RCOEM

Shri Ramdeobaba College of
Engineering and Management, Nagpur

SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR - 440013

An Autonomous College affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME & SYLLABI 2022-23

B. TECH. (COMPUTER SCIENCE & ENGINEERING) (DATA SCIENCE)

About the Department:

The Department of Computer Science & Engineering was established in 2002, is well-equipped with state-of-the-art infrastructure. The state of art infrastructure includes latest configuration desktops organized in four different laboratories.

The department hosts computers, laptops and lab with internet facility. The 24X7 network managed with Cyberoam UTM firewall, and CISCO router offers intranet and internet connectivity. The computer laboratories have high-end servers of IBM and WIPRO along with industry-standard software, viz., Oracle, NetSim, Wireshark, AIX, Robotics Platform, IOT Kit and MSDN. The department promotes high-end computing through Open Source technologies and hosts NVIDIA DGX DL Workstation.

The Department has a distinction of consistently achieving above 95% results in the final year. Students are encouraged to appear in GATE, CAT, GRE and other competitive examinations which have resulted in increasing number of students clearing these exams.

Students teams of CSE have emerged winners at the Grand Finale of 2018, 2019, 2020 and 2022 editions of Smart India Hackthoan and have been excelling at the world renowned prestigious International Collegiate Programming Contest, ACM ICPC Asia West Regional Contents since 2015.

Departmental Vision:

To continually improve the education environment, in order to develop graduates with strong academic and technical background needed to achieve distinction in the discipline. The excellence is expected in various domains like workforce, higher studies or lifelong learning. To strengthen links between industry through partnership and collaborative development works.

Department Mission:

To develop strong foundation of theory and practices of computer science amongst the students to enable them to develop into knowledgeable, responsible professionals, lifelong learners and implement the latest computing technologies for the betterment of the society.

Program Education Objectives:

1. Graduates will have strong foundation of knowledge and skills in mathematics, statistics, programming and computer science to solve problems in data science.
2. Graduates will have the ability and attitude to adapt to emerging technological changes with lifelong learning skills.
3. Graduates will demonstrate collaborative learning and spirit of team work through multidisciplinary Data Science projects ensuring ethical and moral values.
4. Graduates will demonstrate professionalism, ethical attitude, teamwork and leadership skills with lifelong learning in the career.

Programme Outcomes (POs):

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

1. Apply the concepts and practical knowledge of data science in analysis, design and development of computing systems and applications to multi-disciplinary problems.
2. Acquaint with the contemporary trends in industrial/research settings and thereby innovate novel solutions to existing problems.

Teaching Scheme for B. Tech Computer Science & Engineering (Data Science)

Semester - I

Sr. No.	Category	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Conti-nuousEvaluation	End Sem Exam	Total	
1.	BSC	CHT152	Chemistry	3	1	0	4	40	60	100	03
2.	BSC	CHP152	Chemistry Lab	0	0	3	1.5	25	25	50	-
3.	BSC	MAT152	Differential Equation, Linear Algebra, Statistics & Probability	3	0	0	3	40	60	100	03
4.	PCC	CDT101	Programming for Problem Solving	4	0	0	4	40	60	100	03
5.	PCC	CDP101	Programming for Problem Solving Lab	0	0	2	1	25	25	50	-
6.	ESC	IDT151	Creativity Innovation & Design Thinking	1	0	0	1	20	30	50	1.5
7.	ESC	CDT102	Computer Workshop	1	0	0	1	20	30	50	1.5
8.	ESC	CDP102	Computer Workshop Lab	0	0	2	1	25	25	50	-
9.	HSMC	HUT151	English	2	0	0	2	40	60	100	03
10.	HSMC	HUP151	English Lab	0	0	2	1	25	25	50	-
			TOTAL	**14**	**1**	**9**	**19.5**			**700**	

Semester - II

Sr. No.	Category	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Conti-nuousEvaluation	End Sem Exam	Total	
1.	BSC	PHT156	Semiconductor Physics	3	1	0	4	40	60	100	03
2.	BSC	PHP156	Semiconductor Physics Lab	0	0	3	1.5	25	25	50	-
3.	BSC	MAT151	Calculus	3	1	0	4	40	60	100	03
4.	BSC	MAP151	Computational Mathematics Lab	0	0	2	1	25	25	50	-
5.	ESC	CDT103	Digital Electronics	3	0	0	3	40	60	100	03
6.	ESC	CDP103	Digital Electronics Lab	0	0	2	1	25	25	50	-
7.	PCC	CDT104	Object Oriented Programming	3	0	0	3	40	60	100	03
8.	PCC	CDP104	Object Oriented Programming Lab	0	0	2	1	25	25	50	-
9.	HSMC	HUT152	Constitution of India	2	0	0	0	-	-	-	-
10.	MC	PEP151	Physical and Mental Health using Yoga/Sports	0	0	2	0	-	-	-	-
			TOTAL	**14**	**2**	**11**	**18.5**			**600**	

Semester-III

Sr. No.	Category	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	BSC	MAT272	Mathematics for Data Science	2	1	0	3	40	60	100	03 Hrs
2.	PCC	CDT201	Data Structure and Algorithms	3	0	0	3	40	60	100	03 Hrs
3.	PCC	CDP201	Data Structure and Algorithms Lab	0	0	4	2	25	25	50	-
4.	PCC	CDT202	Computer Organization and Architecture	3	0	0	3	40	60	100	03 Hrs
5.	PCC	CDP203	Advanced Object Oriented Programming Lab	0	0	4	2	25	25	50	-
6.	PCC	CDP204	Technical Skill Enhancement Lab	0	0	2	1	25	25	50	-
7.	PCC	CDP205	Statistical Programming Lab	0	0	2	1	25	25	50	-
8.	HSMC	HUT256	Indian Traditional Knowledge	2	0	0	0	-	-	-	-
9.	HSMC	HUT253	Business Communications	3	0	0	3	40	60	100	03 Hrs
10.	HSMC	HUT257	Cyber Laws & Ethics in IT	2	0	0	2	40	60	100	03 Hrs
			TOTAL	**15**	**1**	**12**	**20**			**700**	-

Semester-IV

Sr. No.	Category	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	PCC	CDT206	Artificial Intelligence	3	0	0	3	40	60	100	03 Hrs
2.	PCC	CDT207	Operating Systems	3	0	0	3	40	60	100	03 Hrs
3.	PCC	CDP207	Operating Systems Lab	0	0	4	2	25	25	50	-
4.	PCC	CDT208	Database Management Systems	3	0	0	3	40	60	100	03 Hrs
5.	PCC	CDP208	Database Management Systems Lab	0	0	4	2	25	25	50	-
6.	PCC	CDT209	Theory of Computation	3	0	0	3	40	60	100	03 Hrs
7.	PCC	CDT210	Computer Network	3	0	0	3	40	60	100	03 Hrs
8.	PCC	CDP211	Data Handling and Visualization Lab	0	0	4	2	25	25	50	-
9.	OEC		Open Elective - 1	3	0	0	3	40	60	100	03 Hrs
10.	MC	CHT252	Environmental Sciences	2	0	0	0	-	-	-	-
			TOTAL	**20**	**0**	**12**	**24**			**750**	-

	Recommended Course from MOOC
1	Model Thinking

Semester -V

Sr. No.	Category	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	PCC	CDT301	Machine Learning	3	0	0	3	40	60	100	03 Hrs
2.	PCC	CDP301	Machine Learning Lab	0	0	2	1	25	25	50	-
3.	PCC	CDT302	Information Security and Privacy	3	0	0	3	40	60	100	3Hrs
4.	PCC	CDP303	Programming Languages Lab	0	0	4	2	25	25	50	-
5.	PCC	CDT304	Compiler Design	3	0	0	3	40	60	100	03 Hrs
6.	PEC	CDT305	Program Elective - I	3	0	0	3	40	60	100	03 Hrs
7.	PEC	CDP305	Program Elective – I Lab	0	0	2	1	25	25	50	-
8.	PR	CDP306	Project Based Learning - I	0	0	6	3	25	25	50	-
9.	OEC		Open Elective-II / MOOC	3	0	0	3	40	60	100	03 Hrs
			TOTAL	**15**	**0**	**14**	**22**			**700**	-

Course Code	Program Elective – I
CDT305-1	Digital Image Processing
CDT305-2	Data Warehousing and Business Intelligence
CDT305-3	Design Patterns
CDT305-4	Health Informatics

CourseCode	Program Elective–ILab
CDP305-1	Digital Image Processing Lab
CDP305-2	Data Warehousing and Business Intelligence Lab
CDP305-3	Design Patterns Lab
CDP305-4	Health Informatics Lab

	Recommended course from MOOC
1	Android Programming

Semester-VI

Sr. No.	Category	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Conti-nuousEvaluation	End Sem Exam	Total	
1.	PCC	CDT307	Design and Analysis of Algorithm	3	0	0	3	40	60	100	3Hrs
2.	PCC	CDT308	Deep Learning - I	3	0	0	3	40	60	100	3Hrs
3.	PCC	CDP308	Deep Learning – I Lab	0	0	4	2	25	25	50	-
4.	PEC	CDT309	Program Elective - II	3	0	0	3	40	60	100	3Hrs
5.	PEC	CDP309	Program Elective – II Lab	0	0	2	1	25	25	50	-
6.	PCC	CDT310	Software Engineering and Testing Methodologies	3	0	0	3	40	60	100	3Hrs
7.	PCC	CDP310	Software Engineering and Testing MethodologiesLab	0	0	2	1	25	25	50	-
8.	PR	CDP311	Project Based Learning - II	0	0	6	3	25	25	50	-
9.	OEC		Open Elective-III / MOOC	3	0	0	3	40	60	100	3Hrs
			TOTAL	15	0	14	22			700	-

Course Code	Program Elective – II
CDT309-1	Computer Vision
CDT309-2	Natural Language Processing
CDT309-3	IOT systems and cloud
CDT309-4	Data Science for Healthcare

Course Code	Program Elective – II Lab
CDP309-1	Computer Vision Lab
CDP309-2	NaturalLanguageProcessingLab
CDP309-3	IOT systems and cloud Lab
CDP309-4	DataScienceforHealthcareLab

	Recommended course from MOOC
1	Business Analytics

Semester-VII

Sr. No.	Category	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	PCC	CDT401	Deep Learning - II	3	0	0	3	40	60	100	3Hrs
2.	PCC	CDP401	Deep Learning – II Lab	0	0	4	2	25	25	50	--
3.	PCC	CDT402	Large Scale Data Analytics	3	0	0	3	40	60	100	3Hrs
4.	PEC	CDT403	Program Elective-III	3	0	0	3	40	60	100	3Hrs
5.	PEC	CDP403	Program Elective-III Lab	0	0	2	1	25	25	50	--
6.	PEC	CDT404	Program Elective-IV	3	0	0	3	40	60	100	3Hrs
7.	PEC	CDP404	Program Elective-IV Lab	0	0	2	1	25	25	50	--
8.	OEC		Open Elective-IV / MOOC	3	0	0	3	40	60	100	3Hrs
9.	PR	CDP405	Project Based Learning – III	0	0	6	3	40	60	100	3Hrs
			TOTAL	**15**	**0**	**14**	**22**			**750**	-

Course Code	Program Elective – III	Course Code	Program Elective – IV
CDT403-1	ConvolutionalNeuralNetworksforVisualRecognition	CDT404-1	Graph Mining
CDT403-2	Recurrent Neural Networks for NLP	CDT404-2	Data Science for NLP
CDT403-3	Dockers and Kubernetes	CDT404-3	HighPerformanceComputing

Course Code	Program Elective – III Lab	Course Code	ProgramElective–IVLab
CDP403-1	ConvolutionalNeuralNetworksforVisualRecognitionLab	CDP404-1	Graph Mining Lab
CDP403-2	Recurrent Neural Networks for NLP Lab	CDP404-2	Data Science for NLP Lab H
CDP403-3	Dockers and Kubernetes Lab	CDP404-3	High Performance Computing Lab

	Recommended course from MOOC
1	Human Computer Interaction
2	Robotics

Semester – VIII

Sr. No.	Category	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	PEC	CDT406	Program Elective-V	3	0	0	3	40	60	100	3Hrs
2.	PEC	CDT407	Program Elective-VI	3	0	0	3	40	60	100	3Hrs
3.	PR	CDP408	Project Based Learning - IV	0	0	12	6	50	50	100	-
OR											
4.	PR	CDP409	Industry Internship	-	-	-	12	150	150	300	-
			TOTAL	6	0	12	12				

Course Code	Program Elective – V	Course Code	Program Elective – VI
CDT406-1	Information Retrieval	CDT407-1	Time Series Analysis
CDT406-2	Advanced Multi-Core Systems	CDT407-2	Social and Information Network Analysis
CDT406-3	Mining Massive Data Sets	CDT407-3	Biomedical Image and Signal Processing

Total Credits = 160

Honors and Minor Scheme

Honors Scheme

Sr. No.	Semester	Course Code	Course Title	Hours per Week	Credits	Maximum Marks			ESE Duration in Hou
						Continuous Evaluatio	End Sem	Total	
01	IV	CDTM41	Programming for Data Science	4	4	40	60	100	3
02	V	CDTM51	Data Handling and Visualization	4	4	40	60	100	3
03	VI	CDTM61	Databases and SQL for Data	4	4	40	60	100	3
04	VII	CDTM71	Statistical Machine Learning	4	4	40	60	100	3
05	VIII	CDTM81	Deep Learning	4	4	40	60	100	3

Note:

1. StudentcanoptforMOOCcoursesasperlistprovidedbytheDepartmentatthestartof session.
2. Selection, Completion, Examination process of MOOC course to be done during VIII sem duration only.

Minor Scheme

Sr. No.	Semester	Course Code	Course Title	Hours per Week	Credits	Maximum Marks			ESE Duration in
						Continuous	End Sem	Total	
01	IV	CSTH41	Data Science Programming Languages	4	4	40	60	100	3
02	V	CSTH51	Statistics for Data Analysis	4	4	40	60	100	3
03	VI	CSTH61	Data Engineering	4	4	40	60	100	3
04	VII	CSTH71	Embedded Machine Learning	4	4	40	60	100	3
05	VIII	CSTH81	Web Analytics	4	4	40	60	100	3

Note:

1. If any of the subjects is offered by the parent department, then with the prior permission of HOD, Data Science the student can opt for
   a. ONE/TWO Program Electives (for same/more credits) offered by Data Science OR
   b. MOOC courses (for same/more credits)
2. Studentscannotoptforanopenelectivecourseofanydepartmentswhicharealigned with the courses offered in Minors.
3. Examination of Honors and Minor shall be conducted separately.

Syllabus for Semester I, B. TECH. CSE (Data Science)

Course Code: CHT152 **Course: Chemistry**

L: 3 Hrs, T: 1 Hr, P: 0 Hr, Per Week **Total Credits: 4**

Course Outcomes:

After the successful completion of the course, students shall be able to

- Predict the properties and interactions of chemical substances by understanding their composition at the atomic level.
- Conversant in applying unique properties of nano-materials to solve challenges in our life.
- Explain the differences in the mechanical behavior of engineering materials based upon bond type, structure, composition, and processing.
- Study chemical kinetics using concepts of computational chemistry.
- Discuss how spectroscopic methods are used for qualitative and quantitative analyses.
- Analyse impurities present in the water and suggest the methodology for its removal

Syllabus:

Unit 1: Solid State Chemistry (7 Hours)

Bondings in atoms: Primary bonding: ionic, covalent, metallic. Secondary bonding: dipole-dipole, induced dipole-induced dipole, London dispersion/van der Waals, hydrogen. Shapes of molecules: hybridization, LCAO-MO, VSEPR theory.

Electronic material: Band theory: metals, insulators, and semiconductors. Band gaps, doping. Silicon wafer production.

Unit 2: Nano-material-I(7 Hours)

Basics of Nanochemistry: Defination of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challengs of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), One dimensional, Two dimensional and Three dimensional nanostructured materials, mechanical-physical-chemical properties.

Application of Nanomaterial: Molecular electronics and nanoelectronics, Nanotechnology for waste reduction and improved energy efficiency, Carbon Nanotubes for energy storage, Hydrogen Storage in Carbon Nanotubes, nanotechnology based water treatment strategies.

Unit 3: Advanced Materials: (7 hours)

Composite materials: Introduction, Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber- Reinforced Composites and Applications. **Reinforcements**: Fibres- Glass, Kevlar, Carbon, Silicon Carbide, And Born Carbide Fibres. Industrial Polymer: Thermoplastics, Thermosetting Plastics, Polymers used in electronic industries, Piezo and pyroelectric polymers, Polymers in optical media data storage devices.

Unit 4: Computational Chemistry [6 Hours]

Rate of the reaction, Order and Molecularity of the reaction, Rate expression for Zero Order, First Order and Second Order Reactions, Effect of the temperature, Use of Mathematica for determining rate of the reaction, etc.

Unit 5: Material Characterization using different Spectroscopic Techniques [7 Hours]

Fundamentals of spectroscopy, Infrared Spectroscopy, Electronic Spectrocopy, Nuclear Magnetic Resonance Spectroscopy.

Fundamentals of X-Ray Diffractions (XRD), X-Ray Fluorescence (XRF) spectroscopy.

Unit 6: Water Technology [8 Hours]

Impurities in natural water, hardness and alkalinity, Disadvantages of hardness i. e. sludge and scale formation, softening of water using lime-soda, zeolite and ion-exchange method, advantages and limitations of these water softening processes, Desalination of water using Reverse Osmosis.

