processing
2	Apply the concept of spatial and domain filtering in image processing
3	Identify the cause of image degradation and Applyy restoration methods
4	Evaluate and calculate the image compresion techniques, image segmenation

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Digital Image processing By Rafael C. Gonzalez and Richard E. Woods- Pearson Education	2006
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Digital Image Processing by A.K. Jain, PHI	1995
2	Digital Image processing (An algorithmic approach) By Madhuri A. Joshi - PHI	2006
3	Digital Image Processing And Pattern Recognition, malaya k pakhira, PHI	2011

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	https://onlinecourses.nptel.ac.in/noc22_ee116/preview IIT- khargpur (Prof. Prabir Kumar Biswas,Department Of EECE IIT Karagpur)	NPTEL
2	https://onlinecourses.nptel.ac.in/noc21_ee23/preview Prof MK Bhuyan, IIT Guwahati	NPTEL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	1	-	1	1	1	1	1	1	2	1	1	1
CO2	-	1	1	-	1	1	1	1	1	-	1	1	1	1	1
CO3	-	1	1	-	1	1	1	1	1	-	1	1	1	1	1
CO4	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Computer Networks**
Course Code	**:**	**DSO 1002**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able - • To understand the basic concepts of computer networks • To explore various applications and their protocols • To design and implement various transport layer protocols and algorithms • To analyze and develop various network layer protocols and algorithms • To evaluate the performance of various data link control protocols and algorithms

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**COMPUTER NETWORKS AND THE INTERNET** What is the Internet; network edge; network core; Delay, Loss and throughput in Packet-Switched Networks; Protocol Layers and their Service Models.	**6**
Unit 2	**APPLICATION LAYER** Principles of Network Applications; The Web and HTTP; File Transfer: FTP; Electronic Mail in the Internet; DNS - The Internet's Directory Service	**8**
Unit 3	**TRANSPORT LAYER** Introduction and Transport-Layer Services; Multiplexing and Demultiplexing; Connectionless Transport: UDP; Connection-Oriented Transport: TCP; TCP Congestion Control.	**10**
Unit 4	**NETWORK LAYER** Introduction; Virtual circuit and datagram networks; What is inside a router; Internet Protocol (IP): Forwarding and Addressing in the Internet; Routing Algorithms; Routing in the Internet	**10**
Unit 5	**DATA LINK LAYER** Introduction to the link layer; Error Detection and Correction Techniques; Multiple Access links and Protocols; Switched local area networks.	**8**

List of Experiments:		**Number of Turns**
1	Understanding and using of commands like ping, ipconfig, hostname, getmac, arp, nslookup, netstat, tracert, route,pathping	**2**
2	Socket Programming – Installing and learning Linux operating system,	**3**

	Understanding the syntax, purpose and use of various functions used in sockets programming – connect(), send(), recv(), bind(), listen(), accept(), sendto(), recvfrom() etc. functions, TCP/IP based echo client server and UDP/IP based echo client server	
3	Practicals based on Wireshark – getting started, HTTP, DNS, TCP, IP, ICMP, Ethernet & ARP, DHCP etc.	**9**

Course Outcomes: At the end of the course, students will be able to:	
1	Understand and explain various components of computer networks
2	Illustrate the various applications and protocols
3	Analyze and develop various transport layer protocols and algorithms
4	Explore and apply network layer protocols and algorithms to design and analyze the networks
5	To evaluate and compare various data link control protocols and algorithms

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	James F. Kurose and Keith W. Ross, "Computer Networking: A top down approach", Pearson Education, 6th edition.	2017
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	A.S. Tanenbaum, "Computer Networks", 5th Edition, PHI	2010
2	G. Keiser, "Local Area Networks", 2nd Edition, TMH	2002
3	D. Bertesekas and R. Gallager, "Data Networks", 2nd Edition, PHI	2010
4	William Stallings, "Data & Computer Communication", PHI, 6th Edition	2002
5	B.A. Forouzan, "Data communications and networking", TMH, 1st ed	2000
6	B.A. Forouzan, "Local Area Networks", TMH.	2001
7	B.A. Forouzan, "TCP/IP Protocol Suite", TMH	2005

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	Computer Networks, https://onlinecourses.swayam2.ac.in/cec19_cs07/preview	Swayam

2	Computer Networks and Internet Protocol, https://onlinecourses.nptel.ac.in/noc20_cs23/preview	NPTEL

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	2	2	1	1	1	1	2	3	3	2	2
CO2	2	2	1	2	3	3	2	1	1	2	-	3	3	2	2
CO3	2	3	3	3	3	2	2	1	1	2	1	3	3	3	3
CO4	3	3	3	3	3	2	2	1	2	2	1	3	3	2	2
CO5	3	3	2	2	3	2	1	1	2	2	1	3	3	2	3

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Data Acquisition and Information Retrieval**
Course Code	**:**	**DSO 1003**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

Students should be able -

- Recognize and classify various data structures and types for effective information retrieval
- Apply basic query languages and normalization techniques to optimize data for retrieval.
- Understand web data acquisition fundamentals such as web crawling and indexing for information retrieval.
- Acquire skills in data preprocessing and attribute modification for information extraction.
- Assess information retrieval models and metrics to enhance data retrieval effectiveness.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lecture**
Unit 1	**Introduction to Data and Information:** Concepts and distinctions between data and information. **Data Types and Structures:** Overview of various data types (bits, strings, dates) and simple structures **Basics of Data Abstraction:** Understanding data abstraction and its role in information handling. **Data Models Overview:** Brief explanation of Entity-relationship, network, and other basic data models applicable to information retrieval. **Data Integrity and Manipulation:** Introduction to maintaining data integrity and essential data manipulation operations.	**8**
Unit 2	**Query Languages and Normalization Techniques:** Querying Data: Introduction to basic query languages and their application in information retrieval. **Normalization Concepts**: Understanding the principles and significance of normalization in data management for information retrieval systems. **Query Optimization Basics:** Simplified strategies for basic query optimization. **Operations for IR** : Basic understanding of joins and their role in combining data sets for retrieval.	**8**
Unit 3	**Data Acquisition from the Web:** Basics of Web Data Acquisition, Exploring the basics of web data, search fundamentals, and web	**8**

	crawling. **Web Characterization:** Understanding the fundamental characteristics of the web environment and different web types. **Web Indexing and Link Analysis:** Introduction to web indexing, link analysis, and their relevance to data retrieval.	
Unit 4	**Information Extraction and Data Preparation:** Data Preprocessing: Fundamentals of data cleaning, handling missing data, and outlier detection in preparation for retrieval. **Attribute Modification and Conversion:** Basics of modifying attributes and converting data for information retrieval. **Introduction to Information Extraction:** Basics of extracting relevant information from various data sources.	**10**
Unit 5	**Retrieval Models and Application:** Introduction to Information Retrieval Models: Basics of different retrieval models and their application in practical contexts. **Evaluation in Information Retrieval:** Basics of assessing retrieval systems using metrics like precision, recall, accuracy, and F-measure.	**8**

List of Experiments:		**Number of Turns**
1	Explore and classify different data types like strings, numbers, and dates to understand their characteristics and usage	**2**
2	Use SQL queries to retrieve and organize data, practicing SELECT formatting and various query options.	**2**
3	Simulate web crawling and indexing, analyzing page characteristics and exploring surface, deep, and dark web components.	**2**
4	Apply cleaning methods, handle missing values, and convert data types to prepare datasets for analysis.	**2**
5	Evaluate retrieval models using Precision, Recall, and F-measure metrics to assess their performance.	**2**
6	Employ techniques like tokenization and stemming to extract and process information from web content.	**2**
7	Implement the Vector Space Model and compute TF-IDF weights to understand their role in information retrieval.	**2**

Course Outcomes:	
1	Recognize data types, query languages, and web data fundamentals in information retrieval systems.
2	Comprehend data models, extraction methods, and retrieval principles.

3	Implement data preprocessing, query optimization, and indexing strategies in retrieval simulations.
4	Assess model advantages, evaluate system metrics, and compare retrieval techniques.
5	Critically review web impact on data, analyze retrieval models, and propose system enhancements.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Book Title: "Information Retrieval: Implementing and Evaluating Search Engines" Author: Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormack Publisher: The MIT Press Publication Date: 2016	2016
2	Book Title: "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)" Author: Bing Liu Publisher: Springer Publication Date: 2006	2006
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Book Title: "Introduction to Information Retrieval" Author: Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze Publisher: Cambridge University Press Publication Date: 2008	2008
2	Book Title: "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)" Author: Bing Liu Publisher: Springer Publication Date: 2006	2006
3	Book Title: "Data Mining: Practical Machine Learning Tools and Techniques"Author: Ian H. Witten, Eibe Frank, Mark A. Hall Publisher: Morgan Kaufmann Publication Date: 2016	2016

Equivalent MOOCs courses:

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Sr. No.	Course Links	Offered by
1	Course: Professional Certificate Course in Data Analytics Link: https://ifacet.iitk.ac.in/professional-certificate-course-in-data-analytics/ By IIT Kanpur	IIT Kanpur
2	**Course:** Information Retrieval and Mining Massive Data Sets Link: https://www.udemy.com/course/information-retrieval-and-mining-massive-data-sets/	Udemy

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	1	-	-	1	1	1	2	2	3
CO2	3	2	2	1	2	1	-	-	-	-	-	-	2	3	1
CO3	2	2	3	2	2	-	-	-	-	-	-	-	3	2	1
CO4	3	2	2	2	3	-	-	-	1	-	-	-	1	2	1
CO5	2	1	2	3	3	-	-	1	-	-	-	-	1	2	1

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Semester-VIII

Course Code	Course Name	L	T	P	Credits
	HSM-IV/ HSM-III				3
DSE 1014 – DSE 1021	Deptt. Elective Course-III	3	0	2	4
	Deptt. Elective Course-IV	3	0	2	4
DSO 1004	Open Elective -III	3	0	2	4
	Proficiency	0	0	4	2
DSP 8001	Major Project-II	0	0	8	4
Total					**21**

Deptt. Elective Course-III / Deptt. Elective Course-IV

Course Code	Course Name	L	T	P	Credits
DSE 1014	Computer Vision	3	0	2	4
DSE 1015	Bioinformatics	3	0	2	4
DSE 1016	Information Retrieval and Recommendation Systems	3	0	2	4
DSE 1017	Pattern Recognition	3	0	2	4
DSE 1018	Web Information Retrieval and Crawling	3	0	2	4
DSE 1019	Introduction to Information Science	3	0	2	4
DSE 1020	Architectures for Management of Large Data Sets	3	0	2	4
DSE 1021	Blockchain Technology	3	0	2	4

***Open Elective-III**

Course Code	Course Name	L	T	P	Credits
DSO 1004	Modern Data Base Systems*	3	0	2	4

*Open Elective-III course will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Computer Vision**
Course Code	**:**	**DSE 1014**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able - • To understand the fundamentals of computer vision • To understand depth estimation and multi camera views • To apply various feature extraction methods and perform image segmentation • To apply image classification and clustering algorithms and motion analysis real life applications

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Digital Image Formation and low-level processing** Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Histogram Processing.	**7**
Unit 2	**Depth estimation and Multi-camera views** Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.	**7**
Unit 3	**Feature Extraction** Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters.	**7**
Unit 4	**Image Segmentation** Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean- Shift, MRFs, Texture Segmentation; Object detection.	**7**
Unit 5	**Pattern Analysis** Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.	**7**
Unit 6	**Motion Analysis** Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion	**7**

	parameter estimation.	

List of Experiments:		Number of Turns
1	Learn fundamental commands in MATLAB/Python	1
2	Implement various transformations on digital images	2
3	Implement spatial filters on digital images	2
4	Implement feature extraction methods	3
5	Implement various image segmentation algorithms	3
6	Implement different clustering and classification algorithms	3

Course Outcomes:	
1	Understand the fundamentals of computer vision
2	Understand depth estimation and multi camera views
3	Apply various feature extraction methods and perform image segmentation
4	Apply image classification and clustering algorithms and motion analysis real life applications

Text Book:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Computer Vision: Algorithms and Applications, Richard Szeliski, Springer-Verlag	Latest Edition
Reference Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Digital Image processing By Rafael C. Gonzalez and Richard E. Woods- Pearson Education.	Latest Edition
2	Digital Image Processing by A.K. Jain, PHI	Latest Edtion
3	Practical Computer Vision Applications Using Deep Learning with CNNs: With Detailed Examples in Python Using TensorFlow and Kivy, Apress	Latest Edtion

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by

1	https://onlinecourses.nptel.ac.in/noc23_cs77/preview	SWAYAM
2	https://www.coursera.org/learn/computer-vision-basics	Coursera

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	-	2	3	1	-	-	-	-	-	-	-	-	-	2	-
CO4	-	2	3	1	-	-	-	-	-	-	-	-	-	-	1

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Bioinformatics**
Course Code	**:**	**DSE 1015**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
• To understand the basic concepts behind the sequence and recognize the applications of bioinformatics. • To explore and analyze different biological databases and database search methods • To apply different techniques to compare sequences • To develop modules to perform sequence alignment and gene prediction.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**INTRODUCTION** History, scope and important contributions, aims and tasks of Bioinformatics, applications of Bioinformatics, challenges and opportunities, introduction to NCBI data model, various file formats for biological sequences	**5**
Unit 2	**BIOLOGICAL DATABASES** Importance of databases, biological databases, primary sequence databases, composite sequence databases, secondary databases, nucleic and sequence databases, protein sequence databases, structure databases, bibliographic databases, specialized genomic resources, analysis packages	**6**
Unit 3	**DATABASE SEARCH METHODS** Methods for searching sequence databases like FASTA and BLAST algorithms, Statistical analysis and evaluation of BLAST results.	**6**
Unit 4	**SEQUENCE COMPARISON METHODS** Methods for comparison of two sequences, Needleman Wush and Smith Waterman algorithms. Analysis of computational complexities, merits and demerits of these algorithms, theory of scoring matrices and their use for sequence comparison	**7**
Unit 5	**SEQUENCE ALIGNMENT METHODS** Sequence analysis of biological data, significance of sequence alignment, pair wise sequence alignment methods, use of scoring matrices and gap penalties in sequence alignments, multiple sequence alignment methods, tools and applications of multiple sequence alignment	**7**
Unit 6	**SCORING MATRICES** Similarity searches-PAM and BlOSUM matrix, Dayhoff mutation	**5**

	matrix, construction of PAM and BLOSUM matrix. Differences between PAM & BLOSUM	
Unit 7	**GENE PREDICTION** Gene prediction strategies, protein prediction strategies, molecular visualization tools, phylogenetic analysis: concept of trees, phylogenetic trees and multiple alignments.	**6**