Text Books:

1. J. Michael Hollas, Modern Spectroscopy, Fourth Edition, John Wiley and Sons, 2004.
2. William Kemp, Organic Spectroscopy, Third Edition, Palgrave Publication, 1991.
3. Bradley D. Fahlman, Materials Chemistry, Third Edition, Springer Nature, 2018.
4. Brian W. Pfennig, Principles of Inorganic Chemistry, John Wiley and Sons, 2015.
5. Steven S. Zumdahl, Donald J. DeCoste, Chemical Principles,Eighth Edition, Cengage Learning, 2017.
6. Catherine E. Housecroft and Edwin C. Constable, Chemistry: An Introduction to Organic, Inorganic and Physical Chemistry, Third Edition, Pearson Education Limited, 2006.
7. Michael J. Moran and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, Fifth Edition, John Wiley and Sons, 2006.
8. Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James R. Vyvyan, Introduction to Spectroscopy, Fifth Edition, Cengage Learning, 2009.
9. C. N. R. Rao, A. Muller and A. K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications, Wiley-VCH, 2004.
10. P. C. Jain and Monica Jain, Engineering Chemistry, Dhanpat Rai Publication.
11. S. S. Dara, A Textbook ofEngineering Chemistry, S. Chand Publications.
12. J. D. Lee, Concise Inorganic Chemistry, Fourth Edition, Chapman and Hall Publications.

Course Code: CHP152	**Course: Chemistry Lab**
L: 0 Hrs, T: 0 Hr, P: 3 Hr, Per Week	**Total Credits: 1.5**

Course Outcomes:

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

The students will learn to:

- Estimate the amount of different impurities in water/waste water samples.
- Estimate rate constants of reactions and order of the reaction from concentration of reactants/products as a function of time and to validate adsorption isotherms.
- Measure molecular/system properties such as surface tension, viscosity of aqueous or other industrially important liquids/mixtures etc.
- Synthesize a polymer or drug molecule or nano-material.
- Use principle of spectroscopic techniques for structural determination.

List of Experiments: [Any Eight from the List]

[1] Preparation of different Solutions: Molar solution, Normal solution and percent solution and Determination of concentration.
[2] To find out types of alkalinity and estimation of their extent in the water sample.
[3] Estimation of temporary, permanent and total hardness present in the water sample using complexometric titration method.
[4] Spectroscopic/Colorimetric determine of wavelength of maximum absorption of chemical/biological compound in solution and determination of concentration using Lambert-Beer's Law.
[5] Determination of rate of the reaction of hydrolysis of ethyl acetate at room temperature and analysis of experimental data using Computational Software.
[6] To study chemical kinetics of peroxydisulphate and iodide ions reactions and to find out order of the reaction and analysis of experimental data using Computational Software.
[7] Synthesis of Nano-material/Polymer and its study.
[8] Determination of relative and kinematic viscosities of aqueous solutions of Poly-ethylene glycol (Polymeric Liquid) using Redwood Viscometer (type I or II) at different temperatures.
[9] To study effect of bondings of water molecules with electrolyte (NaCl/KCl) and non-electrolyte solute (Soap) in the solution through Surface Tension Determination.
[10] Study of ion-exchange column for removal of hardness in the water sample.
[11] Demonstrations of organic spectral techniques: IR, NMR.
[12] Demonstration of in-organic spectral techniques: XRD, XRF.

Text Books/Reference Books:

(1) S. S. Dara, **A Textbook on Experiments and Calculations in Engineering Chemistry**, S. Chand Publications.
(2) J. B. Yadav, **Advanced Practical Physical Chemistry**, Krishna's Prakashan Media (P) Limited.
(3) A. J. Elias, **Collection of Interesting General Chemistry Experiments**, Universities Press Publications.
(4) V. K. Ahluwalia, S. Dhingra and A. Gulati, **College Practical Chemistry**, Universities Press Publications.
(5) Ashutosh Kar ,**Advanced Practical Medicinal Chemistry**, New Age International Publisher.

Syllabus for Semester I, B. TECH. CSE (Data Science)

Course Code: MAT152	**Course: Differential Equation, Linear Algebra, Statistics & Probability**
L: 3 Hrs, T: 1 Hr, P: 0 Hr, Per Week	**Total Credits: 3**

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equation, statistics, probability and Matrices. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes

On successful completion of the course, the students will learn:

1. The effective mathematical tools for the solutions of ordinary differential equations that model physical processes.
2. The essential tool of matrices incomprehensive manner.
3. The ideas of probability and various discrete and continuous probability distributions and the basic ideas of statistics including measures of central tendency, correlation and regression.

Syllabus

Module 1: First order ordinary differential equations (7 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for e, equations solvable for y, equations solvable for x and Clairaut's type.

Module 2: Ordinary differential equations of higher orders (8 hours)

Second order linear differential equations with constant and variable coefficients, method of variation of parameters, Cauchy-Euler equation.

Module 3: Basic Statistics: (7 hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabola sandmore generalcurves,correlationandregression–Rankcorrelation,multipleregressionandcorrelation.

Module 4: Basic Probability: (8 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

Module 5: Matrices (10 hours)

Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations;

Symmetric, skew-symmetric and orthogonal matrices; Eigenvalues and eigenvectors;

Diagonalization of matrices;.Cayley Hamilton Theorem, Orthogonal transformation and quadraticto

canonical forms

Topics for Self Learning Application of Differential Equations.

Textbooks/References

1. ErwinKreyszig,AdvancedEngineeringMathematics,9thEdition,JohnWiley&Sons,2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems,9thEdition,WileyIndia,2009.
3. S.L.Ross,DifferentialEquations,3rdEd.,WileyIndia,1984.
4. E.A.Codington,AnIntroductiontoOrdinaryDifferentialEquations,PrenticeHallIndia,1995.
5. E.L.Ince,OrdinaryDifferentialEquations,DoverPublications,1958.
6. B.S.Grewal,HigherEngineeringMathematics,KhannaPublishers,35thEdition,2000.
7. TheoryandProblemsofprobabilityandstatistics:2nded:J.R.Spiegal,Schaumseries
8. AtextbookofAppliedMathematicsVolumeI&II,byP.N.WartikarandJ.N.Wartikar,Pune VidhyarthiGrihaPrakashan,Pune-411030(India).
9. S.Ross,AFirstCourseinProbability,6thEd.,PearsonEducationIndia,2002.

Syllabus for Semester I, B. TECH. CSE (Data Science)

Course Code: CDT101	**Course: Programming for Problem Solving**
L: 4 Hrs, T: 0 Hr, P: 0 Hr, Per Week	**Total Credits: 4**

Course Outcomes :

On successful completion of course student will learn:

1. To formulate simple algorithms for arithmetic and logical problems, translate the algorithms to programs (in C language), test and execute the programs and correct syntax and logical errors.
2. To implement conditional branching, iteration and recursion, to decompose a problem into functions and synthesize a complete program using divide and conquer approach.
3. To use arrays, pointers, structures and I/O operations for the formulation of algorithms and programs.
4. To apply programming to solve matrix addition, multiplication problems and searching & sorting problems.

UNIT-I: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm : Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart / Pseudocode with examples. Arithmetic expressions and precedence

UNIT-II: C Programming Language

Introduction to C language: Keywords, Constant, Variable, Data types, Operators, Types of Statements, Preprocessor Directives, Decision Control Statement-if, if-else, Nested if-else statement, Switch case, Loops and Writing and evaluation of conditionals and consequent branching.

UNIT-III: Arrays and Basic Algorithms

Arrays: 1-D, 2-D, Character arrays and Strings. Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT-IV: Functions and Recursion

User defined and Library Functions, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference. Recursion: As a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-V: Pointers and Structures

Structures, Defining structures, Array of Structures, Introduction to pointers, Defining pointers, Pointer arithmetic, pointer operators, Use of Pointers in self-referential structures, notion of linked list (no implementation)

UNIT-VI: File handling

Streams in C, Types of Files, File Input/ Output Operations: Modes of file opening, Reading and writing the file, Closing the files, using fflush().

Text Books:

1. Programming in ANSI C : E. Balguruswami McGraw Hill
2. Mastering C: K. R. Venugopal and S. R. Prasad, Tata McGraw Hill

Reference Books:

1. Programming with C: Byron Gottfried, Schaums Outline Series.
2. Let Us C: Yashwant Kanetkar, BPB Publication

Syllabus for Semester I, B. TECH. CSE (Data Science)

Course Code: CDP101	**Course: Programming for Problem Solving Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week	**Total Credits: 1**

Course Outcomes :

On successful completion of course student will be able to:

1. Understand the fundamentals of C programming and choose the loops and decision making statements to solve and execute the given problem.
2. Implement different Operations on arrays also design functions to solve the given problem using C programming.
3. Understand pointers, structures, unions and apply them to develop programs.
4. Implement file Operations in C programming for a given application.

Syllabus for Semester I, B. TECH. CSE (Data Science)

Course Code: IDT151	**Course: Creativity, Innovation & Design Thinking**
L: 1 Hrs, T: 0 Hr, P: 0 Hr, Per Week	**Total Credits: 1**

Course Outcomes

1: Be familiar with processes and methods of creative problem solving
2: Enhance their creative and innovative thinking skills
3: Practice thinking creatively and innovative design and development

Detailed Topics

UNIT I. Introduction: Making a case for creativity, Creative thinking as a skill, Valuing diversity in thinking: Thinking preferences, Creativity styles, Creativity in problem solving

UNIT 2. Pattern Breaking: Thinking differently , Lateral thinking, Mind stimulation: games, brain-twisters and puzzles, Idea-collection processes, Brainstorming/Brainwriting, The SCAMPER methods, Metaphoric thinking, Outrageous thinking , Mapping thoughts, Other (new approaches)

UNIT 3. Using Math and Science, Systematic logical thinking, Using math concepts, Eight-Dimensional (8D) Approach to Ideation: Uniqueness, Dimensionality, Directionality, Consolidation, Segmentation, Modification, Similarity, Experimentation

UNIT4. Systematic Inventive Thinking: Systematic inventive thinking: The TRIZ methodology, Decision and Evaluation: Focused thinking framework, Six thinking hats , Ethical considerations

UNIT 5. Design for Innovation: Introduction to design for interaction, nine lessons for innovation, difference in creativity and innovation, Building blocks for innovation

UNIT 6.Intellectual Property: Introduction to intellectual property: Patents, Copyrights©, Trademarks ®, Trade Secret, Unfair Competition.

Reference Books and Text Book :

1. Creative Problem Solving for Managers - Tony Proctor - Routledge Taylor & Francis Group
2. 101 Activities for Teaching creativity and Problem Solving - By Arthur B Vangundy - Pfeiffer
3. H. S. Fogler and S.E. LeBlanc, Strategies for Creative Problem Solving, Prentice Hall
4. E. Lumsdaine and M. Lumsdaine, Creative Problem Solving, McGraw Hill,
5. J. Goldenberg and D. Mazursky, Creativity in product innovation. Cambridge University Press, 2002.

Course Assignments for internal continuous assessment of 20 Marks (NO T1 and T2)

- Brain teasers (aka Puzzle Busters, to be solved individually)
- Cartoon captions (small teams)
- TRIZ, a systematic ideation method, reading (individual)
- Book readings and discussions (small teams)
- Small teams presentations on innovation: (1) innovative individual, (2) innovative company, (3) innovative movie / game, (4) sustainable innovation, (5) innovation in business, (6) innovation in art, (7) innovation in architecture, (8) innovative nation, (9) innovation in science, and (10) innovation in engineering.
- Large groups hands-on projects
- Eight-dimensional (8D) ideation method examples
- Large teams videos

Syllabus for Semester I, B. TECH. CSE (Data Science)

Course Code: CDT102	**Course: Computer Workshop**
L: 1 Hrs, T: 0 Hr, P: 0 Hr, Per Week	**Total Credits: 1**

Course Objectives

1. Understand the fundamentals of writing Python code
2. Learn core Python coding concepts such as data types, variables and flow control structures
3. Discover how to work with lists and sequence data, dictionaries & write functions
4. Use Python to read and write files

Introduction to Python: Installation and working with Python, Variables, Basic Operators
Python Data Types: int , float, complex, User Input, Arithmetic Expressions ,Using Strings and Operations on Strings, Use of list and list slicing, Use of Tuples
Flow Control: Conditional blocks: if, else, elif, For Loops in Python: Loops with range, Strings, List and Dictionaries, While Loop
Python Functions: Defining a function, using a function
Python String, List and Dictionary manipulations
Files: Reading and Writing Files in Python, File Operations

Course Outcomes
On successful completion of the course, students will be able to:

1. Learn basic fundamentals of writing a python code
2. Understand Lists, Dictionaries in Python.'
3. Create Functions in Python
4. Handle Strings and Files in Python

Text Books
1. Python Programming Using Problem Solving Approach: Reema Thareja, Oxford University Press; First edition

Syllabus for Semester I, B. TECH. CSE (Data Science)

Course Code: CDP102	**Course: Computer Workshop Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week	**Total Credits: 1**

Course Objectives

Throughout the course, students will be expected to learn Python Language basics to do the following:

1. Understand basic concepts of python code writing
2. Understand the basics of control flow operations, Use of Lists, Dictionaries
3. Develop program using functions
4. Develop programs for file handling

Syllabus

Programs based on:
1. Python Data Types
2. Flow Control
3. Functions
4. String
5. File handling

Course Outcomes

On successful completion of the course, students will be able to:
1. Write basic python code
2. Implement flow control in python
3. Implement functions in Python
4. Write python code for file handling

Syllabus for Semester I, B. TECH. CSE (Data Science)

Course Code: HUT151	**Course: English**
L: 2 Hrs, T: 0 Hr, P: 0 Hr, Per Week	**Total Credits: 2**

Course Objectives

The main objective of the subject is to enhance the employability skills of engineering students as well as communication skills at work place. The sub-objectives are:

1. To develop vocabulary of students.
2. To orient students in basic writing skills.
3. To orient students in functional grammar.
4. To orient students in the process of effective writing.
5. To provide practice and improve students' oral communication skills.

Course Outcomes

1. Students will have good word power.
2. Students will acquire basic writing skills.
3. Students will understand functional grammar and its usage.
4. Students will organize and express their thoughts effectively through written communication.
5. Students will learn oral communication skills in order to handle themselves effectively in an interview and group discussion

SYLLABUS

1. Vocabulary Building

1.1. The concept of Word Formation
1.2. Root words from foreign languages and their use in English
1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives
1.4. Synonyms, Antonyms and standard abbreviations

2. Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

3. Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Redundancies
3.6 Cliches

4. Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying

4.4 Providing examples or evidence

5. Writing Practices
5.1 Comprehension
5.2 Precis Writing
5.3 Essay Writing
5.4 Letter Writing
5.5 Email Writing

6. Oral Communication
(This unit involves interactive practice sessions in Language Lab)
• Listening Comprehension
• Pronunciation, Intonation, Stress and Rhythm
• Common Everyday Situations : Conversations and Dialogues
• Communication at Workplace
• Interviews
• Formal Presentations

Books
1. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan.2007
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Syllabus for Semester I, B. TECH. CSE (Data Science)

Course Code: HUP151	**Course: English Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week	**Total Credits: 1**

Course objective :
1. To enhance competency of communication in English among learners.

Course outcomes:
1. Students learn presentation and public speaking skills
2. Students learn to practice effective strategies for Personal Interview and Group Discussions
3. Students learn and effectively apply language skills – listening, speaking, reading and writing

List of Practical (2 hours each for each batch) based on unit 6 (oral communication).
1. Common Everyday Situations: Conversations and Dialogues
2. Pronunciation, Intonation , Stress, and Rhythm
3. Formal Presentations: Orientation
4. Formal Presentations : Practice Session
5. Interviews: Orientation
6. Interviews: Practice Session
7. Communication at Workplace: Group Discussion- Orientation
8. Communication at Workplace: Practice Session

Syllabus for Semester II, B. TECH. CSE (Data Science)

Course Code: PHT156	**Course: Semiconductor Physics**
L: 3 Hrs, T: 1 Hr, P: 2 Hr, Per Week	**Total Credits: 4**

Course Objectives:

1. To introduce ideas of quantum mechanics necessary to begin understanding semiconductor devices;

2. To familiarize prospective engineers with fundamental concepts of semiconductors and their interaction with light and resulting devices

Course Outcomes:

After successful completion of the course students will

1. have an elementary understanding of quantum behaviour of electrons in solids;

2. have a grasp of band structure and its consequences for semiconductors;

3. should be able to use band structure to explain effects of doping,on the properties of junctions between semiconductors and metals;

4. have an elementary understanding of working of optoelectronic devices

Module 1 : Quantum Mechanics Introduction
Wave-particle duality, Heisenberg uncertainty relations, the quantum state wave function and its probability interpretation, Schrodinger's equation, Energies and wave functions of a single electron in one-dimensional infinite potentials: formulae, function graphs, number of bound states, tunneling, One electron atom, periodic table, Quantum confinement effects in nanosystems

Module 2: Electronic Materials
Free electron theory, Extension of idea of energy level splitting in molecules to bonding in solids, Energy bands in solids, Kronig-Penny model (to better demonstrate origin of band gaps), Band gap based classification of electronic materials: metals, semiconductors, and insulators, E-k diagram, Direct and indirect bandgaps, Valence and conduction bands, Density of states, Fermi-Dirac statistics: Occupation probability of states, Fermi level, Effective mass.

Module 3: Intrinsic and Extrinsic Semiconductors
Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier transport: diffusion and drift

Module 4: Non-Equilibrium Semiconductors
Carrier generation and recombination, Continuity equation, Ambipolar transport equation, Quasi-Fermi Energy levels, Excess Carrier Lifetime, Qualitative introduction to recombination mechanisms, Shorkley-Read-Hall Recombination, Surface Recombination

Module 5: Junction Physics
p-n junction, Zero applied bias, forward bias, reverse bias, Metal-semiconductor junction, Shottky barrier, Ideal junction properties, Ohmic contacts, ideal non-rectifying barrier, tunneling barrier, Heterojunctions, Nanostructures, Energy band diagram, two dimensional electron gas
Module 6: Light - Semiconductors Interaction

Optical absorption in semiconductors**,** Light emitting diodes, Principles, Device Structures, Materials, High Intensity LEDs, Characteristics, LASERS, Stimulated emission and photon amplification, Einstein Coefficients, Laser oscillation conditions, Laser diode, Solar Energy Spectrum, photovoltaic device principles, Solar Cells

Text Book(s):

Modules 1-5
1. Semiconductor Physics and Devices (Fourth Edition), Donald A. Neamen, McGraw-Hill 2012.
References:

Modules 6
1. Online course: Semiconductor Optoelectronics by M. R. Shenoy on NPTEL
2. Optoelectronics and Photonics: Principles and Practices by S. O. Kasap, Prentice Hall 2001

Syllabus for Semester II, B. TECH. CSE (Data Science)

Course Code: PHP156	**Course: Semiconductor Physics Lab**
L: 0 Hrs, T: 0 Hr, P: 3 Hr, Per Week	**Total Credits: 1.5**

Course Outcomes

The Physics Laboratory course will consist of experiments illustrating the principles of physics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in physics laboratory and draw valid conclusions. At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in physics and compare the results obtained with theoretical calculations.
3. Understand measurement technique, and report the results obtained through proper graph plotting and error analysis.

In addition to the demo experiments, the Lab turns will be utilized for performing the experiments based on the following lists as specific to Program

1. Error analysis and graph plotting
2. Energy gap of semiconductor/thermister
3. Study of Hall Effect
4. Parameter extraction from I-V characteristics of a PN junction diode
5. Parameter extraction from I-V characteristics of a zener diode
6. Study of diode rectification
7. Parameter extraction from I-V characteristics of a transistor in common-emitter configuration.
8. Determination of Planck's constant
9. Determination of time constant of RC circuit
10. V-I Characteristics of Light Emitting Diodes
11. Study of a photodiode
12. Solar Cell (Photovoltaic cell)
13. Resistivity measurement by Four Probe method
14. Van der Pau and conventional techniques for resistivity measurement (LCR meter)
15. Study of R-C filters using C.R.O.
16. Data analysis using *Mathematica.*

A minimum of 8 experiments to be performed from the following list of experiments

Syllabus for Semester II, B. TECH. CSE (Data Science)

Course Code: MAT151	**Course: Calculus**
L: 3 Hrs, T: 1Hr, P: 0 Hr, Per Week	**Total Credits: 4**

Course Objective

Theobjectiveofthiscourseistofamiliarizetheprospectiveengineerswithtechniquesin Calculus and multivariate analysis. It aims to equip the students with standard concepts and tools at an intermediatetoadvancedlevelthatwillservethemwelltowardstacklingmoreadvancedlevelof mathematicsandapplicationsthattheywouldfindusefulintheirdisciplines.

Course Outcomes

On successful completion of the course, the students will learn:

1. The fallouts of Mean Valve Theorems that is fundamental to application of analysis to Engineering problems, to deal with functions of several variables that are essential in most branchesofengineering.
2. Basicsofimproperintegrals,BetaandGammafunctions,CurveTracing,toolofpowerseriesand FourierseriesforlearningadvancedEngineeringMathematics.
3. Multivariable Integral Calculus and Vector Calculus and their applications to Engineering problems.

Syllabus

Module 1: Calculus: (7 hours)

Rolle'stheorem,Meanvaluetheorems,Taylor'sandMaclaurinseriesexpansions;Indeterminate formsandL'Hospital'srule;radiusofcurvature(Cartesianform),evolutesandinvolutes

Module 2:Multivariable Calculus (Differentiation) (8 hours)

Limit, continuity and partial derivatives, Eulers Theorem, chain rule, total derivative, Jacobians, Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 3 Calculus: (6 hours)

Evaluationofdefiniteandimproperintegrals;BetaandGammafunctionsandtheirproperties;Tracing ofcurves(Cartesianform)

Module4:Sequencesandseries:(7hours)

Convergenceofsequenceandseries,testsforconvergence,powerseries,Fourierseries:Halfrange sineandcosineseries,Parseval'stheorem.

Module 5: Multivariable Calculus (Integration) (7 hours)

MultipleIntegration:doubleandtripleintegrals(Cartesianandpolar),changeoforderofintegration indoubleintegrals,Changeofvariables(Cartesiantopolar),Applications:areasandvolumesby doubleintegrationCenterofmassandGravity(constantandvariabledensities).

Module 6: Vector Calculus (7 hours)

VectorDifferentiation,Directionalderivatives,totalderivative,Gradient,curlanddivergence.Vector integration,TheoremsofGreen,GaussandStokes.

Topics for self-learning

Maximaandminimaforfunctionofonevariable,GeometricalinterpretationofPartialDifferentiation (TangentplaneandNormalline),Applicationsofdefiniteintegralstoevaluateperimeter,area,surface areasandvolumesofrevolutions.

Textbooks / References

1. ErwinKreyszig,AdvancedEngineeringMathematics,9thEdition,JohnWiley&Sons,2006.
2. VeerarajanT.,EngineeringMathematicsforfirstyear,TataMcGraw-Hill,NewDelhi,2008.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2010.
4. B.S.Grewal,HigherEngineeringMathematics,KhannaPublishers,35thEdition,2000.
5. RamanaB.V.,HigherEngineeringMathematics,TataMcGrawHillNewDelhi,11thReprint, 2010.
6. AtextbookofAppliedMathematicsVolumeI&II,byP.N.WartikarandJ.N.Wartikar,Pune VidhyarthiGrihaPrakashan,Pune-411030(India).

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Syllabus for Semester II, B. TECH. CSE (Data Science)

Course Code: MAP151	**Course: Computational Mathematics lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week	**Total Credits: 1**

Course Outcomes

The Computational Mathematics Lab course will consist of experiments demonstrating the principles of mathematics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in the lab and draw valid conclusions. At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in mathematics and compare the results obtained with theoretical calculations.
3. Understand basics of mathematics, and report the results obtained through proper programming.

The Lab turns will be utilized for performing the experiments based on the following list:

1. Calculus
2. Ordinary Differential Equations
3. Statistics
4. Linear Algebra

Suggested References:

1. Computational Mathematics Lab Manual written by the Teaching Faculty of Mathematics Department, RCOEM.

A minimum of 8 experiments to be performed based on the above list.

Syllabus for Semester II, B. TECH. CSE (Data Science)

Course Code: CDT103	**Course: Digital Electronics**
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week	**Total Credits: 3**

Course Outcomes:

After successful completion of this course, the student will be able to,

1. Understanding of various optimization techniques used to minimize and design digital circuits.
2. Analyze and design various combinational logic circuits.
3. Analyze and design various sequential circuits.
4. Design different microprocessor based components of computer system using combinational and sequential circuits.

Course Contents:

UNIT-I- **Basics of Digital Electronics**

Motivation for digital systems: Logic and Boolean Algebra, Number Systems. Logic Gates & Truth Tables, Demorgan's law, Minimization of combinational circuits using Karnaugh maps upto five variable. Map manipulation-essential prime implicants, non essential prime implicants.

UNIT-II – Combinational Circuit Design

Design procedure: Multiplexers, Demultiplexer, Encoders ,Decoders ,Code Converters, Adders , Subtractor (Half ,Full), BCD Adder/ Subtractor , ripple and carry look-ahead addition.

UNIT-III- Sequential circuit Design-I

Storage elements, Flip-flops and latches: D, T, J/K, S/R flip-flops. Master Slave Conversion of one of type of F/F to another Sequential circuit. Analysis –Input equations, state table, analysis with J-K Flip flops. Sequential circuit Design, Design procedure, Designing with D & J-K Flip flop.

UNIT-IV-Sequential circuit Design-II

Counters, asynchronous and synchronous design using state and excitation tables. Registers & Shift registers.

UNIT-V- Programmable logic Design

Memory & Programmable logic Devices: RAM, Array of RAM IC's, Read only Memory, PLA, PAL, Flash Memories

UNIT-VI- Fundamental of Microprocessor

Introduction to µp 8085, Addressing modes, Instruction set, Programming of µp 8085.

Text Books :

1. Morris Mano; Digital Logic Design; Fourth edition, McGraw Hill
2. R.P.Jain; Modern Digital Electronic; Fourth edition; Tata McGraw-Hill.
3. V.J.Vibhute; 8-Bit Microprocessor & Microcontrollers; fifth edition.

Reference books :

1. A. Anand Kumar; Fundamental of Digital Electronics; Second Edition, PHI
2. A.P.Godse; Digital circuit & design; Technical Publications; 2009.
3. Ramesh Gaonkar; 8 bit Microprocessor; CBS Publishers; 2011.

Syllabus for Semester II, B. TECH. CSE (Data Science)

Course Code: CDP103	**Course: Digital Electronics Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week	**Total Credits: 1**

Course Outcome :

On Successful completion of course, students will be able to:

1. Use logic gates for designing digital circuits
2. Implement combinational circuits using VHDL
3. Implement sequential circuits using VHDL
4. Apply the knowledge gained for their project work based on the hardware digital circuits

Practicals based on above theory syllabus

Syllabus for Semester II, B. TECH. CSE (Data Science)

Course Code: CDT104	**Course: Object Oriented Programming**
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week	**Total Credits: 3**

Course Objectives

1. To make students understand Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections

2. Introduce students with fundamental concepts like exception handling, generics, multithreading and streams.

SYLLABUS

UNIT I

Features of Object Oriented Programming languages, Abstraction, Encapsulation, Inheritance, polymorphism and late binding.Concept of a class, Access control of members of a class, instantiating a class, constructor and method overloading.

UNIT II

Concept of inheritance, methods of derivation, use of super keyword and final keyword in inheritance, run time polymorphism, abstract classes and methods, Interface, implementation of interface, creating packages, importing packages, static and non-static members, Lambda Expressions Introduction, Block, Passing Lambda expression as Argument.

UNIT III

Exceptions, types of exception, use of try catch block, handling multiple exceptions, using finally, throw and throws clause, user defined exceptions, Introduction to streams, byte streams, character streams, file handling in Java, Serialization.

UNIT IV

Generics, generic class with two type parameter, bounded generics. Collection classes: Arraylist, LinkedList, Hashset, Treeset .

UNIT V

Multithreading: Java Thread models, creating thread using runnable interface and extending Thread, thread priorities, Thread Synchronization, InterThread communications. Basic SQL commands, DDL and DML commands, Java Database Connectivity, Working with Connection, Statement and Resultset, Data Manipulation using JDBC, Data navigation. Page

UNIT VI Introduction to Design Patterns, Need of Design Pattern, Classification of Design Patterns, Role of Design Pattern in Software design, Creational Patterns, Structural Design Patterns and Behavioral Patterns.

Course Outcomes:

On successful completion of the course, students will be able to demonstrate

1. Understand the principles of object-oriented programming; create classes, instantiate objects and invoke methods.

2. Understand concept of generics and implement collection classes. Use exception handling mechanism.

3. Efficiently work with streams, use multithreading for solving classic synchronization problems. Perform java database connectivity and execute basic SQL commands.

4. Understand characteristics and need of Design Pattern in Software Design Process.

Text Books:

1. Herbert Schildt; JAVA The Complete Reference; Ninth Edition, Tata McGraw- Hill Publishing Company Limited.

2. Design Patterns By Erich Gamma, Pearson Education.

Reference Books:

1. Cay S. Horstmann and Gary Cornell; Core JAVA Volume-II Advanced Features; Eighth Edition; Prentice Hall, Sun Microsystems Press 2008.

2. Herbert Schildt and Dale Skrien; Java Fundamentals A Comprehensive Introduction; Tata McGraw- Hill Education Private Ltd 2013.

Syllabus for Semester II, B. TECH. CSE (Data Science)

Course Code: CDP104	**Course: Object Oriented Programming Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week	**Total Credits: 1**

Course Objectives

1. To develop ability of students to implement basic concepts and techniques of object oriented programming paradigm like encapsulation, inheritance, polymorphism, exception handling.

2. Develop solution to problems using collection classes, generics, streams, multithreading and JDBC.

SYLLABUS

Experiments based on above Syllabus.

Course Outcomes:

On completion of the course the student will be able to

1. Design solution to problems using concepts of object oriented programming like classes, objects, inheritance with proper exception handling.

2. Use collection classes, generic classes to design programs and perform database connectivity.

3. Implement programs based on streams and multithreading.

Syllabus for Semester II, B. TECH. CSE (Data Science)

Course Code: HUT152	**Course: Constitution of India**
L: 2 Hrs, T: 0 Hr, P: 0 Hr, Per Week	**Total Credits: 0**

Course outcome

1. Students will understand the role of constitution in democratic India
2. Students will be responsible students by knowing their fundamental rights and duties
3. Students will develop better understanding of democratic functions of the government of India
4. Students will form better understanding of system of governance for effective participation

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the Fundamental Rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Union Executive: structure, functions
10. Judiciary: Structure, role with special reference to PIL, writ petitions, strengthening of democracy & social Justice 11. Amendment of the Constitutional Powers and Procedure
12. Emergency Provisions: National Emergency, President Rule, Financial Emergency
13. Local Self Government – Constitutional Scheme in India
14. Provisions of civil services: Characteristics, functions, merits and demerits
15. Democratic principles in industry

Book

1. Durga Das Basu “An Introduction to Constitution of India” 22nd Edition, LexisNexis

Syllabus for Semester II, B. TECH. CSE (Data Science)

Course Code: PEP151	**Course: Physical and Mental Health using Yoga/Sports**
L: 0Hrs, T: 0 Hr, P: 2Hr, Per Week	**Total Credits: 0**

Course outcome

On successful completion of the course, students will be able to:_

1. Understand fundamental skills and basic rules of games offered by the Physical Education Department of RCOEM.
2. Obtained health related physical fitness.
3. Develop body-mind co-ordination through games and yoga.
4. Changed sedentary life styles towards active living.

Brief Objectives of Sports/Yoga Practical Classes:

It has long been proven that a healthy body leads to a healthy mind. With a strong belief in this, Physical Education Department at RCOEM will conduct Sports/Yoga Classes with the objective of maintaining health, fitness and wellness of students as well as create awareness about need for good health and physical fitness. The objective would also be to make the all-round development with team spirit, social values as well as to identify and develop leadership qualities in students through various sports activities. Sports activities would also be conducted with the objective to provide better interaction and recreation to the students which is an important neutralizer for stress. Additionally, the objective would be to evaluate the health related fitness of students so as to recommend and conduct specific Yoga and Sports activities. The emphasis is on participation, with healthy competition.

Programme Outline:

Sports :

1. Introduction to sports, offered by the department.
2. Health and safety issues related to sports; knowledge, recognition and ability to deal with injuries and illness associated with sports.
3. Practicing the fundamental skills and bringing awareness of basic rules and regulations.
4. Conduction of small recreational games and activities.

Yoga : Includes various sitting, standing and lying Asanas, Suryanamaskars and Pranayamas.

Physical Efficiency Tests : This includes 6 health related physical fitness tests.

Scheme for B. TECH. Computer Science and Engineering (Data Science)

Semester-III

Sr. No.	Category	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	BSC	MAT272	Mathematics for Data Science	2	1	0	3	40	60	100	03 Hrs
2.	PCC	CDT201	Data Structure and Algorithms	3	0	0	3	40	60	100	03 Hrs
3.	PCC	CDP201	Data Structure and Algorithms Lab	0	0	4	2	25	25	50	-
4.	PCC	CDT202	Computer Organization and Architecture	3	0	0	3	40	60	100	03 Hrs
5.	PCC	CDP203	AdvancedObjectOrientedProgrammingLab	0	0	4	2	25	25	50	-
6.	PCC	CDP204	Technical Skill Enhancement Lab	0	0	2	1	25	25	50	-
7.	PCC	CDP205	Statistical Programming Lab	0	0	2	1	25	25	50	-
8.	HSMC	HUT256	Indian Traditional Knowledge	2	0	0	0	-	-	-	-
9.	HSMC	HUT253	Business Communications	3	0	0	3	40	60	100	03 Hrs
10.	HSMC	HUT257	Cyber Laws & Ethics in IT	2	0	0	2	40	60	100	03 Hrs
			TOTAL	**15**	**1**	**12**	**20**			**700**	-

Semester-IV

Sr. No.	Category	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	PCC	CDT206	Artificial Intelligence	3	0	0	3	40	60	100	03 Hrs
2.	PCC	CDT207	Operating Systems	3	0	0	3	40	60	100	03 Hrs
3.	PCC	CDP207	Operating Systems Lab	0	0	4	2	25	25	50	-
4.	PCC	CDT208	Database Management Systems	3	0	0	3	40	60	100	03 Hrs
5.	PCC	CDP208	Database Management Systems Lab	0	0	4	2	25	25	50	-
6.	PCC	CDT209	Theory of Computation	3	0	0	3	40	60	100	03 Hrs
7.	PCC	CDT210	Computer Network	3	0	0	3	40	60	100	03 Hrs
8.	PCC	CDP211	Data Handling and Visualization Lab	0	0	4	2	25	25	50	-
9.	OEC		Open Elective - 1	3	0	0	3	40	60	100	03 Hrs
10.	MC	CHT252	Environmental Sciences	2	0	0	0	-	-	-	-
			TOTAL	**20**	**0**	**12**	**24**			**750**	-

	Recommended Course from MOOC
1	Model Thinking

Syllabus for Semester III, B. TECH. CSE (Data Science)

Course Code: MAT272 **Course: Mathematics for Data Science**
L: 2Hrs, T: 1Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Objective:
The objective of this course is to familiarize the prospective engineers with techniques in linear algebra and statistics. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes :
On successful completion of the course, the students will learn:
1. Computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, vector spaces, eigen values and eigenvectors, orthogonality and diagonalization.
2. Visualization, spatial reasoning, as well as geometric properties and strategies to model, solve problems, and view solutions, especially in R^2 and R^3, as well as conceptually extend these results to higher dimensions.
3. To prepare the background of students to pursue statistical theory or methodology and analyze data in any stream of computer science and information technology.