List of Experiments:		**Number of Turns**
1	Hands-on with Nucleic acid databases (NCBI, DDBJ, EMBL), Protein databases (Primary, Composite and Secondary)	**3**
2	Hands-on with Specialized Genome databases (SGD, TIGR, ACeDB), Structure databases (CATH, SCOP, PDBsum)	**3**
3	Hands-on with methods for searching sequence databases	**3**
4	Hands-on with sequence comparison and sequence alignment methods	**3**
5	Hands-on with predictive methods	**2**

Course Outcomes:	
1	Identify different biological databases and categorize them
2	Use theoretical approaches to model and analyze complex biological systems
3	Apply the knowledge of bioinformatics in the biotechnology research and industry
4	Analyze sequence and bio-molecular data

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Ghosh Z, and Mallick B, Bioinformatics – Principles and Applications, Oxford University Press	2008
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Xiong J, Essential Bioinformatics, Cambridge University Press	2006
2	Minoru Kanehesa, "Post-genome Informatics", Oxford University Press UK	2000
3	C.A. Orengo et al., "Bioinformatics- Genes, Proteins and Computers" BIOS Scientific Publishers	2003

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	BioInformatics: Algorithms and Applications By Prof. Michael Gromiha https://onlinecourses.nptel.ac.in/noc21bt06/preview	Swayam
2	Fundamentals of Bioinformatics By Dr. Vivek P J https://onlinecourses.swayam2.ac.in/cec21bt04/preview	Swayam

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	1	1	3	2	1	1	1	3	2	2	3
CO2	3	3	3	3	1	1	1	2	1	1	1	2	3	1	1
CO3	3	3	3	3	3	1	1	1	2	3	2	3	2	3	1
CO4	3	3	3	3	3	2	2	2	3	3	3	2	3	3	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Information Retrieval and Recommendation Systems**
Course Code	**:**	**DSE 1016**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives :

Students should be able -

- To learn algorithms for generation of recommendations using content-based, collaborative filtering and hybrid techniques.
- To develop and apply algorithms for generating personalized recommendations based on user-profile.
- To automate a variety of choice-making strategies for multidisciplinary contexts to obtain high-quality recommendations.
- To evaluate the effectiveness of the recommendation system.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**INTRODUCTION TO IR** Need of search and analysis techniques of massive information, Search and analysis vs. databases, Information retrieval process, Preprocessing and lexical analysis, abstract models of documents and query languages**.**	**7**
Unit 2	**INDEXING AND EVALUATION** Boolean model, Vector model, Latent Semantic Indexing, Inverse and signature files, Recall and precision, Relevance feedback and query expansion, Ranking and relevance in the web.	**7**
Unit 3	**INTRODUCTION TO RS** User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Impact of Bad Ratings, Applications of recommendation systems, Issues with recommender system, Item profiles, User profiles Discovering features of documents, pre-processing and feature extraction	**7**
Unit 4	**CONTENT-BASED FILTERING AND COLLABORATIVE FILTERING** High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization	**10**

Unit 5	**HYBRID APPROACHES AND EVALUATION** Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.	**7**
Unit 6	**Recent trends in recommender systems** Explainable RS, Cross-domain Recommendations, RS in social networks(Facebook, Twitter, LinkedIn, Instagram, Github, etc.)	**4**

List of Experiments:		**Number of Turns**
1	Program to explore non-personalized data and features	**2**
2	Program for rating conversion from normal data	**2**
3	To compute Mean Rating, Rating Count, correlation and generate recommendations	**2**
4	To compute Pearson correlation and cosine similarity for given dataset	**2**
5	Write program to that make predictions for the test item- user pair and use user-based or item-based Collaborative Filtering	**3**
6	Implementing PageRank	**1**
7	To evaluate recommendations on the basis of accuracy and other metrics on	**2**

Course Outcomes:	
1	Ability to pre-process/analyze unstructured web content
2	Explain a variety of approaches for building recommender systems
3	Design recommendation system for a particular application domain
4	Evaluate recommender systems on the basis of various metrics

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Recommender Systems: An Introduction, Cambridge University Press 1sted. Jannach D., Zanker M. and FelFering A.	2011
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**

1	Recommender Systems: The Textbook, Springer (2016), 1st ed. Charu C.Aggarwal	2016
2	Recommender Systems Handbook, Springer(2011), 1st ed. Ricci F., RokachL., Shapira D., Kantor B.P	2015
3	Recommender Systems For Learning, Springer (2013), 1st ed. Manouselis N., Drachsler H., Verbert K., Duval E.	2013

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	Recommender Systems Specialization https://www.coursera.org/specializations/recommender-systems	Coursera
2	Recommender System: Recommender System with Machine Learning https://www.udemy.com/share/108466/	Udemy

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	3	3	3	2	1	2	2	2	3	2	3	3	3
CO2	2	3	2	2	1	1	2	1	1	1	1	1	2	2	2
CO3	2	3	3	3	3	3	3	2	2	1	2	3	2	3	3
CO4	3	3	2	3	2	1	1	1	2	1	1	1	3	2	3

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Pattern Recognition**
Course Code	**:**	**DSE 1017**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
Students should be able - • To understand the components of pattern recognition and discriminant functions • To understand various pattern recognition algorithms • To apply pattern recognition algorithms for problem solving • To evaluate pattern recognition algorithms for different problems

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	Introduction, Components of Pattern Recognition System, Design Cycle, Applications, Bayes Decision theory, Discriminant Functions for the normal density, Error Bounds – Chernoff and Bhattacharya	**9**
Unit 2	Maximum Likelihood and Bayesian Parameter Estimation, Curse of Dimensionality, Principal Component Analysis, Linear Discriminant Analysis, Hidden Markov Models. Non-parametric Classification, Parzen Windows and k-nearest neighbor estimation.	**9**
Unit 3	Generalized Linear Discriminant Analysis Perceptron, Support Vector Machines. Multilayer Neural Networks, Backpropagation Algorithms, Practical techniques for improving Backpropagation. Singular Value Decomposition.	**9**
Unit 4	Nonmetric Methods: Decision Tree based classifiers, Recognition with Strings, String Matching, Edit Distance, Computational Complexity. Algorithm Independent Topics: No Free Lunch Theorem, Bias-Variance Dilemma, Jacknife and Bootstrap Methods	**9**
Units 5	Unsupervised Learning/Clustering: Similarity Measures, k-means clustering, fuzzy k-means clustering, Expectation Maximization and Gaussian Mixture Models. Nonlinear Component Analysis, Independent Component Analysis	**6**

List of Experiments:		**Number of Turns**
1	Fundamental commands in MATLAB / Scilab	**2**
2	Implement Bayes' classifier	**2**

3	Implement Principal Component Analysis	**2**
4	Implement Linear Discriminant analysis	**2**
5	Implement Hidden Markov Models	**2**
6	Implement Non-metric methods for pattern classification,	**2**
7	Implementation of Clustering algorithms k-means and fuzzy k-means	**2**

Course Outcomes:	
1	Understand the fundamentals of pattern recognition
2	Apply various methods for parameter estimation and dimensionality reduction
3	Evaluate pattern recognition algorithms on real life data
4	Design pattern recognition algorithms for real life problem solving

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Pattern Classification, Richard O. Duda, Peter E. Hart, David G. Stork, Nitin Kumar, Wiley India Pvt. Ltd.	2021
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Pattern Recognition, Konstantinos Koutroumbas and Sergios Theodoridis 4th Edition., Academic Press	Latest Edition
2	Pattern Recognition and Machine Learning, Bishop, Christopher, Springer	Latest Edition
3	Introduction to Statistical Pattern Recognition, K. Fukunaga, Academic Press	Latest Edition

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	https://nptel.ac.in/courses/117105101	NPTEL
2	https://ocw.mit.edu/courses/mas-622j-pattern-recognition-and-analysis-fall-2006/	MIT Open courseware

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**

CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	2	2	-	-	-	-	-	-	-	-	1	2	-
CO4	-	-	3	1	1	-	-	-	-	-	-	-	-	1	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Web Information Retrieval and crawling**
Course Code	**:**	**DSE 1018**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

Students should be able -

- To learn advanced and cutting edge state-of-the-art knowledge and implementation in information retrieval for WWW.
- To read and understand concept and working of various types of search engines
- To understand components, beyond the traditional textbook level.
- To conduct independent project and to equip for scholarly research in information retrieval for WWW

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**INTRODUCTION TO WORLD WIDE WEB** Various version of WWW and differences between them, Surface PIW web, hidden web, dark web. Working of WWW, World wide web and Internet, Theethos of the web	**8**
Unit 2	**SEARCH ENGINE** Working of Search engine and its components, Various types of Search engines, Web crawlers, indexer, difference between web scrapper and web crawler, Document Conversion, Storing the Documents, Detecting Duplicates, Noise Detection and Removal Search engine algorithms, keyword search and user behaviour	**8**
Unit 3	**WEB CRAWLERS** Comparative study of various open source web crawler, BeautifulSoup, Requests and Selenium, Focused web crawler, Hidden web crawler, Mobile crawler, incremental web crawler, Robots.txt, Challenges in crawling the Web	**8**
Unit 4	**FOCUSED WEB CRAWLERS** Focused web crawling techniques using soft computing techniques, Performance metrics for various type of Web crawlers, Precision, Recall, F- measure	**9**
Units 5	**RANKING** Ranking with Indexes, Abstract Model of Ranking, Inverted indexes, Information Retrieval as Classification, Social Search: Networks of People and Search Engines, User tagging, Searching within Communities, Filtering and recommending,	**9**

	Metasearch	

List of Experiments:		Number of Turns
1	To demonstrate and understand the working of various search engines	3
2	Study various open source web crawler and how to extend them as per requirements.	3
3	Implementing web crawlers using various AI techniques	4
4	Extending the crawling strategies for hidden web and mobile web crawling.	4

Course Outcomes:	
1	Demonstrate the knowledge of, web search, web crawling, dictionaries and tolerant retrieval, index construction and compression, etc.
2	Practice examples of information retrieval and open source tools, and implement example information retrieval applications
3	Practice examples of web crawling and using machine learning approaches for web crawling.
4	Demonstrate the ability to do research in information retrieval: able to read/understand current research papers and implement research group project in information retrieval.

Text Book:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication / Reprint
1	Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, *Introduction to Information Retrieval*, Cambridge University Press.	2009
Reference Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication / Reprint
1	"Information Retrieval: Implementing and Evaluating Search Engines" by Stefan Buettcher, Charles L. A. Clarke, Gordon V. Crmack, ISBN: 978-0262026512, MIT Press	2010
2	"Search Engines: Information Retrieval in Practice" by Bruce Croft, Donald Metzler, Trevor Strohman, ISBN: 978-0136072249, AddisonWesley	2019
3	"Web Information Retrieval (Data-Centric Systems and Applications)" by Stefano Ceri, Alessandro Bozzon , Marco Brambilla , & 3 More	2015

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	Search Engines for Web and Enterprise Data https://www.coursera.org/learn/search-engine	Coursera
2	Information Retreival and mining Massive Data sets https://www.udemy.com/course/information-retrieval-and-mining-massive-data-sets/	Udemy

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	2	2	1	1	1	1	1	1	1	2	3	3
CO2	2	1	3	3	3	3	3	1	1	1	3	3	1	3	3
CO3	1	2	3	2	2	1	1	1	1	1	1	1	2	3	3
CO4	2	1	3	3	3	3	3	1	1	1	3	3	1	3	3

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Introduction to Information Science**
Course Code	**:**	**DSE 1019**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

- To introduce students to the fundamental concepts and principles of information science, including the nature of information, its representation, and its role in various domains.
- To provide an overview of information systems and technologies, covering topics such as data structures, data storage, and data retrieval methods.
- To explore the ethical and legal aspects of information science, including issues related to information privacy, intellectual property, and information security.
- To develop critical thinking and problem-solving skills in the context of information science, enabling students to analyze and address real-world information-related challenges.
- To examine the impact of emerging technologies and trends on information science, including topics such as big data, artificial intelligence, and the changing landscape of information dissemination.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Fundamental Concepts of Information Science:** Introduction to Information Science, Nature of Information, Information Representation, Role of Information in Various Domains, Historical Development of Information Science	**8**
Unit 2	**Information Systems and Technologies:** Overview of Information Systems**,** Data Structures in Information Science**,** Data Storage Techniques**,** Data Retrieval Methods**,** Database Management Systems**,** Information Architecture and Organization	**8**
Unit 3	**Ethical and Legal Aspects:** Ethical Considerations in Information Science**,** Information Privacy and Data Protection**,** Intellectual Property and Copyright**,** Information Security and Cybersecurity**,** Legal Regulations and Compliance	**8**
Unit 4	**Critical Thinking and Problem-Solving:** Developing Critical Thinking Skills, Problem-Solving Strategies in Information Science, Case Studies and Real-World Scenarios, Analyzing Information-Related Challenges, Effective Communication of Information Solutions	**10**
Unit 5	**Emerging Technologies and Trends:** Introduction to Big Data and Data Analytics, Artificial Intelligence and Machine Learning in Information Science, The Changing Landscape of Information	**8**