Module 1(10-Lectures): Data summaries and descriptive statistics, central tendency, variance, covariance, correlation, Simple and multiple Regression, Non linear regression, logistic regression.
Module 2(8-lectures): t-distribution, Z-distribution, Hypothesis testing for sampling distributions of means, proportions, sum and differences of means and proportions for large and small samples. Chi-square test, ANOVA Test.
Module 3(10-Lectures) Vector Space; Subspaces; Linear Dependence/Independence; Basis; Dimension; Linear transformation; Range Space and Rank; Null Space and Nullity; Rank nullity theorem, Matrix Representation of a linear transformation; Linear Operators on Rn and their representation as square matrices; Invertible linear operators; Inverse of a non-singularmatrix.
Module 4(8-Lectures): Eigenvalues and eigenvectors of a linear operator; Inner Product Spaces, Norm; Orthonormal Sets, Gram Schmidt orthogonalization process; projections, positive definite matrices, and Singular Value Decomposition, Principal Component Analysis.

Text Books:

(1) Hoffman and Kunze : Linear Algebra, Prentice Hall of India, New Delhi
(2) Gilbert Strang : Linear Algebra And Its Applications (Paperback) , Nelson Engineering (2007)
(3) M R. Spiegal : Theory and Problems of probability and statistics :,2nded :,Schaum series

Reference Books :

(1) Seymour Lipschutz et al: Linear Algebra, 3rded:Schaum series.
(2) V. Krishnamoorthy et al : An introduction to linear algebra , Affiliated East West Press, New Delhi P.G. Bhattacharya, S.K. Jain and S.R.
(3) Nagpaul : First course in Linear Algebra, Wiley Eastern Ltd., New Delhi
(4) K.B.Datta : Matrix and Linear Algebra, Prentice Hall of India, New Delhi
(5) S.C. Gupta and V. K. Kapoor: Fundamentals of Mathematical Statistics (A Modern Approach), 10th Edition.

Syllabus for Semester III, B. TECH. CSE (Data Science)

Course Code:CDT201 **Course: Data Structures and Algorithms**
L: 3Hrs, T: 0Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Objectives

1. To impart to students the basic concepts of data structures and algorithms.
2. To familiarize students on different searching and sorting techniques.
3. To prepare students to use linear (stacks, queues, linked lists) and non-linear (trees, graphs) datastructures.
4. To enable students to devise algorithms for solving real-world problems.

SYLLABUS

UNIT I Data Structures and Algorithms Basics

Introduction: basic terminologies, elementary data organizations, data structure operations; abstractdata types (ADT) and their characteristics.Algorithms: definition, characteristics, analysis of an algorithm, asymptotic notations, time and spacetradeoffs.Array ADT: definition, operations and representations – row-major and column- major.

UNIT II Stacks and Queues

Stack ADT: allowable operations, algorithms and their complexity analysis, applications of stacks – expression conversion and evaluation (algorithmic analysis), multiple stacks.
Queue ADT: allowable operations, algorithms and their complexity analysis for simple queue andcircular queue, introduction to double-ended queues and priority queues.

UNIT III Linked Lists

Singly Linked Lists: representation in memory, algorithms of several operations: traversing, searching,insertion, deletion, reversal, ordering, etc.Doubly and Circular Linked Lists: operations and algorithmic analysis. Linked representation of stacksand queues, header node linked lists.

UNIT IV Sorting and Searching

Sorting: different approaches to sorting, properties of different sorting algorithms (insertion, Shell,quick, merge, heap, counting), performance analysis and comparison.
Searching: necessity of a robust search mechanism, searching linear lists (linear search, binary search)and complexity analysis of search methods.

UNIT V Trees

Trees: basic tree terminologies, binary tree and operations, binary search tree [BST] and operations with time analysis of algorithms, threaded binary trees. Self-balancing Search Trees: tree rotations, AVL tree and operations, B+-tree: definitions, characteristics, and operations (introductory).

UNIT VI Graphs and Hashing

Graphs: basic terminologies, representation of graphs, traversals (DFS, BFS) with complexity analysis, path finding (Dijkstra's SSSP, Floyd's APSP), and spanning tree (Prim's method) algorithms.
Hashing: hash functions and hash tables, closed and open hashing, randomization methods (division method, mid-square method, folding), collision resolution techniques.

Course Outcomes:

On completion of the course the student will be able to

1. Recognize different ADTs and their operations and specify their complexities.
2. Design and realize linear data structures (stacks, queues, linked lists) and analyze theircomputation complexity.
3. Devise different sorting (comparison based, divide-and-conquer, distributive, and tree-based) and searching (linear, binary) methods and analyze their time and space requirements.
4. Design traversal and path finding algorithms for Trees and Graphs.

Text Books

1. Ellis Horowitz, SartajSahni& Susan Anderson-Freed, Fundamentals of Data Structures in C,Second Edition, Universities Press, 2008.
2. Mark Allen Weiss; Data Structures and Algorithm Analysis in C; Second Edition; PearsonEducation; 2002.
3. G.A.V. Pai; Data Structures and Algorithms: Concepts, Techniques and Application; FirstEdition; McGraw Hill; 2008.

Reference Books

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein; Introduction to Algorithms; Third Edition; PHI Learning; 2009.
2. Ellis Horowitz, SartajSahni and SanguthevarRajasekaran; Fundamentals of ComputerAlgorithms; Second Edition; Universities Press; 2008.
3. A. K. Sharma; Data Structures using C, Second Edition, Pearson Education, 2013.

Syllabus for Semester III, B. TECH. CSE (Data Science)

Course Code :CDP201 Course : Data Structures and Algorithms Lab
L: 0 Hrs, T: 0 Hr, P: 4 Hr, Per Week Total Credits: 02

Course Objectives

1. To enable students to employ different searching and sorting methods.
2. To prepare students to identify and apply linear (stacks, queues, linked lists) and non-Linear(trees, graphs) data structures in solving problems.
3. To encourage students to design and execute tree-based algorithms for solving real-worldproblems.

SYLLABUS

Experiments based on CDT201 Syllabus in C / C++ / Java / Python

Course Outcomes

On completion of the course the student will be able to

1. Design and realize different linear data structures.
2. Identify and apply specific methods of searching and sorting to solve a problem.
3. Implement and analyze operations on binary search trees and AVL trees.
4. Implement graph traversal algorithms, find shortest paths and analyze them.

Reference Books

1. K R. Venugopal and Sudeep. R Prasad; Mastering C; Second Edition; McGraw Hill; 2015.
2. Ellis Horowitz, SartajSahni& Susan Anderson-Freed, Fundamentals of Data Structures in C,Second Edition, Universities Press, 2008.
3. Mark Allen Weiss; Data Structures and Algorithm Analysis in C; Second Edition; PearsonEducation; 2002.

Syllabus for Semester III, B. TECH. CSE (Data Science)

Course Code:CDT202 Course: Computer Organization and Architecture
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Objectives:

1. Introduction of the design structure, function and characteristics of computer systems.
2. To understand the design of the various functional units, components of computers and working of all the modules to get the expected output.

SYLLABUS

UNIT I :

Basic Structure Of Computers: Functional units of computer. Instructions set architecture of a CPU- Instruction sequencing, Addressing modes, and instruction set classification, subroutine & parameter passing, expanding opcode.

UNIT II:

Basic Processing Unit: Bus architecture, Execution of a Complete Instruction, sequencing of control signals, Hardwired control, Micro-programmed Control.

UNIT III :

Computer arithmetic – integer addition and subtraction, design of Fast Adders, Multiplication- shift and add, booth's Algorithm, bit-pair recoding, Integer Division- restoring and non-restoring division. Floating point numbers-representation, arithmetic, guard bits and rounding.

UNIT IV:

Memory System Design: Semiconductor RAM memories, ROM, higher order memory design, multi-module memories, Secondary storage – Magnetic disk, Optical disk.

UNIT V :

Memory Organization: Memory interleaving, concept of hierarchical memory, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policy. Pipelining: Basic concepts of pipelining, throughput and speedup.

UNIT VI :

Input/output Organization: I/O mapped I/O and memories mapped I/O, interrupt and interrupt handling mechanisms, vectored interrupts, synchronous vs. asynchronous data transfer, Direct Memory Access

Course Outcomes:

On Successful completion of course, students will be able to:

1. Understand the basic components of a computer, including CPU, memories, and input/output, and their organization.
2. Understand the execution of complete instruction and sequencing of control signals.
3. Understand the implementation process for mathematical operations on arithmetic and floating point.
4. Understand the memory hierarchy and its organization in Computer Architecture.

Text Books

1. V.C.Hamacher, Z.G.Vranesic and S.G.Zaky; Computer Organisation; 5th edition; Tata McGraw Hill, 2002.
2. W. Stallings; Computer Organization & Architecture; PHI publication; 2001.
3. J. P. Hayes; Computer Architecture & Organization; 3rd edition; McGraw-Hill; 1998.

Reference Books

1. M Mano; Computer System and Architecture; PHI publication; 1993.
2. A.S.Tanenbaum; Structured Computer Organization; Prentice Hall of India Ltd.

Syllabus for Semester III, B. TECH. CSE (Data Science)

Course Code: CDP203 Course: Advanced Object-Oriented Programming Lab
L: 0 Hrs, T: 0 Hr,P: 4 Hr,Per Week Total Credits: 02

Course Pre-requisites:

CDT104 - Object Oriented Programming
CDP104 - Object Oriented Programming Lab

Course Objectives:

The objective of this course is to impart necessary and practical knowledge of recent Java based frameworks and develop skills required to design real-life web based projects by:

1. Designing Enterprise applications by encapsulating an application's business logic.
2. Designing and developing multi-tier web applications
3. Designing applications using existing frameworks like Spring and Hibernate.

Syllabus

Experiments based on:

JDBC Java Database Connectivity (JDBC): The Design of JDBC, Basics of Structured Query Language, JDBC Configuration, Executing a basic SQL Statement, using PreparedStatement.

Servlet : Handling the Client Request, Generating HTML response, Reading Form Data From Servlets: Reading Three Parameters, managing a session.

Java Server Pages (JSP): Invoking Java Code with JSP Scripting Elements, JSP directives and actions, Integrating Servlets and JSP

Spring Framework: Spring Bean Life Cycle, Spring Bean Scope, Basic Bean Wiring,

Hibernate: Hibernate Configuration, Hibernate Sessions, Collections Mappings, Association Mappings, Hibernate Query Language

Course Outcomes

On successful completion of the course, the student will be able to:

1. Implement Java based database application.
2. Demonstrate server and client side programming using servlets and Java server pages.
3. Perform Dependency Injection using Spring, and create mappings in Hibernate using HQL.

Text Books:

1. M. Deitel, P. J. Deitel, S. E. Santry; Advanced Java 2 Platform HOW TO PROGRAM; Prentice Hall.
2. Cay Horstman, Gary Cornell; Core JAVA Volume-II Advanced Features; 8th Edition.
3. Craig Walls; Spring In Action; 2nd Edition
4. Marty Hall, Larry Brown; Core Servlets and Java Server Pages Volume-1: Core Technologies; 2nd Edition.

Reference Books:

1. Jim Keogh; "J2EE:The Complete Reference"; McGraw Hill; Fifth Edition.
2. Spring Framework Documentation https://spring.io/
3. Hibernate Framework architecture Documentation https://hibernate.org/

Syllabus for Semester III, B. TECH. CSE (Data Science)

Course Code: CDP204	**Course: Technical Skill Enhancement Lab**
L: 0 Hr, T: 0 Hr, P: 2Hr, Per Week	**Total Credits: 01**

Course Objectives

The objective of this course is to familiarize the students with various web developmenttools/languages.

SYLLABUS

Practical to be based on following topics:

- Development of static web pages using HTML.
- Enhance above developed web pages by using CSS
- Validations of web pages using JavaScript
- XML Files and Document Type Definition (DTD) to validate the XML document.
- XHTML
- Implementation of PHP language

Course Outcomes:

On successful completion of the course, students will be able to:

1. Develop static and dynamic web pages using HTML, CSS, XML and XHTML.
2. Implement web programs using Java Scripts and JSP Struts.
3. Demonstrate client and server side programming using PHP.

Text Books:

1. Web Design: A Beginner Guide Second Edition by Wendy Willard
2. Introduction to XML and Web Technologies by Anders Moller

Syllabus for Semester III, B. TECH. CSE (Data Science)

Course Code: CDP205 Course: Statistical Programming Lab
L: 0 Hr, T: 0 Hr, P: 2 Hr, Per Week Total Credits: 01

Course Objectives

The objective of this course is to familiarize the students with the use and applicationsof various statistical tools and packages.

Experiments may include, but are not limited to the following:

- Introduction to different statistical tools and packages
- Reading and writing different types of datasets
- Descriptive statics : Measures of central tendency and Measures of Variability
- Inferential statistics
- Probability distributions
- Binomial distributions
- Confidence Intervals
- Hypothesis Testing
- Correlation and covariance
- Regression

Course Outcomes:

On completion of the course the student will be able to

1. Understand and apply different statistical techniques on given data.
2. Perform and interpret different distribution.
3. Carry out hypothesis testing and calculate confidence intervals.
4. Create regression models.

Reference Books:

1. An Introduction to Statistics with Python: With Applications in the Life Science by Thomas Haslwanter, Springer.
2. Practical Statistics for Data Scientists by Peter Bruce, Andrew Bruce, Peter Gedeck, Reilly Media.

Syllabus for Semester III, B. TECH. CSE (Data Science)

Course Code: HUT256 Course: Indian Traditional Knowledge
L: 2Hr, T: 0 Hr, P: 0Hr, Per Week Total Credits: 00

Course Objective

The course is designed with the objective of developing understanding of the students about the essence of Indian traditional knowledge in terms of its scientific approach, legality, role in natural resource protection, as well as its contribution to philosophy and art.

Course outcome:

Students will have increased ability to understand the importance and application of:

CO1: Indian Knowledge system and its scientific approach
CO2: Indian philosophical tradition
CO3: Indian artistic tradition
CO4: Traditional knowledge and protection of nature
CO5: The legality and its importance for the protection of Indian traditional knowledge

Syllabus

1. **Basic Structure of Indian Traditional Knowledge:** *Vedas, Upavedas, Vedang, Upadang,* scientific approach
2. **Ecology and Indian Traditional Knowledge:** Meaning, role, case studies
3. **Intellectual Property Rights and Indian traditional Knowledge:** Meaning, role in protection of Indian traditional knowledge, cases studies
4. **Indian Philosophical traditions:** Nyay, Sankaya, Yog, Mimansa, Jainism, Buddhism, Sikhism, and other approaches
5. **Indian Artistic Traditions:** Chitrakala, Murtikala, Vastukala, Sangeet, Sthpatya, Nritya evam Sahitya, case studies

Reference material

1. RR Gaur, Rajeev Sangal, GP Bagaria, *Human Values and Professional Ethics* (Excel Books, New Delhi, 2010)
2. V. Sivaramakrishanan (ed.), *Cultural Heritage of India – Course material,* BharatiyaVidyaBhavan, Mumbai, 5th Edition, 2014
3. Swami Jitatmanand, *Modern Physics and Vedant,* BharatiyaVidyaBhavan
4. Swami Jitatmanand, *Holistic Science and Vedant,* BharatiyaVidyaBhavan
5. S.C. Chatterjee and D.M. Datta, *An introduction to Indian Philosophy,* University of Calcutta, 1984
6. Pramod Chandra, *Indian Arts,* Howard University Press, 1984
7. Krishna Chaitanya, *Arts of India,* Abhinav Publications, 1987

Syllabus for Semester III, B. TECH. CSE (Data Science)

Course Code: HUT253 Course: Business Communications
L: 3Hr, T: 0 Hr, P: 0Hr, Per Week Total Credits: 03

Course objective

The course aims to develop the skills of students of writing effective business documents and applying effective strategies of verbal business communication

Course outcome

On completion of the course, students will be able to achieve the following:

CO1: Understand the fundamentals and objectives of business communication, and role of audience in effective communication.
CO2: Develop technical writing skills and produce effective workplace documents.
CO3: Apply the rules of English grammar in writing.
CO4: Develop skills to enhance visual appeal of documents.
CO5: Evaluate and apply strategies for effective oral communication for professional needs.

Syllabus

Unit1: Fundamentals of Business Communication:

Definition of communication and business communication, Objectives of Business Communication, Audience recognition, Barriers of Communication, Product Promotion, Usage of Social Media, Negotiation Skills, Persuasive Communication, PAC concept

Unit 2: Technical Writing:

Process of Technical Writing, Letters: Job application, Job Description andResume, enquiry, complaint, order, follow-up, cover/transmittal letters,Sales Letters, and e-mails. Other Forms of Technical Writing: Organizational announcements, Notices, Agenda, Minutes of Meeting, Memorandums.

Unit 3: Grammar for Writing:

Punctuations, Mechanics, Active/ Passive, Transformation of Sentences, Subject-Verb Agreement, Articles, Prepositions

Unit 4: Business Reports:

Basic formats and types - Annual, Progress, Project (Project Charter, Project Timeline), Market Search, Sales, Feasibility/Recommendation, Case Study evaluation.