	Dissemination, Social Media and Information Sharing, Future Directions and Innovations in Information Science	

List of Experiments:		**Number of Turns**
1	**Information Representation:** To introduce students to the fundamental concepts of information representation and its various forms.	**2**
2	**Data Structures and Storage:** To provide an overview of data structures and storage methods used in information science, including databases and file systems.	**2**
3	**Data Retrieval Techniques:** To explore various data retrieval techniques and technologies, such as SQL queries and search algorithms.	**4**
4	**Ethical and Legal Considerations in Information Science:** To investigate ethical and legal issues related to information privacy, intellectual property, and information security.	**2**
5	**Problem-Solving in Information Science:** To develop critical thinking and problem-solving skills by analyzing and addressing real-world information-related challenges.	**2**
6	**Emerging Technologies in Information Science:** To examine the impact of emerging technologies and trends, such as big data analysis, artificial intelligence, and information dissemination in the digital age.	**2**

Course Outcomes:	
1	Understand the fundamental concepts and principles of information science, including the nature of information, its representation, and its role in various domains.
2	Explain the significance of information systems and technologies, including their roles in data structures, data storage, and data retrieval methods.
3	Interpret the ethical and legal aspects of information science, recognizing issues related to information privacy, intellectual property, and information security.
4	Apply knowledge of information science to real-world scenarios, demonstrating the ability to solve practical problems related to information management and technology.
5	Evaluate the impact of emerging technologies and trends in information science, such as big data, artificial intelligence, and changes in information dissemination methods.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Book Title: Introduction to Information Science Author: David Bawden, Lyn Robinson Publisher: Facet	2012

	Edition: 1st Publication Year: 2012	
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Book Title: An Introduction to Information Science Author: Roger Flynn Publisher: CRC Press Edition: 1st Publication Year: 2020	2020

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	Course Name: " Being a researcher (in Information Science and Technology)" Online Platform: Coursera Course Link: https://www.coursera.org/learn/being-researcher	Coursera

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	-	-	-	-	1	-	1	3	3	1
CO2	3	2	2	2	1	-	-	1	-	1	-	2	2	3	2
CO3	3	2	1	2	3	-	-	-	-	-	1	1	1	2	3
CO4	2	1	1	2	2	-	-	1	-	-	1	1	2	2	1
CO5	2	1	2	1	2	-	-	1	-	-	1	-	3	1	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Architectures for Management of Large Data Sets**
Course Code	**:**	**DSE 1020**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

- Analyze and compare various architectural patterns for managing large datasets, focusing on scalability and industry applicability.
- Comprehend parallel processing models and distributed computing systems for efficient data computation in batch and stream processing.
- Differentiate between RDBMS, NoSQL databases, and storage systems like Hadoop HDFS for managing vast datasets.
- Apply data warehousing, OLAP, and machine learning pipelines for real-time decision-making and large-scale data analysis.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Introduction to Data Management Architectures:** Overview of Large Data Sets and their Characteristics, Architectural Patterns for Data Management, Scalability, Reliability, and Availability in Architectures, Introduction to Distributed Systems and Parallel Computing	**12**
Unit 2	**Database and Storage Architectures:** Relational Database Management Systems (RDBMS) vs. NoSQL Systems, Overview of Storage Architectures: SAN, NAS, and Object Storage, Distributed File Systems: Hadoop HDFS and its Architecture, Replication and Sharding in Database Architectures	**10**
Unit 3	**Processing and Computation Architectures:** Parallel Processing Models: MapReduce and its variations, In-Memory Computing Architectures: Apache Spark and Redis, Stream Processing Architectures: Apache Kafka and Stream Analytics, GPU-Accelerated Computing and High-Performance Computing (HPC) Architectures	**10**
Unit 4	Architectures for Big Data Analytics and Machine Learning: Big Data Analytics Architectures: Data Warehousing and OLAP Cubes, Machine Learning Architectures: Training and Inference Pipelines, Real-time Analytics and Real-time Decision-Making Architectures, Case Studies: Architectures in Cloud Computing Platforms	**10**

List of Experiments:		**Number of Turns**
1	Performance Evaluation of Distributed Storage: Compare Hadoop	**2**

	Distributed File System (HDFS) and object storage systems to assess their scalability and fault tolerance handling large datasets.	
2	Data Replication and Sharding Techniques: Implement data replication and sharding methods in a database system to manage growing data volumes effectively.	**2**
3	Parallel Computing with MapReduce/Spark: Develop programs using MapReduce or Apache Spark to understand parallel computing techniques in distributed architectures.	**2**
4	Machine Learning Pipeline on Large Datasets: Construct and evaluate a machine learning pipeline on distributed data, analyzing the efficiency of various algorithms.	**2**
5	Real-time Stream Processing using Kafka: Design and analyze real-time processing pipelines using Apache Kafka for stream processing architectures.	**2**
6	Data Warehousing Implementation: Implement and evaluate a data warehousing solution to manage structured and unstructured data for analytics purposes.	**2**
7	Scaling Analytics Workloads on Cloud: Explore cloud-based services to scale and manage large data analytics workloads, understanding their capabilities and limitations.	**2**

Course Outcomes:	
1	Understand the pros and cons of the traditional relational databases and need for distributed architecture for data processing of large datasets.
2	Implement map reduce programs to solve data analysis tasks.
3	Explain the need and use cases for emerging architectures such as Spark, Storm, Giraph, Hive etc. and how they differ from Apache Hadoop
4	Understand and explain distributed software architectures, runtime and storage strategies used by Apache Hadoop.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013	2013
2	V.K. Jain, Big Data and Hadoop, Khanna Book Publishing Company 2020.	2020
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication**

		/ Reprint
1	"Designing Data-Intensive Applications" by Martin Kleppmann Publisher: O'Reilly Media, Year: 2017	2017
2	"Hadoop: The Definitive Guide" by Tom White, Publisher: O'Reilly Media, Year: 2015	**2015**
3	"Distributed Systems: Principles and Paradigms" by Andrew S. Tanenbaum and Maarten Van Steen, Publisher: Pearson, Year: 2017	**2017**

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	Fundamentals of Software Architecture for Big Data by University of Colorado Boulder on Coursera Online Link: https://www.coursera.org/learn/software-architecture-for-big-data-fundamentals	Coursera
2	Fundamental Course of Data Architecture 2.0 by Dr Jose J Link: https://www.udemy.com/course/data-architecture-big-data-architecture-data-mesh-database-management/	Udemy

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	1	-	1	-	-	-	1	3	2	2
CO2	2	2	3	2	3	1	-	-	-	-	-	-	2	2	3
CO3	3	2	2	2	3	1	-	-	-	-	-	-	2	2	2
CO4	3	2	3	3	1	1	-	-	-	-	-	1	3	3	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Blockchain Technology**
Course Code	**:**	**DSE 1021**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

Students should be able –

- To analyze and understand the conceptual model of blockchain technology and its working along with fundamental knowledge of cryptocurrency.
- To explore emerging abstract models for blockchain technology and to familiarize with the functional/operational aspects of cryptocurrency eco-system.
- To apply the appropriate tools and algorithms to solve the problems and assess the security issues and safeguards related to blockchain network attacks.
- To develop skills in students for independent research and study in blockchain technology.
- To enable practice on real-time application development using blockchain with different tools.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Introduction-** Need for distributed record keeping, Modeling faults and adversaries, Fault-tolerant distributed computing, Paxos, Byzantine Generals Problem, Consensus algorithms and their scalability problems, Nakamoto's concept with Blockchain based cryptocurrency (Bitcoin). **Technical concepts of Blockchain systems-** Block, Hash pointers and Merkle tree, Digital signature, Public-key cryptography, Digital cash, Zero-knowledge systems, Public vs Private Blockchain, Permissioned model of Blockchain, Concept of Smart Contract.	**10**
Unit 2	**Bitcoin and Blockchain-** Creation of coins, Payments and double spending problem, Bitcoin scripts, Bitcoin P2P network, Transaction in Bitcoin network, Block mining, Block propagation and Block relay. **Consensus in Bitcoin-** Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW): Basic introduction, Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake (PoS), The life of a Bitcoin Miner, Mining Difficulty, Mining Pool. **Ethereum Basics**- Ethereum and Smart Contracts, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum smart contracts, Writing smart contracts using Solidity &	**12**

	JavaScript.	
Unit 3	**Security and Privacy Issues-** Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, Scalability problems, Stopping adoption, Network attacks to destroy bitcoin. **Attacks on Blockchains-** Sybil attacks, selfish mining, 51% attacks, advent of Algorand, Sharding-based consensus algorithms to prevent these attacks	**10**
Unit 4	**Blockchain Application Development and Case Studies-** Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda. **Case Studies**- Block chain in Financial Service, Supply Chain Management and Government Services	**10**

List of Experiments:		**Number of Turns**
1	Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on Cloud to run. Resources: https://github.com/hyperledger/, https://docs.docker.com/get-started/ https://console.ng.bluemix.net/docs/services/block chain/index.html	**1**
2	Create and deploy a block chain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chaincode, and perform invoke and query on your blockchain network.	**1**
3	Build blocks by using MetaMask wallet and creating Ethereum transactions.	**2**
4	Write Hello World smart contract in a higher programming language (Solidity)	**2**
5	Programming of smart contracts on Ethereum and implementation of Hyperledger Fabric.	**2**
6	Developing programs using Web3.js.	**2**
7	**Project Work:** Create an Android app with Blockchain integration for healthcare/education/business application.	**4**

Course Outcomes:	
1	Describe and explain the blockchain technology, its distributed computing, cryptographic and cryptocurrency primitives.
2	Illustrate the concept of Bitcoin, its usage and apply security features in blockchain technologies.

3	Experiment and develop blockchain-based solutions and write smart contract using Hyperledger Fabric and Ethereum frameworks.
4	Build Ethereum and other blockchain based contract for real-world project development as well as handling societal applications.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Imran Bashir, "Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing.	2nd ed., 2018
2	Josh Thompsons, "Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming", Createspace Independent Pub.	2017
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Merunas Grincalaitis, "Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols", Packt Publishing	2019
2	Anshul Kaushik, "Block Chain and Crypto Currencies", Khanna Publishing House	2018
3	Narayanan, Bonneau, Felten, Miller and Goldfeder, "Bitcoin and Cryptocurrency Technologies– A Comprehensive Introduction", Princeton University Press	2016

Equivalent MOOCs courses:

Sr. No.	**Course Links**	**Offered by**
1	"Blockchain Architecture Design and Use Cases" by Prof. Sandip Chakraborty and Dr. Praveen Jayachandran, IIT Kharagpur Link: https://nptel.ac.in/courses/106/105/106105184/	NPTEL
2	"Blockchain A-Z: Build a Blockchain" Link: https://www.udemy.com/course/build-your-blockchain-az/	UDEMY

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	3	1	1	1	-	-	-	-	-	-	-	3	1	2

CO2	3	2	2	2	3	2	-	-	-	-	-	-	2	3	2
CO3	3	1	3	3	3	-	-	-	2	-	-	-	1	3	3
CO4	1	2	1	2	3	2	3	-	2	-	-	2	1	1	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Modern Data Base Systems**
Course Code	**:**	**DSO 1004**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

- To analyze various database models and their structural components for effective data management.
- To explore advanced database design methodologies and query optimization techniques for efficient data retrieval and manipulation.
- To apply normalization principles and advanced integrity measures to ensure data consistency and optimize database performance.
- To develop an understanding of emerging trends, including NoSQL databases, in-memory storage, and spatial data handling in modern database systems.
- To enable students to evaluate and implement diverse database technologies for specific applications, encompassing performance tuning, data governance, and evolving data security measures.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**Introduction to Database Systems and Relational Model** : Introduction to Databases, Definitions and characteristics of databases, Importance and applications **Relational Database Model:** Concepts of tuples, attributes, domains, Integrity Constraints: Entity integrity, referential integrity, Keys in Relational Databases: Primary keys, candidate keys, foreign keys, ER Diagrams	**8**
Unit 2	**Database Design and Querying:** Database Design Process, Design phases and methodologies, schema design and optimization SQL and Query Optimization, Advanced SQL: Queries, subqueries, joins, views, stored procedures, Query optimization techniques and strategies	**8**
Unit 3	**Normalization and Advanced Data Integrity:** Normalization, Detailed study of 4th and 5th Normal Forms Practical applications and examples: Transactions, Concurrency Control, and Locking, ACID properties of transactions Concurrency issues, isolation levels, and locking mechanisms (e.g., Two-Phase Locking) Database Security, Authorization, and Indexing, Security models, access control, encryption, Different types of indexing	**8**

	methods	
Unit 4	**Applications and Emerging Trends :** Query Optimization and Execution, Query processing steps, cost estimation, execution plans **Emerging Trends in Databases:** In-memory databases, columnar stores, big data integration, Introduction to NoSQL, Types of NoSQL databases and their characteristics Document-based Databases and Key-Value Stores	**8**
Unit 5	**Modern Databases and Applications:** Advanced NoSQL Databases, In-depth study of specific NoSQL databases, Database Performance Tuning, Query optimization techniques Temporal Databases, Spatial and Geographic Information Systems (GIS) in Databases, Data Lakes and Data Warehousing, In-memory Databases, Time Series Databases, Multi-Modal Databases, Data Governance and Quality	**10**