Unit 5: Preparation of Documents:

Visual Appeal: Document Design, Graphics, Tables, User Manuals, Brochures, Fliers

Unit 6: Effective Oral Communication:

Non- Verbal Communication, Presentation and Public speaking, Group Discussion

Books

1. Sharon Gerson, Steven Gerson, "*Technical Communication: Process and Product*", 2018, Pearson
2. Sanjay Kumar, Pushpa Lata, *Communication Skills*, 2nd Edition, Oxford Publication, 2018.
3. Shalini Verma, *Business Communication,* Vikas Publishing House Pvt. Ltd., 2015.
4. P.D. Chaturvedi and Mukesh Chaturvedi, *Fundamentals of Business Communication*, Pearson Publications, 2012.
5. William Strunk Jr. and E.B. White *The Elements of Style,* Allyn & Bacon 'A Pearson Education Company'.

Syllabus for Semester III, B. TECH. CSE (Data Science)

Course Code : HUT257 **Course : Cyber Laws and Ethics in IT**
L: 2 Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits : 02**

Course Objectives

1. Describe laws governing cyberspace and analyze the role of Internet Governance in framing policies for Internet security
1. Identify intellectual property right issues in the cyberspace and design strategies to protect your intellectual property
3. Understand the importance of freedom of expression, defamation and hate speech in Cyber world.
4.Recognize the importance of digital divide, contingent workers and whistle blowing situations.

SYLLABUS

UNIT I

Cyber laws and rights in today's digital age; IT Act, Intellectual Property Issues connected with use and management of Digital Data, Emergence of Cyberspace, Cyber Jurisprudence.

UNIT II

Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber terrorism, Cyber Defamation, Different offences under IT Act, 2000,Cyber Torts.

UNIT III

Ethics in business world, Ethic s in IT, Ethics for IT professionals and IT users, IT professional malpractices, communications eavesdropping, computer break-ins, denial-of-service, destruction and modification of data, distortion and fabrication of information, Types of Exploits and Perpetrators.

UNIT IV

Intellectual Property: Copy rights, Patents, Trade Secret Laws, Key Intellectual property issues, Plagiarism, Competitive Intelligence, Cybersquatting, Information warfare policy and ethical Issues.

UNIT V

Privacy: The right of Privacy, Protection, Key Privacy and Anonymity issues, Identity Theft, Consumer Profiling, Defamation, Freedom of Expression, Anonymity, National, Security Letters, Defamation and Hate Speech.

UNIT VI

Ethics of IT Organization: Contingent Workers H- IB Workers, Whistle- blowing, Protection for Whistle- Blowers, Handling Whistle- blowing situation, Digital divide.

Course Outcomes:

On successful completion of the course, students will be able

1. To identify and analyze statutory, regulatory, constitutional, and organizational laws that affects the software professional.
2. To understand carious cyber laws with respect to legal dilemmas in the Information Technology field.
3. To interpret various intellectual property rights, Privacy, Protection issues in software development field.
4. To understand role of ethics in IT organization.

Text Books

1. George Reynolds, “Ethic s in information Technology”,5th edition, Cengage Learning
2. Hon C Graff, Cryptography and E-Commerce - A Wiley Tech Brief, Wiley Computer Publisher,2001.

Reference Books

1. Michael Cross, Norris L Johnson, Tony Piltzecker, Security, Shroff Publishers and Distributors Ltd.
2. Debora Johnson," Computer Ethic s",3/e Pearson Education.
3. Sara Baase, "A Gift of Fire: Social, Legal and Ethical Issues, for Computing and the Internet," PHI Public at ions.
4. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).

Syllabus for Semester IV, B. TECH. CSE (Data Science)

Course Code: CDT206 Course: Artificial Intelligence
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Objectives:

1. To understand challenges involved in designing intelligent systems.
2. To represent given problem using state space representation and solve it by using different search techniques.
3. To understand knowledge representation methods using logic programming.
4. To understand uncertainty theory in designing AI systems.

Syllabus

UNIT I:

Introduction: Basics of problem solving, problem representation (toy problems and real world problems); Structure of agent, rational agent, Specifying task environment, Properties of task environment; measuring problem-solving performance

UNIT II:

Uninformed search techniques: Depth, Breadth, Uniform Cost, Depth Limited, Iterative deepening DFS, Bidirectional Search

UNIT III:

Informed search techniques: Heuristic Based Search, Greedy Best First Search, A* Search; Local Search algorithms: Hill-climbing, Simulated Annealing, Genetic Algorithms.

UNIT IV:

Adversarial Search: Two player Games, The min-max algorithm, Alpha-Beta pruning. Constraint Satisfaction Problems: Constraint propagation, backtracking search

UNIT V:

Propositional Logic: Inference, Equivalence, Validity and satisfiability, Resolution, Forward and Backward Chaining, First Order Logic: Syntax and Semantics of FOL, Inference in FOL, Unification, Forward Chaining, Backward Chaining, and Resolution.

UNIT VI:

Uncertainty Knowledge and Reasoning: Probability and Baye's Theorem, Statistical reasoning: Bayesian networks, Naïve Bayes algorithm, Fuzzy Logic, Introduction to expert system

Course Outcomes:

On successful completion of the course, students will be able to:

1. Represent given problem using state space representation and apply uninformed and informed search techniques on it.
2. Solve the fully informed two player games using different AI techniques.
3. Solve the AI problems by using logic programming
4. Apply uncertainty theory based on techniques like probability theory and fuzzy logic.

Text Book:

1. Stuart Russel and Peter Norvig; Artificial Intelligence: A Modern Approach; Third Edition; Pearson Education, 2009.

Reference Books:

1. E.Rich, K. Knight, S. B. Nair; Artificial Intelligence; 3rd Edition; Tata McGraw Hill, 2014.
2. Denis Rothman; Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases; Kindle Edition, Packt Publishing Ltd, 2018

Syllabus for Semester IV, B. TECH. CSE (Data Science)

Course Code: CDT207 Course: Operating Systems
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Objectives

1. The course focuses on developing a fundamental knowledge of operating systems.
2. The course targets at the detail understanding of the basic tasks such as scheduling, memory management and file system management
3. It also covers the complex concepts of inter process communication and deadlocks.

SYLLABUS

Unit I:

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine, Case study on LINUX and Windows Operating System.

Unit II:

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.
Threads: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.
ProcessScheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SRTF, Priority, RR, Case study on Process Management in LINUX Operating System.

Unit III:

Inter-processCommunication: Critical Section, Race Conditions, Mutual Exclusion, Peterson's solution, Hardware Solution, Semaphores, Monitors, Message Passing, Classical IPC Problems: Producer-Consumer Problem, Reader-Writer Problem, Dinning Philosopher Problem etc.

Unit IV:

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Unit V:

MemoryManagement: Basic concept, Logical and Physical address mapping, Memory allocation: Contiguous Memory allocation – Fixed and variable partition, Internal and External fragmentation and Compaction, Paging: Principle of operation – Page allocation, Hardware support for paging, Protection and sharing, Advantages & Disadvantages of paging.

VirtualMemory: Basics of Virtual Memory, Hardware and control structures, Locality of reference, Page fault, Working Set, Dirty page/ Dirty bit, Demand paging; Page Replacement algorithms: First in First Out (FIFO), Least Recently used (LRU), and Optimal.

Unit VI:

FileManagement: Concept of File, Access methods, File types, File operations, Directory structure, File System structure, Allocation methods, Free-space management.
DiskManagement: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK, Disk

reliability, Disk formatting, Boot block, Bad blocks, case study on File Systems in LINUX operating System.

Course Outcomes

On successful completion of the course, students will be able to:

1. Describe and Classify differing structures for operating systems.
2. Understand the role of various components (process, memory, file systems, etc.) of operating system.
3. Analyze and apply resource (CPU, Memory, Disk) management policies.
4. Determine challenges in inter process communication and design solutions for it.

Text Books

1. Operating System Concepts, 8th Edition by A. Silberschatz, P.Galvin, G. Gagne,Wiley India Edition.
2. Modern Operating Systems, 2nd Edition by Andrew Tanenbaum, PHI.

Reference Books

1. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings,Prentice Hall of India.
2. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly.

Syllabus for Semester IV, B. TECH. CSE (Data Science)

Course Code: CDP207 Course: Operating Systems Lab
L: 0 Hrs, T: 0 Hr, P: 4 Hr, Per Week Total Credits: 02

Course Objectives

Using C language in Linux environment

1. To develop ability of students to design and implement concepts of operating systems such as system calls, CPU scheduling, process/thread management.
2. To develop the components and management aspects of concurrency management, memory management, and File management.

SYLLABUS

Experiments based on CDT207 Syllabus.

Course Outcomes

On completion of the course the student will be able to demonstrate

1. Ability to use LINUX system calls and implement system commands.
2. Ability to implement process and process schedulers.
3. Ability to design and implement solution to handle synchronization and deadlock.
4. Ability to implement memory and File management algorithms.

Syllabus for Semester IV, B. TECH. CSE (Data Science)

Course Code: CDT208	**Course: Database Management Systems**
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week	**Total Credits: 03**

Course Objectives

1. To understand the role of a database management system in an organization.
2. To construct simple and advanced database queries using a data language.
3. To understand and apply logical database design principles and database normalization.
4. To recognize the need for transaction management and query processing.

SYLLABUS

UNIT I

Databases and Database Users, Characteristics of the Database Approach, Advantages of Using the DBMS Approach, When Not to Use a DBMS, Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment. Introduction to NoSQL databases and In-Memory databases.

UNIT II

Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions, and Dealing with Constraint Violations, SQL Data Definition, Data Types and Constraints, Data Management in SQL, Transforming ER Model into Relational Model. Introduction to datawarehouse schemas, data cubes.

UNIT III Database Design and Normalization

Functional Dependencies, Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decomposition, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Other Dependencies and Normal Forms.

UNIT IV Indexing and Hashing

Ordered Indices, B+-Tree Index Files and its Extensions, Static Hashing and Dynamic Hashing,Comparison of Ordered Indexing and Hashing, Bitmap Indices, Some General Issues Concerning Indexing.

UNIT V Query Processing and Optimization

Measures of Query Cost, Query Operation: Selection, Sorting and Join Operation, Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans.

UNIT VI Transaction Processing, Concurrency Control and Recovery

Introduction to Transaction Processing, Characterizing Schedules Based on Recoverability,Characterizing Schedules Based on Serializability, Two-Phase Locking Techniques for Concurrency Control, Deadlock Handling and Multiple Granularity, Database Recovery Techniques.

Course Outcomes

On completion of the course the student will be able to

1. Identify the basic concepts and various data model used in database design.
2. Recognize the use of normalization and functional dependency.
3. Understand the purpose of query processing and optimization.
4. Apply and relate the concept of transaction, concurrency control and recovery in database.

Text Books

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan; “Database System Concepts”; Sixth Edition, Tata McGraw Hill, 2011.
2. RamezElmasri and ShamkantNavathe; “Fundamentals of Database Systems”; SixthEdition, Addison Wesley 2011.

Reference Books

1. Raghu Ramakrishnan and Johannes Gehrke; “Database Management Systems”; Third Edition,Tata McGraw Hill Publication, 2003.
2. C. J. Date; “Database in Depth – Relational Theory for Practitioners”; O`Reilly Media, 2005

Syllabus for Semester IV, B. TECH. CSE (Data Science)

Course Code: CDP208 **Course:Database Management Systems Lab**
L: 0 Hrs, T: 0 Hr, P: 4 Hr, Per Week **Total Credits: 02**

Course Objectives

1. To enable students to use DDL, DML and DCL.
2. To prepare students to conceptualize and realize database objects (tables, indexes, views and sequences) and execute SQL queries.
3. To encourage students to design and execute PL/SQL blocks and triggers.

SYLLABUS

Experiments based on CDT208 Syllabus in Oracle 11g | MySQL.
[Few experiments to be conducted to demonstrate handling of databases on cloud, Few experiments to be conducted on noSQL]

Course Outcomes

On completion of the course the student will be able to

1. Understand the use of database languages such as DDL, DML, and DCL.
2. Construct simple, nested, multiple table, and advanced queries for data retrieval.
3. Construct PL-SQL block structure and Trigger for specific application.
4. Implement various integrity constraints, views, sequences, indices and synonym on database.

Reference Books

1. James Groff, Paul Weinberg and Andy Oppel, SQL - The Complete Reference, 3rd Edition, McGraw Hill, 2017.

Syllabus for Semester IV, B. TECH. CSE (Data Science)

Course Code: CDT209 **Course:Theory of Computation**
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Objectives

1. To provide students an understanding of basic concepts in the theory of computation.
2. To teach formal languages and various models of computation.
3. To exhibit fundamental concepts related with computability theory.

SYLLABUS

UNIT I

Basics of Sets and Relation, Countability and Diagonalisation, Principle of mathematical induction,Pigeon-hole principle. Fundamentals of formal languages and grammars, Chomsky hierarchy of languages.

UNIT II

Finite automata: Deterministic finite automata (DFA), Nondeterministic finite automata (NFA) and equivalence with DFA, Minimization of finite automata, NFA with Epsilon Transitions, Finite Automata with output.

UNIT III

Regular expressions and Regular languages, Regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, Context-free grammars (CFG) and language(CFL), parse trees, ambiguity in CFG, Reduction of CFGs, Chomsky and Greibach normal forms.

UNIT IV

Push Down Automata: Deterministic pushdown automata and Non-Deterministic pushdownautomata, Acceptance by two methods: Empty stack and Final State, Equivalence of PDA with CFG, closure properties of CFLs.

UNIT V

Turing machines: The basic model for Turing machines (TM), Turing recognizable recursivelyenumerable) and Turing-decidable (recursive) languages, variants of Turing machines, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

UNIT VI

Undecidability: Church-Turing thesis, Universal Turing machine, Undecidable problems about languages, Recursive Function Theory.Course Outcomes:

Course Outcomes

On successful completion of the course, students will be able to demonstrate

1. Describe the formal relationships among machines, languages and grammars.
2. Design and Optimize finite automata for given regular languages.
3. Design Pushdown Automata, Turing Machine for given languages.
4. Demonstrate use of computability, decidability, recursive function theory through problem solving.

Text Books

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

Reference Books

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
2. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
4. John Martin, Introduction to Languages and The Theory of Computation, Tata McGraw Hill

Syllabus for Semester IV, B. TECH. CSE (Data Science)

Course Code: CDT210 **Course:Computer Networks**

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Objectives

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in network protocols.
3. To provide an opportunity to do network programming

SYLLABUS

UNIT I

Data communication Components: Representation of data and its flow Networks, VariousConnection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division

UNIT II

Data Link Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ.

UNIT III

Medium Access Sub Layer: Switching, Random Access, Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA, IEEE 802 standard protocols.

UNIT IV

Network Layer: Internet Protocol (IP) – Logical Addressing: IPV4, IPV6; Address mapping: ARP,RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT V

Transport Layer: Elements of Transport protocols: Addressing, Connection establishment,Connection release, Crash recovery, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), TCP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT VI

Application Layer: Socket Interface and Socket programming , Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP),WWW, HTTP.

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand basics of computer networks and reference models
2. Identify the Design issues of each layer of OSI model
3. Implement the protocols of OSI model

Text Books

1. Computer Networks: 5th ed by Andrew. S. Tanenbaum. PHI Publication.
2. Data Communications and Networks: 3rd ed by Behrouz A. Forouzan. Tata McGraw Hill publication.

Reference Books

1. James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition.
2. William Stallings, "Data and Computer Communications", PHI 6th Edition

Syllabus for Semester IV, B. TECH. CSE (Data Science)

Course Code: CDP211 **Course: Data Handling and Visualization Lab**

L: 0 Hrs, T: 0 Hr,P: 4 Hr Per Week **Total Credits:02**

Course Objectives

The course aims to familiarize the students with the process of gathering data, transforming data, and presenting it in a way that is meaningful to others.

SYLLABUS:

Experiments may include, but are not limited to the following :

- Extract data from different sources like text files, APIs, databases.
- Data cleaning techniques
- Data processing techniques
- Data loading techniques
- Data visualization techniques like plots (line plot, scatter plot, etc), charts (bar charts, pie chart, donut chart, etc) , histograms, Box and Whisker Plot, Maps, Word Clouds, Network diagrams, Correlation Matrices, etc

Course Outcomes:

On completion of the course the student will be able to

1. Perform data extraction.
2. Understand and apply different data transformation and loading techniques.
3. Identify and apply appropriate data visualization technique(s).

Reference Books :

1. Claus O. Wilke, "Fundamentals of Data Visualization – A Primer on Making Informative and Compelling Figures", O'Reilly, 2019.
2. Kyran Dale, "Data Visualization with Python and JavaScript – Scrape, Clean and transform Your Data", O'Reilly, 2016.

Syllabus for Semester IV, B. TECH. CSE (Data Science)

Course Code: CHT252 **Course: Environmental Sciences**

L: 2 Hrs, T: 0 Hr,P: 0Hr Per Week **Total Credits:00**

SYLLABUS

UNIT I

Air pollution and its control techniques: (4 lectures)

Contaminant behaviour in the environment, Air pollution due to SOx, NOx, photochemical smog, Indoor air pollution Natural pathways for degradation: Carbon cycle, Sulphur cycle, Nitrogen cycle, Oxygen cycle Factors responsible for altering the composition of atmosphere (deforestation, burning of fossil fuels, industrial and vehicular emissions, CFCs). Techniques to control Air pollution, ambient air quality and continuous air quality monitoring, Control measures at source, Kyoto Protocol, Carbon Credits.