List of Experiments:		**Number of Turns**
1	Database Design and Schema Development: Construct normalized database schemas adhering to 3NF principles for a given scenario to optimize structural organization and data integrity.	**2**
2	Advanced SQL Queries and Query Optimization: Create intricate SQL queries involving subqueries, joins, and aggregate functions, then optimize their performance using query plan analysis tools.	**2**
3	Concurrency Control and Locking Mechanisms: Simulate concurrent transactions, apply Two-Phase Locking (2PL), and analyze the impact of isolation levels on database operations.	**2**
4	NoSQL Implementation and Document-based Databases: Set up a document-based NoSQL database (e.g., MongoDB), create collections, insert documents, and perform basic queries to understand its structure.	**2**
5	Database Performance Optimization: Experiment with indexing strategies and query optimization techniques to enhance database performance and analyze query execution.	**2**
6	Spatial and Temporal Databases: Design databases for spatial (geographical) and temporal (time-based) data, allowing queries for spatial and temporal data storage and retrieval.	**2**
7	In-memory Databases and Emerging Trends: Implement and compare in-memory databases with traditional disk-based storage, analyzing enhanced data retrieval and manipulation in in-memory environments.	**2**

Course Outcomes:	
1	Recall and identify the fundamental components of a relational database system, including keys, integrity constraints, and basic SQL commands.
2	Explain the concepts of database normalization, demonstrating an understanding of the principles and significance in data management.
3	Apply different indexing methods and concurrency control techniques to optimize database performance and ensure data integrity in simulated scenarios.
4	Analyze and compare the advantages and disadvantages of different types of databases, such as relational, NoSQL, and in-memory databases, in diverse data management scenarios.
5	Evaluate the impact of emerging trends in database systems, such as spatial databases and temporal data handling, by critically assessing their application in real-world contexts.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Book Title: "Database System Concepts" Author: Abraham Silberschatz, Henry F. Korth, S. Sudarshan Publisher: McGraw-Hill Education Edition: 7th Edition Publication Year: 2020	2020
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Book Title: "Data Management: Databases and Organizations" Author: Richard T. Watson, Rick T. Watson Publisher: Wiley Edition: 6th Edition Publication Year: 2017 ISBN-13: 978-1119003274	2017
2	Book Title: "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence" Author: Pramod J. Sadalage, Martin Fowler Publisher: Addison-Wesley Professional Edition: 1st Edition Publication Year: 2012	2012
3	Book Title: "Database Management Systems" Author: Raghu Ramakrishnan, Johannes Gehrke	2003

	Publisher: McGraw-Hill Education Edition: 3rd Edition Publication Year: 2003	

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1	Course Name: "Database Management Essentials" Online Platform: Coursera Course Link: https://www.coursera.org/learn/database-management Details: Offered by the University of Colorado System, this course covers key concepts of database management, including relational databases, SQL, normalization, transactions, and database design.	Coursera
2	Course Name: " Fundamentals of Database Engineering" Online Platform: Udemy Course Link: https://www.udemy.com/course/database-engines-crash-course/ Details: A comprehensive course covering database systems fundamentals, ER modeling, normalization, SQL, transactions, and database design principles suitable for beginners.	Udemy

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	1	0	0	0	0	0	0	0	3	3	1
CO2	1	2	2	2	1	0	0	1	0	0	0	0	2	3	2
CO3	1	2	1	2	3	0	0	0	0	0	0	0	1	2	3
CO4	2	1	1	2	2	0	0	1	0	0	0	0	2	2	1
CO5	1	1	2	1	2	0	0	1	0	0	0	0	3	1	2

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

***Minor Specialization in Computer Science & Engineering (Data Science)**

Semester	Course Code	Course Name	L	T	P	Credits
III	DSM 1001	Python for Data Science	3	0	2	4
IV	DSM 1002	Statistical Thinking for Data Science	3	0	2	4
V	DSM 1003	Analytical Tools for Data Science	3	0	2	4
VII	DSM 1004	Minor Specialization Project-I	0	0	6	3
VIII	DSM 1005	Minor Specialization Project-II	0	0	6	3
Total						**18**

*Minor Specialization Courses and Minor Specialization Projects will not be offered to B. Tech. (CSE), B. Tech. CSE (Data Science) and B. Tech. CSE (Artificial Intelligence)

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Python for Data Science**
Course Code	**:**	**DSM 1001**
Credit	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
• Basic process of data science. • Understanding of how to manipulate and analyze uncurated datasets. • Basic statistical analysis and machine learning methods. • Visualize results effectively.

Total No. of Lecture - 42

Lecture wise breakup		**No. of Lectures**
Unit 1	**INTRODUCTION:** Introduction to data science, Data acquisition, data pre-processing and preparation, data quality, Tools for data science, significance of python for data science.	**10**
Unit 2	**PYTHON PROGRAMMING:** Python Basics, Setting up python, Python Data Structures: lists and tuples, dictionaries, sets; Jupyter, Spyder.	**08**
Unit 3	**PYTHON PROGRAMMING FUNDAMENTALS:** Conditions and Branching, Loops, Functions, Objects and Classes, reading files with open, writing files with open.	**10**
Unit 4	**PYTHON LIBRARIES FOR DATA SCIENCE:** Numpy, loading data with Pandas, working with and Saving data with Pandas, MatplotLib, Seaborn, Scikit-Learn.	**10**
Unit 5	**CASE STUDIES:** Regression, Classification.	**04**

List of Experiments:		**No. of Turns**
1.	Installing SPYDER (TOOL), Setting working Directory, Creating and saving a script file, File execution, clearing console, removing variables from environment, clearing environment, Commenting script files, Variable creation, Arithmetic and logical operators.	**1**
2.	Basics of Python, Loops, Functions, String, Exception Handling.	**1**
3.	Data Structures in Python (List, Dictionary, Tuples and Sets)	**1**
4.	File Handling by performing File manipulations- open, close, read, write, append and copy from one file to another and other related programs.	**1**

5.	Implement OOP concepts like Data hiding and Data Abstraction	**2**
6.	Create NumPy arrays from Python Data Structures, Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting. Import a CSV file and perform various Statistical and Comparison operations on rows/columns. Load an image file and do crop and flip operation using NumPy Indexing.	**2**
7.	Data Manipulation using Pandas: Pandas dataframe and dataframe related operations on Toyota Corolla dataset for Reading files, Exploratory data analysis , Data preparation and preprocessing.	**2**
8.	Data visualization on Toyoto Corolla dataset using matplotlib and seaborn libraries	**2**
9.	Case Studies on Regression: Predicting price of pre-owned cars and Case Studies on Classification: Classifying personal income	**2**

Course Outcomes:	
1	Understanding various process of data science and fundamental building blocks of python programing.
2	Developing robust applications using the features of Python programming.
3	Understanding the usage of standard and advanced Python libraries and data analysis using python tools.
4	Designing platform-independent and GUI based python applications for business problems.

Suggested Books:		**Year of Publication / Reprint**
Text Books		
1	Python Data Science Handbook: Essential Tools for Working with by Jake VanderPlas, O'Reilly Media, Inc.	Latest edition
Reference Books		
1	Python for Data Science For Dummies, Book by John Mueller and Luca Massaron, John Wiley & Sons	Latest edition
2	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, Wes McKinney, Shroff/O'Reilly.	Latest edition
3	Mastering Python for Data Science By Samir Madhavan	Latest edition

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by
1.	https://www.edx.org/course/python-for-data-science-2	Engineering services company
2.	https://courses.mooc.fi/org/uh-cs/courses/data-analysis-with-python-2023-2024	MOOC.fi

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-
CO 2	2	2	2	2	3	2	-	-	-	-	-	-	-	-	-
CO 3	3	3	2	2	3	2	-	-	-	-	-	-	2	-	-
CO 4	2	3	1	3	2	-	-	-	-	-	-	-	-	-	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Statistical Thinking for Data Science**
Course Code	**:**	**DSM 1002**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

Students should be able –

- To analyze tools and techniques for performing data sampling and distribution.
- To explore the techniques for predicting future trends from data using regression and classification.
- To apply the knowledge and skill to adopt strategies to derive insights while visualizing data.
- To develop statistical thinking in designing data collection.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	DATA EXPLORATION AND ANALYSIS Elements of Structured, Estimates of Location - Mean, Median, Mode, Outliers, Estimates of Variability- Standard Deviation, Z-Score, Frequency Table and Histograms, Correlation	**8**
Unit 2	DATA SAMPLING AND DISTRIBUTION Normalization, Sampling Data-Simple Random sampling, Stratified, Cluster Sampling, Sampling Error/Bias. Bootstraping, Central Limit Theorem, Confidence intervals, Normal distribution, Binomial distribution, Poisson distribution	**9**
Unit 3	HYPOTHESIS TESTING A/B Testing, Hypothesis Tests- null, one-way, two-way, P-value, Type 1 & 2 errors, t-tests, multiple testing, degrees of freedom, ANOVA, Chi-Square Tests, Power and Sample Size	**9**
Unit 4	REGRESSION Simple Linear Regression, Multiple Linear Regression, Confidence and Prediction Intervals, Categorical Variables, Multicollinearity, Polynomial Regression	**8**
Unit 5	CLASSIFICATION Naive Bayes, Discriminant Analysis, Logistic Regression, Evaluating Classification Models.	**8**

Total no. of turns: 14

List of Experiments:		**Number of Turns**
1	Draw correlation between the features of various datasets.	**2**
2	For a given dataset, display a chosen feature using different mean values and display the confidence interval of a chosen feature based on a sample.	**2**
3	Perform t-test on selected feature in a dataset .	**2**
4	For a given dataset create Boxplots for different groups of a feature.	**2**
5	Construct Linear Regression model for a dataset and display the error measures.	**2**
6	Apply classification algorithms such as Naive Bayes, Logistic Regression algorithm on a dataset to estimate the accuracy.	**2**
7	Apply classification algorithms on various datasets and analyse performance metrices.	**2**

Course Outcomes: At the end of the course, students will be able to:	
1	Understand various data sampling and distribution techniques.
2	Perform Hypothesis testing on datasets
3	Apply statistical tests for Regression and classification tasks.
4	Analyze the data from real world applications with statistical techniques.

Text Book:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Bruce, Peter, and Andrew Bruce. Practical statistics for data scientists: 50 essential concepts. " O'Reilly Media, Inc.".	2017
Reference Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication / Reprint**
1	Ismay, Chester, and Albert Y. Kim. Statistical Inference via Data Science: A Modern Dive into R and the Tidyverse. CRC Press.	2019
2	The Elements of Statistical Learning, by Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, Springer Series in Statistics.	2009

Equivalent MOOCs courses:

Sr. No	**Course Links**	**Offered by**

.		
1	https://www.coursera.org/learn/statistical-inference	Coursera
2	https://www.datacamp.com/community/open-courses/statistical-inference-and-data-analysis	DataCamp

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	-	2	2	2	2	-	-	-	-	1	2	2	-
CO2	-	-	1	1	1	-	-	-	-	-	-	2	2	2	1
CO3	-	2	-	2	1	-	-	-	-	-	1	1	1	1	-
CO4	2	2	3	2	2	2	2	1	1	1	-	1	2	3	-

1-Low, 2-Medium, 3-High

Semester Scheme B.Tech. CSE (DS) 1st TO 8TH SEMESTER 2023-24 ONWARDS

Course Name	**:**	**Analytical Tools for Data Science**
Course Code	**:**	**DSM 1003**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

Students should be able –

- To analyze tools and techniques for generating useful information out of the data.
- To explore the techniques of data science to structure and obtain insights from complex data.
- To apply the knowledge and skill to visualize and adopt strategies for better decision making.
- To develop queries and dashboard for different real-world problems for managing data.

Total No. of Lectures – 42

Lecture wise breakup		**No. of Lectures**
Unit 1	INTRODUCTION TO DATA ANALYTICS Introduction to analytics process, Types of Analytical Techniques: Descriptive, Predictive, Perspective, Social Media Analytics	**3**
Unit 2	MS EXCEL Conditional Formatting, Sparklines and Number Formats, macros, drop down lists, charting techniques, Create an Interactive Dashboard	**7**
Unit 3	POWER BI Introduction to Power BI, Power BI Desktop, Data Analysis Expressions, Data Visualization, QlikView Workbench	**8**
Unit 4	TABLEAU Introduction to Tableau, Common charts, Transformations and calculations, Interactions, Data storytelling	**8**
Unit 5	MySQL Introduction to database, SQL and MySQL, basic DDL and DML statements, joins and views, Importing-exporting and querying data, creating and manipulating documents, CRUD operation, indexing.	**8**
Unit 6	R Studio Introduction to R, Importing data, data inputting, data visualization, manipulating and managing data, statistical modeling, R and database.	**8**

Total no. of turns: 14

List of Experiments:		Number of Turns
1	Create table and perform operations with formula and functions, create charts through Excel.	2
2	Analyze the data from a real world application through PowerBI.	2
3	Perform data blending, data collaboration through Tableau on social media data.	2
4	Create MySQL database and apply CRUD operations.	2
5	Manage and handle MySQL database and apply CRUD operations	2
6	Perform data manipulation using R.	2
7	Perform visualization and statistical modelling using R.	2

Course Outcomes: At the end of the course, students will be able to:	
1	Understand and handle data through various analytical data science tools.
2	Analyze various techniques to perform data analytics.
3	Prepare queries to retrieve data, create and manipulate documents and perform indexing.
4	Develop dashboard for different real-world problems for managing data.

Text Book:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication / Reprint
1	Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer.	2007
Reference Books:		
Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication / Reprint
1	EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analysing, Visualizing and Presenting Data", Wiley publishers.	2015
2	Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization, O’Reilly.	2016
3	Communicating Data with Tableau: Designing, Developing, and Delivering Data Visualizations, Jones, O′Reilly publisher	2014

Equivalent MOOCs courses:

Sr. No.	Course Links	Offered by

1	Introduction to Data Analytics, https://nptel.ac.in/courses/110/106/110106072/	NPTEL
2	https://www.coursera.org/learn/data-visualization	Coursera

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	2	3	2	2	-	-	-	-	1	3	1	-
CO2	2	2	2	3	2	-	-	-	-	-	-	1	2	2	-
CO3	1	-	-	1	1	-	-	-	-	1	-	1	2	1	1
CO4	2	2	2	2	-	2	2	1	1	-	-	2	3	2	-

1-Low, 2-Medium, 3-High