UNIT II

Noise pollution and its control techniques: (2 lectures)

Introduction to noise pollution and its causes. Noise pollution control: Recent advances in noise pollution control and benefits.

UNIT III

Soil pollution and its control techniques: (5 lectures)

Soil pollution: Soil around us, Soil water characteristics, soil pollution.

Solid waste management: Composting, vermiculture, landfills, hazardous waste treatment,bioremediation technologies, conventional techniques (land farming, constructed wetlands),and phytoremediation. Degradation of xenobiotics in environment: Petroleum hydrocarbons, pesticides, heavy metals

UNIT IV

Water pollution and its control techniques: (8 lectures)

Major sources of water pollution: Eutrophication, acid mine drains, pesticides and fertilizers,dyeing and tanning, marine pollution, microplastics Techniques to control water pollution: Conventional waste water treatment-types of sewage, sewerage system, alternative systems, primary, secondary and tertiary processes including aerobic and anaerobic techniques, safe disposal. Case studies: Treatment schemes for waste water from dairy, textile, power plants,pharmaceutical industries, and agro based industries such as rice mills.

UNIT V

E-wastes (2 lectures)

Introduction, types of e-wastes, environmental impact, e-waste recycling, e-waste management rules.

Unit VI

Environmental Sustainability: Role of Green technology (5 lectures)

Concept of green technologies, categories, goals and significance, sustainability Green energy, green chemistry, challenges to green technology, advantage and disadvantages of green processes, Eco mark certification- its importance and implementation VII- Different government initiatives (2 lectures) National ambient air quality standard 2009, Swacch Bharat Abhiyan, National afforestation program and Act- 2016, National river conservation plan, Formation of National Green Tribunal

Course Outcomes

On successful completion of the course, students

1. Will get sufficient knowledge regarding different types of environmental pollutions, their causes, detrimental effects on environment and effective control measures.
2. Will realize the need to change an individual's outlook, so as to perceive our Environmental issues correctly, using practical approach based on observations and self-learning.
3. Will become conversant with recent waste management techniques such as E-wastes, itsrecycling and management.
4. Will gain knowledge about the modes for sustainable development, importance of green energy and processes.
5. Will be able to identify and analyze environmental problems as well as risks associated with these problems and greener efforts to be adopted, to protect the environment from getting polluted.

Suggested Books

1. Benny Joseph, Environmental Studies, McGraw Hill Education (India) Private Limited
2. B. K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut
3. P AarneVesilind, J. Jeffrey Peirce and Ruth F. Weiner, Environmental Pollution and Control,Butterworth-Heinemann
4. D. D. Mishra, S. S. Dara, A Textbook of Environmental Chemistry and Pollution Control, S.Chand& Company Ltd. Sultan Chand & Company
5. Shree Nath Singh, Microbial Degradation of Xenobiotics, Springer-Verlag Berlin Heidelberg
6. P.T. Anastas& J.C. Warner, Green Chemistry: Theory & practice, Oxford University Press.
7. P. Thangavel&Sridevi, Environmental Sustainability: Role of Green technologies, Springer publications.

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDT301 **Course: Machine Learning**

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Objectives:

1. To introduce the basic concepts and techniques of machine learning.
2. To understand major machine learning algorithms.
3. To identify machine learning techniques suitable for a given problem.

Course Syllabus:

UNIT I:

The concept learning task, General-to-specific ordering of hypotheses, Version spaces, Inductive bias, Decision Tree Learning, Over-fitting, Cross-Validation, and Experimental Evaluation of Learning Algorithms.

UNIT II:

Instance-Based Learning: k-Nearest neighbor algorithm, Weighted k-Nearest neighbor algorithm, Case-based learning.

Regression: Linear Regression, Logistic Regression.

UNIT III:

Probabilistic Machine Learning: Maximum Likelihood Estimation, MAP, Naive Bayes classifier, Bayes optimal classifiers, Minimum description length principle.

UNIT IV:

Association Rule Mining: Apriori Algorithm, FP Tree Algorithm. Association to correlation analysis.

UNIT V:

Clustering and Unsupervised Learning: K-means, k-medoids, Hierarchical Clustering using single linkage, complete linkage and average linkage methods.

UNIT VI:

Support Vector Machine, Hidden Markov Models, and Ensemble learning: boosting, bagging, Random Forest.

Course Outcomes:

On successful completion of the course, students will be able to:

1. Apply supervised machine learning model to solve a specific problem.
2. Develop probabilistic machine learning model for a given application.
2. Apply unsupervised machine learning model to solve a specific problem.
3. Solve problems using support vector machine, hidden markov model, and Ensemble learning.

Text Books:

1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986.
2. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books:

1. Soumen Chakrabarti; Mining the Web: Discovering Knowledge from Hypertext Data, Morgan-Kaufmann, 2003.
2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988.
3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

Semester-V

Sr. No.	Category	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Conti-nuousEvaluation	End Sem Exam	Total	
1.	PCC	CDT301	Machine Learning	3	0	0	3	40	60	100	03 Hrs
2.	PCC	CDP301	Machine Learning Lab	0	0	2	1	25	25	50	-
3.	PCC	CDT302	Information Security and Privacy	3	0	0	3	40	60	100	3Hrs
4.	PCC	CDP303	Programming Languages Lab	0	0	4	2	25	25	50	-
5.	PCC	CDT304	Compiler Design	3	0	0	3	40	60	100	03 Hrs
6.	PEC	CDT305	Program Elective - I	3	0	0	3	40	60	100	03 Hrs
7.	PEC	CDP305	Program Elective – I Lab	0	0	2	1	25	25	50	-
8.	PR	CDP306	Project Based Learning - I	0	0	6	3	25	25	50	-
9.	OEC		Open Elective-II / MOOC	3	0	0	3	40	60	100	03 Hrs
			TOTAL	**15**	**0**	**14**	**22**			**700**	-

Course Code	Program Elective – I
CDT305-1	Digital Image Processing
CDT305-2	Data Warehousing and Business Intelligence
CDT305-3	Design Patterns
CDT305-4	Health Informatics

CourseCode	Program Elective–ILab
CDP305-1	Digital Image Processing Lab
CDP305-2	Data Warehousing and Business Intelligence Lab
CDP305-3	Design Patterns Lab
CDP305-4	Health Informatics Lab

	Recommended course from MOOC
1	Android Programming

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDP301 **Course: Machine Learning Lab**

L: 0Hrs, T: 0 Hr, P: 2Hr, Per Week **Total Credits: 01**

Course Objectives:

1. To implement basic machine learning algorithm for solving problem.
2. To understand the usage of datasets in implementing machine learning problems.
3. To learn various modern tools, packages and techniques for machine learning.

Course Syllabus:

Experiments based on CDT301 (Machine Learning) Syllabus.

Technology: Python

Course Outcomes:

On completion of the course the student will be able to

1. Understand the implementation procedures for machine learning algorithms.
2. Design python programs for various learning algorithms.
3. Apply appropriate machine learning algorithms to various data sets.
4. Apply machine learning algorithms to solve real world problems.

Text Books:

1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986.
2. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books:

1. Soumen Chakrabarti; Mining the Web: Discovering Knowledge from Hypertext Data, Morgan-Kaufmann, 2003.
2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988
3. Ethem Alpaydin, Introduction to Machine Learning, PHI

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDT302 **Course: Information Security and Privacy**

L: 3Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Pre-requisite

- Computer Network

Course Objectives

This course will provide students with a practical and theoretical knowledge of Information security and Privacy. By the end of the course, students should be able to:

1. To build strong fundamental of Information Security and algorithm to realize goals of Security.
2. Understand authentication, intrusion detection and prevention and privacy issues.
3. Identify and mitigate software security vulnerabilities in existing systems.

Syllabus:

Unit I

Introduction to Information Security

Security Goals, Different Types of Attacks on Networks, Threats, Vulnerabilities, Attacks, Data Integrity, Confidentiality, Anonymity Message and Entity Authentication Authorization, Non-repudiation, Network Security Model, Classical Encryption Techniques.

Unit II

Introduction to Symmetric Key Algorithms

Introduction to stream cipher, block cipher, Introduction to Symmetric key block cipher Algorithms DES and strength of DES and block cipher modes of operation.

Unit III

Asymmetric Key Algorithms

Introduction to basic mathematics required for understanding asymmetric key algorithms. Asymmetric key algorithms, related attacks and applications.

Unit IV

Information Authentication Mechanisms

Security of hash functions, MAC, Authentication protocols and applications: Passwords, Biometrics, Message Digest algorithms, Digital signature, Kerberos

Unit V

Introduction to data privacy

Definitions, Statistics, Data Privacy policies,privacy in differentdomains- medical, financial etc.
Problems producing anonymous data.

Unit VI

Privacy Techniques & Protection Models

Disclosure Risk, Suppression and Generalization, Anonymization Techniques, k-Anonymity, Overview of Differential Privacy& techniques.

Course Outcomes:

On completion of the course the student will be able to

1. Identify and investigate network security threat.

2. Apply encryption techniques to build security related applications.

3. Solve the problems related to key generation and key exchange algorithms.

4. Analyse the privacy attacks for real life application

5. Apply privacy related algorithms for risk assessment.

Text Books

1. William Stallings; Cryptography & Networks Security Principles and Practice; 6th Edition
Pearson Education, 2013.
2. Behrouz A. Forouzan, Cryptography and network security MC Graw Hill 3rd Edition
3.L. Sweeney, Computational Disclosure Control: A Primer on Data Privacy Protection, MIT Computer Science, 2002.
4.The Algorithmic Foundations of Differential Privacy, by Cynthia Dwork and Aaron Roth

5.B.Raghunathan, The Complete Book of Data Anonymization: From Planning to Implementation, Auerbach Pub, 2013.

Reference Books

1. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall PTR
2. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall
3. Cryptography: Theory and Practice by Douglas R. Stinson, CRC press.

Syllabus for Semester V, B. Tech. CSE (Data Science)

Course Code: CDP303 **Course: Programming Language Lab**

L: 0Hrs, T: 0 Hr, P: 4Hr, Per Week **Total Credits: 02**

Course Objectives

- The objective of this course is to develop the ability of student to design android applications.
- Use various features of android like broadcast receivers, services, threads, content providers etc. Effectively use files and database to store the data.
- Use location based services to develop navigation based application.

Syllabus

- UI Widgets and layout Manager
- Activity, Intent and fragment
- Android Menu
- Data Storage
- Android Service
- Android Notification, Dialog, SMS and Broadcast Receiver
- SQLite and Content Provider and Location Services

Course Outcomes

1. Design Basic android applications using UI Resources: Activity, viewgroup and Intents and enhance user interactivity by using toast, notification, dialogs
2. Effectively use android's API's for data storage, retrieval, preferences, files, databases and content providers.
3. Implement Android's communication APLs for SMS, location based services.
4. Develop efficient applications by utilizing background services and broadcast receivers.

Text Books

1. Beginning android programming with android studio, 4E by J. F. DiMarzio, Wrox publication
2. Professional android 4 application development by Reto Meier, Wiley Publication

Reference Book

1. Android programming for beginners – Second Edition by John Horton, Packt Publishing Pvt. Ltd

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDT304 **Course: Compiler Design**

L: 3Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Pre-requisite

- Theory of Computation

Course Objectives

- To understand the theory and practice of compiler implementation.
- To explore the principles, algorithms, and data structures involved in the design and construction of compilers.
- To understand various phases of compiler and their working.

Syllabus:

UNIT I

Introduction to Compilers- Introduction to Compilers, Phases of compiler design, Relating Compilation Phases with Formal Systems.

Lexical Analysis- Lexical analysis, tokens, pattern and lexemes, Design of Lexical analyzer, Regular Expression, transition diagram, recognition of tokens, Lexical Errors.

UNIT II

Syntax Analysis- Specification of syntax of programming languages using CFG, Top- down parser, design of LL(1) parser, bottom up parsing technique, Handle and Viable Prefix, LR parsing, Design of SLR, CLR, LALR parsers, Parser Conflicts, Handling Ambiguous Grammars, Applications of the LR Parser.

UNIT III

Syntax directed translation- Study of syntax directed definitions & syntax directed translation schemes, Type and Type Checking, A Simple Type Checking System, implementation of SDTS, intermediate notations- postfix, syntax tree, TAC, translation of Assignment Statement, expressions, controls structures, Array reference.

UNIT IV

Storage allocation & Error Handling- Run time storage administration stack allocation, Activation of Procedures, Storage Allocation Strategies, Garbage Collection, symbol table management, Error detection and recovery- lexical, syntactic and semantic.

UNIT V

Code optimization- Machine-independent Optimisation- Local optimization techniques, loop optimization-control flow analysis, data flow analysis, Loop invariant computation, Induction variable removal, other loop optimization techniques, Elimination of Common sub expression, and Machine-dependent Optimization techniques.

UNIT VI

Code generation – Problems in code generation, Simple code generator, code generation using labelling algorithm, Register allocation by Graph Colouring, Code Generation by Dynamic Programming.

Course Outcome:

At the end of the course, the students should be able to:

1. Implement lexical analyzer from language specification.
2. Realize bottom up and top down parses incorporating error handling.
3. Demonstrate syntax directed translation schemes, their implementation for different programming language constructs.
4. Implement different code optimization and code generation techniques using standard data structures.

Text Books:

1. Aho, Sethi, and Ullman; Compilers Principles Techniques and Tools; Second Edition, Pearson education, 2008.
2. Alfred V. Aho and Jeffery D. Ullman; Principles of Compiler Design; NarosaPub.House, 1977.
3. Manoj B. Chandak, Khushboo P Khurana; Compiler Design; Universities Press, 2018.

Reference Books:

1. Vinu V. Das; Compiler Design using Flex and Yacc; PHI Publication, 2008.
2. V. Raghavan; Principles of Compiler Design, McGraw Hill Education (India), 2010.

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDT305-1 Course: Digital Image Processing (Program Elective I)

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Pre-requisite

- MAT272: Mathematics for Data Science

Course Objectives

1. To introduce the concepts of image processing and basic analytical methods to be used in image processing.
2. To familiarize students with image enhancement and restoration techniques,
3. To explain different image compression techniques.
4. To introduce segmentation and morphological processing techniques.

Syllabus:

Unit-1

Introduction to Digital Image Processing

What is Digital Image Processing, The Origins of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System ,

Digital Image Fundamentals: Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Mathematical Tools

Unit-2

Intensity Transformations and Spatial Filtering

Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Using Fuzzy Techniques for Intensity Transformations and Spatial Filtering

Filtering in the Frequency Domain: Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform (DFT) , Filtering, Image Smoothing, Image Sharpening, Selective Filtering

Unit-3

Image Restoration and Reconstruction:

Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Geometric Mean Filter

Unit-4

Color Image Processing

Color Fundamentals, Color Models, Pseudocolor Image Processing, Color Transformations, Smoothing and Sharpening, Image Segmentation, Noise in Color Images

Image Compression : Need for Data Compression, Huffman Coding, Golomb coding, Arithmetic coding

Unit-5

Morphological Image Processing

Erosion and Dilation, Opening and Closing, Hit-or-Miss Transformation, Morphological Algorithms: Boundary Extraction, Hole Filling, Extraction of Connected Components , Convex Hull, Thinning, Thickening, Skeletons, Pruning, Morphological Reconstruction

Image Segmentation: Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, The Use of Motion in Segmentation

Unit-6
Object Recognition
Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Neural Network, CNN

Course Outcome:
At the end of the course, the students should be able to:

1. Understand fundamentals of digital image and its processing.
2. Perform image enhancement techniques in spatial and frequency domain.
3. Elucidate the mathematical modelling of image restoration and compression
4. Apply the concept of image segmentation

Text Books:

1. Digital Image Processing, RafealC.Gonzalez, Richard E.Woods, Third Edition, Pearson Education/PHI

Reference Books:

1. Digital Image Processing, Kenneth R Castleman, Pearson Education.
2. Digital Image Procesing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill, Education, 2009.

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDT305-1 Course: Digital Image Processing Lab (Program Elective I)

L: 0Hrs, T: 0 Hr, P: 02Hr, Per Week Total Credits: 01

Course Objectives

1. To introduce the concepts of image processing and basic analytical methods to be used in image processing.
2. To familiarize students with image enhancement and restoration techniques,
3. To explain different image compression techniques.
4. To introduce segmentation and morphological processing techniques

Syllabus

The instructor should design the practical such that the student should be able to design and simulate the following exercises in Python |C|C++:

- Mathematical Operations On Images
- Image Enhancement With Spatial Filters
- Image Enhancement With Frequency Filters
- Morphological Operations On Image
- Edge Detection And Linking
- Image Segmentation
- Working With Color Models

Course Outcomes:

At the end of the course, the students should be able to:

1. Implement algorithms that perform basic image processing like noise removal and image enhancement
2. Perform morphological operations on images and work with color images.
3. Apply algorithms for advanced image analysis like image segmentation, edge detection and extraction of region of interest

Text Books:

1. Hands-On Image Processing With Python, Sandipan Dey,Packt, 2018

Reference Books:

1. J.C. Russ," The Image Processing Handbook", (5/e), CRC, 2006
2. R.C.Gonzalez& R.E. Woods; "Digital Image Processing with MATLAB", Prentice Hall, 2003

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDT305-2 Course: Data Warehousing and Business Intelligence(Program Elective I)

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Objectives

- To understand data warehouse concepts and conduct dimensioning modeling in building data warehouses
- To know business intelligence architecture
- To understand enterprise reporting techniques
- To study big data analytics techniques and understand application of stream analytics
- To demonstrate data visualization and perform visualization analytics

Syllabus:

UNIT-I:

Introduction to BI, Leveraging Data and knowledge for BI, BI Components, BI Dimensions, Information Hierarchy, Business Intelligence and Business Analytics. BI Architecture , BI Life Cycle. Role of Data Warehousing in BI, data warehousing building blocks, Metadata in the data warehouse

UNIT-II:

Architecture of DW, OLTP vs OLAP, Dimensional modelling : dimensions and facts, Star and Snowflake schema, pros & cons of the Star / Snowflake schema, Types of dimension and facts.

UNIT-III:

Basics of Data Integration: Concepts of data integration need and advantages of using data integration, introduction to common data integration approaches, data integration technologies, Introduction to data quality, data profiling concepts and applications. Extraction, Transformation, and Load.

UNIT-IV:

Data and Information Visualization, Different Types of Charts and Graphs, The Emergence of Data Visualization and Visual Analytics, Performance Dashboards, Business Performance Management

UNIT-V:

Enterprise Reporting : Introduction to business metrics and KPIs, Basics of Enterprise Reporting: Introduction to enterprise reporting, concepts of dashboards, balanced scorecards, Business Activity Monitoring, Six Sigma.Memento Design pattern and its implementation

UNIT-VI:

Big Data and Future Directions for Business Analytics: Fundamentals of Big Data Analytics, Big Data Technologies, Data Scientist, Big Data and Data Warehousing, Big Data and Stream Analytics, Applications of Stream Analytics.

Course Outcome:

After the completion of the course, the students will be able to:

1. Implement the concepts of data warehousing
2. Apply appropriate BI methods to find solutions to business problems
3. Create appropriate visualizations for the given business problem
4. Demonstrate application of big data in business anaytics

Text Books:

1. Business Intelligence: A Managerial Perspective on Analytics, 3rd Edition, Ramesh Sharda, Dursun Delen, Efaim Turban, Prentice Hall 2013
2. Fundamentals of Business Analytics, R N Prasad and S Acharya, Wiley India.
3. Paulraj Ponnian, - Data Warehousing Fundamentals||, John Willey

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDP305-2 **Course: Data Warehousing and Business IntelligenceLab**

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Implement the ETL process.
2. Design a data warehouse
3. Execute OLAP queries on a data warehouse.
4. Design good visuals for effective analysis.
5. Create good reports.

Practicals based on above CDT305-2 syllabus

Course Outcomes:

1. Design multi-dimensional databases and data warehouse.
2. Implement online analytical processing (OLAP) queries.
3. Perform data analytics on big data.
4. Design and construct a dynamic reporting solution.

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDT305-3 **Course: Design Patterns (Program Elective I)**

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Pre-requisite

1. CDT104: Object Oriented Programming
2. CDP104: Object Oriented Programming Lab
3. CDP203: Advanced Object Oriented Programming Lab

Course Objectives

- To learn the fundamentals of software design by referring a catalog of design patterns:
- Demonstrate how to use design patterns to address code design and user interface issues.
- Identify the most suitable design pattern to address a given application design problem.
- Apply design principles (e.g., open-closed, dependency inversion, etc.).
- Critique code by identifying and refactoring anti-patterns.

Syllabus:

UNIT-I:

Elements of Design Pattern, Describing Design Pattern, Design Pattern Classification, Role of design Patterns in software design, how design patterns solve design problems, selection and use of Design Pattern, Example implementation of design pattern using UML

UNIT-II:

Creational Patterns:

Creational Design pattern: Introduction, Role of Creational pattern, instantiation of objects using creational patterns, Types i) Factory method ii) Abstract Factory iii) Builder iv) Prototype v) Singleton, Structure and comparison of various types of creational patterns, Examples of creational patterns.

UNIT-III:

Structural Design Patterns:

Structural Design Pattern: Introduction, Role of Structural pattern, creating flexible and efficient arrangement of objects and classes using structural patterns, Types i)Adapter ii) Bridge iii)Composite iv) Decorator v)Façade vi) Proxy, Structure and comparison of various types of structural patterns, Examples of structural patterns, Comparative study of Creational and Structural Design patterns

UNIT-IV:

Behavioral Patterns-I:

Behavioral Design pattern: Introduction, Role of Behavioral pattern, Types: Interpreter Design pattern, Language grammar handling using interpreter design pattern, Template Method, Implement run-time variable on template design pattern, Iterator design pattern, Handling aggregate objects using Iterator design pattern, Chain of Responsibility principle, Methodology of responsibility sharing using request passing approach, Example of functional responsibility of object.

UNIT-V:

Behavioral Patterns-II:

Mediator Design Pattern, Analysis of Mutual Behavior of classes, Observer Design Pattern, Effect of single object on set of objects, Reference control between objects, State Design Pattern, State-wise behavior of object, Strategy

Design pattern, selecting an algorithm at runtime Memento Design pattern and its implementation

UNIT-VI:

A Case Study: Designing a Document Editor:

Design Problems, Document Structure, and Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations, Spelling Checking and Hyphenation, Summary, Complexity computation of Various Design Patterns.

Course Outcome:

After the completion of the course, the students will be able to:

1. Apply the knowledge of applicability, structure and consequences characterstics of design pattern in software design.
2. Identify role, functionality and various abilities of Creational and Structural design patterns in software design.
3. Identify role, functionality and various abilities of Behavioral design pattern in software design.
4. Demonstrate the design of software using design patterns and evaluate complexity of design process.

Text Books:

1. Design Patterns by Erich Gamma, Pearson Education
2. Design Patterns Explained by Alan Shalloway and James Trott, Addison-Wesley; 2nd edition

Reference Books:

1. Pattern's in JAVA Vol-I by Mark Grand, WileyDreamTech.
2. Pattern's in JAVA Vol-II by Mark Grand, WileyDreamTech.
3. JAVA Enterprise Design Patterns Vol-III by Mark Grand, WileyDreamTech.
4. Head First Design Patterns by Eric Freeman, O'Reilly

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDP305-3 **Course: Design Patterns Lab (Program Elective I)**

L: 0Hrs, T: 0 Hr, P: 02Hr, Per Week **Total Credits: 01**

Course Outcomes:

On successful completion of the course, students will be able to:

1. Construct a design consisting of a collection of modules.
2. Apply creational, structural, behavioral design patterns to incremental/iterative development.
3. Design the software using Pattern Oriented Architectures.

Practicals based on above CDT305-3 syllabus

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDT305-4 Course: Health Informatics (Program Elective I)

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Objectives

- Introduce students to problems and challenges that health informatics addresses
- Educate students to the research and practice of health informatics
- Provide all students with basic skills and knowledge in health informatics to apply in their future health-related careers
- Lead students in discussion around ethical and diversity issues in health informatics

Syllabus:

Unit-1

Overview of Health Informatics: Introduction, Health Informatics programs, organization, Resources

Healthcare data, Information, Knowledge: Flow of Data to Information to Knowledge, Clinical Data Warehouse (CDWS), Market Informatics

Unit-2

Healthcare Data Analytics: Introduction, challenges, Application of analytics and Role of informaticians in analytics

Electronic Health Records: Need, Key Components, Clinical decision support system (CDSS), Electronic prescribing, Example case studies

Unit-3

Health Information Exchange: Health information network, Organizations related to Health information, Examples and concerns

Data Standards and Medical Coding: Content standards, Transport standards, Medical coding standards

Unit-4

Health Information Privacy and Security: Health Insurance Portability and Accountability Act (HIPAA) review, security principles, security breach and attacks, news analysis related to current medical privacy and security stories, Architecture of Information System

Unit-5

Health Information Ethics: Medical ethics in digital world, Health information system ethics and medical students

Mobile Technology: Mobile Health (MHealth), Mobile technology to track health habits, Mobile Telemedicine

Unit-6

Data science, Analytics and Visualization in Health Informatics: Understanding the clinical data, pitfalls, Role of analytics in improving health care, Case studies

Course Outcome:

At the end of the course, the students should be able to:

1. Develop knowledge about problems and challenges that health informatics addresses
2. Understand basic knowledge of healthcare data analytics and data standards and medical coding
3. Analyze privacy, security ethical and diversity issues in health informatics
4. Illustrate visualization and simple analysis of a clinical datasets

Text Books:

1. Hoyt, RE and Yoshihashi, A, Eds. (2014). Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, Sixth Edition. Pensacola, FL, Lulu.com

Reference Books:

1. Health Care Information Systems: A Practical Approach for Health Care Management, 4th Edition Karen A. Wager, Frances W. Lee, John P. Glaser
2. Wager, K. A., Lee, F. W., & Glaser, J. P. (2017). Health care information systems: A practical approach for health care management -4th Edition, Jossey-Bass

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDP305-4 **Course: Health Informatics Lab (Program Elective I)**

L: 0Hrs, T: 0 Hr, P: 02Hr, Per Week **Total Credits: 01**

Course Outcomes:

On successful completion of the course, students will be able to:

1. 1. Implement fundamental concepts in health informatics.
2. Demonstrate health information exchange, data standards and medical coding.
3. Perform tracking on health habits using Mobile technology
4. Demonstrate visualization in health informatics on clinical data

Practicals based on above CDT305-4syllabus

Syllabus for Semester V, B. TECH. CSE (Data Science)

Course Code: CDP306 **Course: Project Based Learning - I**

L: 0Hrs, T: 0 Hr, P: 06Hr, Per Week **Total Credits: 03**

Course Objectives:

The objective of the project based learning is to let the students map and utilize the technical knowledge acquired in the previous semesters to solve a real-world problem through team effort.

Course Outcomes:

On completion of this course, the student will be able to

1. Identify and finalize the problem statement by investigating various domains and society needs.
2. Perform requirement analysis and design methodology for solving the identified problem.
3. Apply programming techniques and modern tools for the development of the solution.
4. Apply ethical principles, project management skills and demonstrate the ability to work in teams for project development within the confines of a deadline.
5. Communicate technical information employing written reports and presentations.

Semester-VI

Sr. No.	Category	Course Code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Conti-nuousEvaluation	End Sem Exam	Total	
1.	PCC	CDT307	Design and Analysis of Algorithm	3	0	0	3	40	60	100	3Hrs
2.	PCC	CDT308	Deep Learning - I	3	0	0	3	40	60	100	3Hrs
3.	PCC	CDP308	Deep Learning – I Lab	0	0	4	2	25	25	50	-
4.	PEC	CDT309	Program Elective - II	3	0	0	3	40	60	100	3Hrs
5.	PEC	CDP309	Program Elective – II Lab	0	0	2	1	25	25	50	-
6.	PCC	CDT310	Software Engineering and Testing Methodologies	3	0	0	3	40	60	100	3Hrs
7.	PCC	CDP310	Software Engineering and Testing MethodologiesLab	0	0	2	1	25	25	50	-
8.	PR	CDP311	Project Based Learning - II	0	0	6	3	25	25	50	-
9.	OEC		Open Elective-III / MOOC	3	0	0	3	40	60	100	3Hrs
			TOTAL	15	0	14	22			700	-

Course Code	Program Elective – II
CDT309-1	Computer Vision
CDT309-2	Natural Language Processing
CDT309-3	IOT systems and cloud
CDT309-4	Data Science for Healthcare

Course Code	Program Elective – II Lab
CDP309-1	Computer Vision Lab
CDP309-2	NaturalLanguageProcessingLab
CDP309-3	IOT systems and cloud Lab
CDP309-4	DataScienceforHealthcareLab

	Recommended course from MOOC
1	Business Analytics

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDT307 **Course: Design and Analysis of Algorithm**

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Objectives

1. To familiarize the students with techniques for effective problem solving in computing.
2. To enable the students to analyze different paradigms of problem solving to solve a given problem in efficient way.

Syllabus

UNIT I

Mathematical foundations for arithmetic and geometric series, Recurrence relations and their solutions, Principles of designing algorithms and complexity calculation, Asymptotic notations for analysis of algorithms, worst case and average case analysis, amortized analysis and it's applications.

UNIT II

Divide and Conquer- basic strategy, Binary Search, Quick sort, Merge sort, Strassen's matrix multiplication, Maximum sub-array problem, Closest pair of points problem, Convex hull problem.

UNIT III

Greedy method – basic strategy, fractional knapsack problem, Minimum cost spanning trees, Huffman Coding , activity selection problem, Find maximum sum possible equal to sum of three stacks, K Centers Problem.

UNIT IV

Dynamic Programming -basic strategy, Bellmen ford algorithm, all pairs shortest path, multistage graphs, optimal binary search trees, traveling salesman problem, String Editing, Longest Common Subsequence problem and its variations.

UNIT V

Basic Traversal and Search Techniques, breadth first search and depth first search, connected components. Backtracking basic strategy, 8-Queen's problem, graph coloring, Hamiltonian cycles, sum of subset problem, Introduction to Approximation algorithm.

UNIT VI

NP-hard and NP-complete problems, basic concepts, non-deterministic algorithms, NP-hard and NPcomplete, decision and optimization problems, polynomial reduction,graph based problems on NP Principle , vertex cover problem, clique cover problem

Course Outcomes

On successful completion of the course, students will be able to:

1. Use mathematical formulation, complexity analysis and methodologies to solve the recurrence relations for algorithms.
2. Apply Greedy and Divide and Conquer algorithms and their usage in real life examples.
3. Apply Dynamic programming and Backtracking Paradigms to solve the real life problems.
4. Analyze NP class problems and formulate solutions using standard approaches.

Text Books

1. Thomas H. Cormen et.al; “Introduction to Algorithms”; 3 Edition; Prentice Hall, 2009.
2. Horowitz, Sahani and Rajasekaram; “Computer Algorithms”, Silicon Press, 2008.
3. Brassard and Bratley; “Fundamentals of Algorithms”, 1 Edition; Prentice Hall, 1995. 4. Richard Johnsonbaugh, “Algorithms”, Pearson Publication, 2003.

Reference Books

1. Parag Himanshu Dave, Balchandra Dave, “Design and Analysis of Algorithms” Pearson Education, O’relly publication
2. Richard Johnsonbaugh, “Algorithms”, Pearson Publication, 2003.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDT308 **Course: Deep Learning - I**

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week **Total Credits: 03**

Course Objectives:

4. To introduce basic deep learning algorithms.
5. To understand real world problem which will be solved by deep learning methods.
6. To identify deep learning techniques suitable for a real world problem.

Course Syllabus:

UNIT I:Basic of Deep Learning

History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed forward Neural Networks

UNIT II: Training of feedforward Neural Network

Representation Power of Feed forward Neural Networks, Training of feed forward neural network, Gradient Descent, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam

UNIT III: Optimization Algorithm

Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Activation Function and Initialization Methods: Sigmoid, Tanh, Relu, Xavier and He initialization,
Regularization: Bias and variance, Overfitting, Hyperparameters tuning, L1 and L2 regualarization, Data Augmentation and early stopping, Parameter sharing and tying

UNIT IV: Convolution Neural Network (CNN)

Convolutional Neural Networks, 1D convolution network, 2D convolution network Visualizing Convolutional Neural Networks, Guided Backpropagation

UNIT V: Recurrent Neural Network (RNN)

Recurrent Neural Networks, Backpropagation through Time (BPTT), Vanishing and Exploding Gradients, Long Short Term Memory (LSTM) Cells, Gated Recurrent Units (GRUs)

UNIT VI: Variants of CNN and RNN

Encoder Decoder Models, Attention Mechanism, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet

Course Outcomes:

On successful completion of the course, students will be able to:

1. Train fully connected deep neural networks to real world problem.
2. Evaluate the performance of different deep learning models with respect to the optimization, bias-variance trade-off, overfitting and underfitting etc.
3. Apply the convolution networks and recurrent neural networks in context with real world problem solving.
4. Design variants of convolution networks and recurrent neural networks for various real world problems.

Text Books:

1. Sandro Skansi,Introduction to Deep Learning ,Springer
2. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
4. Dr. S Lovelyn Rose,Dr. L Ashok Kumar,Dr.D Karthika Renuka ,Deep Learning using Python,Willey Publication

Reference Books:

1. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. A. Ravindran, K. M. Ragsdell , and G. V. Reklaitis, Engineering Optimization: Methods and Applications , John Wiley & Sons, Inc. , 2016.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDP308 **Course: Deep Learning – I Lab**

L: 0 Hrs, T: 0 Hr, P: 4Hr, Per Week **Total Credits: 02**

Course Objectives:

4. To solve problems in linear algebra, probability, optimization.
5. To understand the usage of publically available datasets.
6. To use various python packages and tools for deep learning.

Course Syllabus:

Experiments based on

1. Implementation of Linear Algebra, Probability etc.
2. CDT308 (Deep Learning-I) Syllabus.

Technology: Python, Tensorflow/Pytorch

Course Outcomes:

On completion of the course the student will be able to

1. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
2. Implement deep learning models in Python using the PyTorch/Tensorflow library and train them with real-world datasets.
3. Analyze a deep learning model's hardware node and GPU scalability.

Text Books:

1. Sandro Skansi,Introduction to Deep Learning ,Springer
2. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Reference Books:

3. Francois Chollet,Deep Learning with Python , Manning Publications Co.
4. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDT309-1 Course: Computer Vision (Program Elective II)

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Prerequisite:

Basic knowledge of Image Processing and Computer graphics is encouraged.

Computer Vision focuses on development of algorithms and techniques to analyze and interpret the visible world around us. The main objectives of this course are:

1. To understand the fundamental concepts related to computer vision like multi-dimensional signal processing, image formation, image alignment, feature extraction, pattern analysis visual geometric modelling, etc.
2. To explore topics like motion analysis, tracking and other topics with the scope of research to be able to contribute towards the research and further developments in the field of computer vision.
3. To understand various applications ranging from Biometrics, Medical diagnosis, document processing, to surveillance, advanced rendering etc.

Syllabus:

UNIT-I

Introduction to computer vision, Digital Image Formation and Camera Geometry: Fundamentals of Image Formation, Transformations in 2D: translation, rotation, scaling, shearing; affine and rigid transformations, Transformations in 3D: translation, rotation about X,Y,Z axis, rotation about arbitrary axis, 3D affine, homogeneous coordinates in 2D and 3D, Concept of pinhole camera, camera calibration, Homography, Stereo Geometry, Binocular Stereopsis: Camera and Epipolar Geometry, Depth estimation.

UNIT-II

Image Alignment: Physically and digitally corresponding points, Feature detection and description: Line detectors (Hough Transform), Corners - Harris and Hessian Affine, SIFT, SURF, HOG, Feature matching and model fitting, RANSAC, Control point based image alignment using least squares - derivation for pseudo-inverse, Applications of image alignment.

UNIT-III

Motion and Optical Flow: Motion Analysis: Background Subtraction and Modeling, Horn and Shunck method, Lucas-Kanade algorithm, Feature Point Tracking, motiving object detection and tracking; Kalman filter

UNIT-IV

Adaboost algorithm: binary classification, face detection, Adaboost for Computation of Haar-like features; Image Segmentation; Object recognition and shape representation**.**

UNIT-V

Pattern Analysis: Clustering: K-Means, K-Medoids, Classification: Supervised, Un-supervised, Semi-supervised; Classifiers: KNN, ANN models; Viola Jones algorithm for face detection and Boosting: Features, Integral images, Boosting, cascade; Activity Recognition in videos.

UNIT-VI

Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods; deep neural architectures and applications.

Course Outcomes:

After successful completion of the course students will be able to:

1. Review the basic concepts, terminology, theories, models and methods in the field of computer vision.
2. Analyse, evaluate and examine various computer vision system and access their novelty, applicability and practicability.
3. Choose appropriate method and apply it to solve problems in the field of computer vision.
4. Formulate, suggest design and develop a computer vision application or system.

Text Books:

1. Computer Vision: Algorithms and Applications by R. Szeliski, Springer, 2011.
2. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill, 2nd ed., 2011.
3. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall, 1998.

Reference Books:

1. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.
2. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.
3. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.
4. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012
5. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012
6.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDP309-1 **Course: Computer Vision Lab (Program Elective II)**

L: 0 Hrs, T: 0 Hr, P: 2Hr, Per Week **Total Credits: 01**

Course Prerequisite:

Basic knowledge of Image Processing is encouraged.

Course Objectives:

This laboratory course is intended to make the students experiment with various algorithms and techniques of computer vision, to gain deeper insights of visual representations.

Syllabus:

Experiments based on syllabus of Computer Vision (CDT309-1).

Course Outcomes:

On successful completion of the course, students will be able to

1. Implement and test some fundamental computer vision algorithms.
2. Extract features and use these features for tasks like object recognition, face detection, etc.
3. Perform image alignment, Pattern Analysis and dimensionality reduction.
4. Implement various video processing tasks, perform motion computation and tracking.

Text Books:

1. Multiple View Geometry in Computer Vision 2nd Edition
2. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDT309-2 Course: Natural Language processing (Program Elective II)

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Pre-requisite

- Compiler Design

Course Objectives

- To introduce students to the basic mathematical models and methods used in NLP applications.
- To provide students with in-depth understanding on designing procedures for natural language resource annotation and the use of tools for text analysis.
- To encourage students towards research in information retrieval, information extraction and knowledge discovery.

Syllabus:

UNIT-I: Introduction

NLP tasks in syntax, semantics, and pragmatics. Key issues & Applications such as information extraction, question answering, and machine translation. Problem of ambiguity. Role of machine learning. Brief history of the field.

UNIT-II: N-gram Language Models

Role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Part Of Speech Tagging and Sequence Labeling Lexical syntax. Hidden Markov Models. Maximum Entropy models.

UNIT-III: Syntactic parsing

Grammar formalisms and tree banks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs

UNIT-IV: Semantic Analysis

Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

UNIT-V: Information Extraction (IE)

Named entity recognition and relation extraction. IE using sequence labeling. Automatic summarization Subjectivity and sentiment analysis.

UNIT-VI: Machine Translation (MT)

Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars.

Course Outcome:

At the end of the course, the students should be able to:

1. Implement methods for morphological analysis and POS tagging.
2. Design formal grammars for NLP.
3. Implement important parsing algorithms, and evaluate parsing systems.
4. Implement information extraction, NER & perform sentiment analysis for accurate MT process.

Text Books:

1. D. Jurafsky and R. Martin; Speech and Language Processing; 2nd edition, Pearson Education, 2009.
2. Allen and James; Natural Language Understanding; Second Edition, Benjamin/Cumming, 1995.
3. Charniack& Eugene, Statistical Language Learning, MIT Press, 1993.

Reference Books:

1. Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal; NLP: A Paninian Perspective, Prentice Hall, New Delhi, 1994.
2. T. Winograd; Language as a Cognitive Process; Addison-Wesley, 1983.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDP309-2 Course: Natural Language Processing Lab (Program Elective II)

L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week Total Credits: 01

Course Pre-requisite

- Compiler Design

Course Objectives

This laboratory course is intended to make the students experiment with fundamental concepts of Natural Language Processing. They will be able to implement systems for natural language processing, with an emphasis on Traditional NLP tasks and more recent NLP tasks such as language models, sentiment analysis, parsing, information extraction. It will encourage students towards research in the field of NLP and make them contribute towards the research.

Syllabus:

Experiments based on syllabus of Natural Language Processing (CDT309-2).

Course Outcomes:

On successful completion of the course, students will be able to

1. Implement traditional natural language processing techniques and algorithms.
2. Implement more recent and advanced NLP tasks.
3. Select and Apply appropriate technique to real problems in NLP domain and develop various NLP applications.

Text Books:

1. Multiple View Geometry in Computer Vision 2nd Edition
2. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDT309-3 Course: IOT systems and Cloud (Program Elective II)

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Pre-requisite

- Operating Systems, Computer Networks.

Course Objectives

The objective of this course is to impart necessary and practical knowledge of components of Cloud computing and develop skills required to design real-life cloud based projects by:

- Learning basic issues, policy and challenges in the Internet of Things.
- Understanding application areas where Internet of Things can be applied.
- Learning concepts of virtualization, cloud and challenges in implementation.
- Understanding the concepts of migration and areas where cloud computing can be applied.

Syllabus:

UNIT I

Introduction to IoT: Definition, Characteristics, Physical design, Logical design, Functional blocks, Components in internet of things, Sensors and Actuators, M2M and IoT Technology Fundamentals- Devices and gateways, Challenges in IoT: Design challenges, Development challenges, Security challenges, other challenges.

UNIT II

Message Queue Telemetry Transport(MQTT), XMPP, Advanced Message Queuing Protocol (AMQP), Connectivity Technologies & Communication Protocols: IEEE 802.15.4, Bluetooth, RFID, HART, Network layer- IP/ IPv6, Transport Layer- UDP, TCP, Application Layer- Constrained Application Protocol(CoAP), HTTP.

Basics of Networking: Sensor Networks: Wireless sensor networks, sensor nodes, its components. IoT network configurations, Network & Communication: Wireless medium access issues, MAC protocol survey, Survey routing protocols.

UNIT III

Resource Management in the Internet of Things: Clustering, Software Agents, Data Synchronization, Clustering Principles in an Internet of Things Architecture, The Role of Context, Design Guidelines, Software Agents for Object, Role of Data Synchronization.

Interoperability in IoT, Cloud in IoT, Iot to Web of Things, Cloud of Things, Introduction to different IoT tools,developing applications through IoT tools, Introduction to development of sensor based application through embedded system platform.

UNIT IV

Introduction to Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning, Applications, deployment models - Public, Private and Hybrid Clouds, and service models - Infrastructure as a Service (IaaS) - Resource Virtualization: Server, Storage,Network. Platform as a Service (PaaS) - Cloud platform & Management: Computation, Storage. Software as a Service (SaaS) - Anything as a service (XaaS).

UNIT V

Virtualization: Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms,Issues with virtualization, virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, introduction to Various Hypervisors, virtualization of data centers, and Issues with Multi-tenancy.

UNIT VI

Resource Management and Load Balancing: Dynamic provisioning and resource management, Resource Optimization, Resource dynamic reconfiguration, Load Balancing, various load balancing techniques, Migration-Migration of virtual Machines and techniques, Interoperability, and Fault Tolerance,Security issues.

Course Outcome:

On successful completion of the course, the student will be able to:

1. Analyze various concepts in Internet of Things, protocols of IoT and network configurations
2. Manage IoT resources, understand interoperability and role of cloud in IoT.
3. Articulate the concepts of cloud computing, its various deployment and service models.
4. Develop the concepts of virtualization, virtual machine live migration and fault tolerance mechanism.

Text Books:

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier – 2012
2. "Cloud Computing Principles and Paradigms", RajkumarBuyya,JamesBroberg, AndrzejGoscinski, Wiley Publishers.2011
3. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press-2012.
4. Dieter Uckelmann, Mark Harrison, "Architecting the Internet of Things", Springer2011.
5. ArshdeepBahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.
6. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

Reference Books:

1. Barrie Sosinsky, " Cloud Computing Bible" John Wiley & Sons, 2010
2. Technical research papers from major journals and major conferences on cloud computing.
3. Luigi Atzori, Antonio Lera, GiacomoMorabito, "The Internet of Things: A Survey", Journal on Networks, Elsevier Publications, October, 2010.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDP309-3 Course: IOT systems and Cloud Lab (Program Elective II)

L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week Total Credits: 01

Course Objectives

The objective of this course is to impart necessary and practical knowledge of components of Cloud computing and develop skills required to build real-life cloud based projects by:

1. Learning basic implementation issues and challenges in the configuration of Internet of Things based applications.
2. Understanding the areas and various tools used for communications based on Internet of Things.
3. Studying various cloud environments and implementing various cloud programming concepts.
4. Designing and developing processes involved in creation of a cloud based application.

Practical's based on CDT309-3 syllabus

Experiments based on syllabus of Natural Language Processing (CDT309-2).

Course Outcomes:

On completion of this course, the students will be able to:

1. Evaluate the mechanism of IoT protocols, network configurations and resources.
2. Design IoT applications in different domains and using different tools.
3. Configure various virtualization and load balancing tools.
4. Design, deploy, install and use a generic cloud environment tools and applications.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDT309-4 Course: Data Science for Healthcare (Program Elective

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Pre-requisite

Health Informatics

Course Objectives

- Understanding healthcare data and data preprocessing techniques.
- Learn data preprocessing tools and techniques used for problem solving in healthcare industry.
- Learn predictive model for healthcare application and develop a prototype model for healthcare application.

Syllabus:

Unit-1

Understanding HealthCare Data:

Data information, knowledge and wisdom hierarchy, sources of health care data, Challenges in healthcare data collection and sourcing, approach for effective use of data collection and sourcing methods.

Unit-2

Data Preparation

Information and data value chain, data context and preparation processes, common data types, basic statistical terms, understanding common patterns or distributions in data, data distributions using numerical measures such as mean, median and standard deviation.

Unit-3

Data processing Tools and Techniques:

Understanding data analytics terms, role of the data processing, tools and techniques used to analyze and interpret healthcare data effectively, understanding hierarchy of databases and how they are structured, enterprise data architecture in health care organizations.

Unit-4

Problem Solving:

Measures, metrics, and indicators, use of Key Performance Indicators (KPI's), health care organizations to prioritize performance, various problem-solving model and the tools, techniques and methodologies used to solve health care issue.

Unit-5

Predictive Analytics:

Stemming, experimental data with interactions between all components of health and disease and environmental factors. Using healthcare data to understand various predictive models using classification and clustering techniques.

Unit-6

Application Prototyping:
Address biological and healthcare case studies. Cases will be analyzed in terms of what data are generated and use in the case, and how that data can be represented, visualized and analyzed computationally so as to address the biological or healthcare challenge and decide appropriate predictive model to address the issue.

Course Outcome:
At the end of the course, the students should be able to:

- To understanding healthcare data and data preprocessing techniques.
- To understand data preprocessing tools and techniques used for problem solving in healthcare industry.
- To understand predictive model for healthcare application.
- To design and develop a prototype model for healthcare application.

Books:

1. Data Science Fundamentals And Practical Approaches by Rupam Kumar Sharma Gypsy Nandi, BPB Publications
2. Data Science for Healthcare: Methodologies and Applications by Sergio Consoli , Diego ReforgiatoRecupero, Milan Petković, Springer, 2019.
3. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'REILLY Publication, 2nd Edition, by Wes McKinney.
4. Practical Statistics for Data Scientists: Concepts Using R and Python O'REILLY 2nd Edition by Peter Bruce , Andrew Bruce , Peter Gedeck.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDP309-4 Course: Data Science for Healthcare Lab (Program Elective II)

L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week Total Credits: 01

Lab Syllabus:

- Identification and selection of appropriate tools for healthcare data processing and application development.
- Perform exploratory data analysis (EDA) (Data Sourcing, Web scraping, Data cleaning, etc.) over healthcare data using python packages and libraries.
- Perform scientific computation and analysis over healthcare data.
- Demonstrate problem-solving model and the tools, techniques and methodologies used to solve health care using python.
- Using healthcare data and implement various predictive models using classification and clustering techniques.
- Prototyping a healthcare application using python to represent , visualize and analyze the healthcare issues.

Course Outcome:

At the end of the course, the students should be able to:

- To demonstrate tools for data science applications.
- To perform exploratory data analysis on healthcare data.
- To demonstrate predictive model for healthcare data.
- To implement various data science techniques for application prototyping.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDT310 Course: Software Engineering and Testing Methodologies

L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Objectives

The objective of this course is:

1. To familiarize the prospective engineering graduates with the strong fundamental knowledge of software engineering and practices.
2. To facilitate development of interpersonal skills and practicing group dynamics with work ethics.
3. To enable the graduates to apply the theory in practice and to channelize solutions to challenging real-world problems.

Syllabus

Unit 1:

Introduction to Software Engineering, Software engineering principles, Software Myths, Software Engineering - a Layered Technology, Software Process Framework, Requirements Engineering Tasks, Requirement Engineering Process, Eliciting Requirement: Software Requirements Specification. Software Process Models: Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models.

Unit 2:

Agile Process Models, Requirements Analysis, Analysis Modeling Approaches, Data Modeling, Object-Oriented Analysis, Scenario-Based Modeling, Flow-Oriented Modeling, Class-based Modeling, Behavioral Model. Design Engineering Concepts, Design Model.

Unit 3:

Software Project Management, The Business Case, Project Success and Failure, Project Evaluation, Cost-benefit evaluation technique, Project Planning-stepwise project Planning, Software Effort Estimation- Albrecht Function Point Analysis, COCOMO Model, COSMIC Function Point, Project Scheduling.

Unit 4:

Testing Life Cycle, Testing Strategies - Structural Testing, Functional Technique, Static testing, Dynamic testing, Unit Testing, Integration Testing, Validation Testing, System Testing, Debugging. Software Approaches - Black-Box Testing, White-Box Testing, Web Testing, Test case design, building and execution. Automated Testing.

Unit 5:

Software Quality, A Framework for Product Metrics, Metrics for Analysis and Design Models, Metrics for Source Code, Metrics for Testing and Maintenance. Metrics for process and project - Software measurement, metrics for software quality, metrics for small organization, Managing people in software environment.

Unit 6:

Risk management - Risk strategies, Software risk identification, Risk refinement, RMMM, Risk Response development and Risk Response Control, Risk Analysis, Agile risk management using Jira, Software Configuration Management, SCM Repository, SCM Process, Estimation, Software reengineering, Reverse engineering.

Course Outcomes:

After successful completion of this course, the student will be able to:

1. Implement software engineering practices and various models.
2. Apply software engineering processes for modeling and solving real-world problems.
3. Analyze impact of different software testing strategies.
4. Apply approaches to assessment of software quality and management.

Text books and Reference Books:

1. Roger Pressman, Software Engineering - A Practitioner's Approach, Sixth Edition, McGraw Hill, 2010.
2. Ian Somerville, Software Engineering, Seventh Edition, Pearson Education, 2008.
3. Rajib Mall, Software Project Management, Fifth Edition, McGraw Hill, 2008.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDP310 Course: Software Engineering and Testing Methodologies Lab

L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week Total Credits: 01

Course Objectives

The objective of this Lab is:

1. To familiarize students with UML modeling tool and processes.
2. To help students understand and model software solutions applying the best software engineering practices.
3. To introduce students to the state-of-the-art tools in testing and validation of standalone and web applications.

PRACTICALS BASED ON CDT310 SYLLABUS

Using UML 2.X Tools and Open Source Testing Tools (JUnit, Selenium, Katalon, etc)

Course Outcomes:

After successful completion of this course, the student should be able to:

1. Create documentation of an effective approach by analyzing the software engineering problem.
2. Design different structural models for the underlying problem.
3. Construct behavioral models for the underlying problem.
4. Validate the software product using appropriate testing strategies.

Syllabus for Semester VI, B. TECH. CSE (Data Science)

Course Code: CDP311 **Course: Project Based Learning - II**

L: 0Hrs, T: 0 Hr, P: 06Hr, Per Week **Total Credits: 03**

Course Objectives:

The objective of the project based learning is to let the students map and utilize the technical knowledge acquired in the previous semesters to solve a real-world problem through team effort.

Course Outcomes:

On completion of this course, the student will be able to

1. Identify and finalize the problem statement by investigating various domains and society needs.
2. Perform requirement analysis and design methodology for solving the identified problem.
3. Apply programming techniques and modern tools for the development of the solution.
4. Apply ethical principles, project management skills and demonstrate the ability to work in teams for project development within the confines of a deadline.
5. Communicate technical information employing written reports and presentations.