



# CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

An Autonomous Institute | Affiliated to Osmania University  
Kokapet Village, Gandipet Mandal, Hyderabad, Telangana-500075. www.cbti.ac.in



## DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

### 1.2.1 Details of courses introduced across all programmes offered during the year

Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
<b>A.Y 2022-23</b>		
<b>UG</b>		
<b>R-22 REGULATION</b>		
<b>SEM-1</b>		
Linear Algebra & Calculus	22MTC01	Skill development
Optics and Semiconductor Physics	22PYC01	Skill development
Problem Solving and Programming	22CSC01	Skill development and Employability
English	22EGC01	Employability
Optics and Semiconductor Physics Lab	22PYC03	Skill development
English lab	22EGC02	Employability
Problem Solving and Programming Lab	22CSC02	Skill development and Employability
CAD AND DRAFTING	22MEC01	Skill development and Employability
Digital Fabrication Lab	22MEC38	Skill development
<b>SEM-2</b>		
Differential Equations & Numerical Methods	22MTC04	Skill development
Chemistry	22CYC01	Skill development
Basic Electrical Engineering	22EEC01	Skill development
Object Oriented Programming	22CSC03	Skill development and Employability



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Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
Chemistry Lab	22CYC02	Skill development
Community Engagement	22MBC02	Entrepreneurship
Object-Oriented Programming Lab	22CSC04	Skill development and Employability
Robotics & Drones Lab	22MEC37	Skill development
Basic Electrical Engineering Lab	22EEC02	Skill development
<b>R-20 REGULATION</b>		
<b>SEM-5</b>		
Artificial Intelligence	20ADC06	Skill development and Employability
Embedded Systems and IoT	20ITC24	Skill development and Employability
Operating Systems	20ITC19	Skill development and Employability
Full Stack Development	20ADC07	Skill development and Employability
Computer Networks	20ITC20	Skill development and Employability
Artificial Intelligence Lab	20ADC08	Skill development and Employability
Embedded Systems and IoT Lab	20ITC26	Skill development and Employability
Minor Project - I (Full Stack Development)	20ADC09	Employability
Industrial / Rural Internship		Employability
<b>Professional Elective – 2</b>		
Cyber Security	20ITE08	Skill development and Employability



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Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
<b>SEM-6</b>		
Software Engineering	20ITC13	Employability
Deep Learning	20ADC10	Skill development and Employability
Data Science with R	20ADC11	Skill development and Employability
Cloud Computing	20ITC25	Skill development and Employability
Software Engineering Lab	20ITC16	Employability
Deep Learning Lab	20ADC12	Skill development and Employability
Minor Project -II (Data Science)	20ADC13	Employability
Employability Skills	20EGC03	Employability
<b>Professional Elective – 3</b>		
Applied Predictive Analytics	20ITE14	Skill development and Employability
Chain	20ITE16	Skill development
<b>A.Y 2023-24</b>		
<b>UG</b>		
<b>R-22 REGULATION</b>		
<b>SEM-1</b>		
<b>SEM-3</b>		
Mathematical and Statistical Foundations	22MTC07	Skill development



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Operating Systems	22CSC15	Skill development and Employability
Database Management Systems	22CSC11	Skill development and Employability
Java Programming	22ITC02	Skill development and Employability
Digital Logic and Computer Architecture	22ITC01	Skill development
Data Structures	22CSC05	Skill development and Employability
Indian Constitution and Fundamental Principles	22EGM01	Skill development
Database Management Systems Lab	22CSC33	Skill development and Employability
Java Programming Lab	22ITC03	Skill development and Employability
Data Structures Lab	22CSC31	Skill development and Employability
MOOCs/Training/Internship	22ADI01	Employability
<b>SEM-4</b>		
Stochastic Process and Queueing Theory	22MTC16	Skill development
Systems and Signal Processing	22ECC39	Skill development
Design and Analysis of Algorithms	22CSC14	Skill development and Employability
Fundamentals of Machine Learning	22ADC01	Skill development and Employability
Professional Elective – I		
Engineering Economics and Accountancy	22MBC01	Skill development
Environmental Science	22CEM01	Skill development
Stochastic Process and Queueing Theory Lab	22MTC17	Skill development



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### 1.2.1 Details of courses introduced across all programmes offered during the year

Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
Design and Analysis of Algorithms Lab	22CSC34	Skill development and Employability
Machine Learning Lab	22ADC02	Skill development and Employability
Linux and Latex Lab	22ADC04	Skill development and Employability
<b>Professional Elective – I</b>		
and	22ADE01	Skill development and Employability
<b>R-20 REGULATION</b>		
<b>SEM-7</b>		
Big Data Analytics	20ADC14	Skill development and Employability
Professional Elective – 4		
Open Elective – 1		
Harmony	20EGM03	Skill development
Gender Sensitization	20EGM04	Skill development
Big Data Analytics Lab	20ADC15	Skill development and Employability
Project Part – 1	20ADC16	Employability
Internship		Employability
<b>Professional Elective – 4</b>		
Business Intelligence	20ADE11	Entrepreneurship
<b>Open Elective – 1</b>		



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Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
Neural Networks and Fuzzy Logic	20ECO14	Skill development
Technical Writing Skills	20EGO01	Skill development
<b>SEM-8</b>		
Open Elective – 2		
Open Elective – 3		
Technical Seminar	20ADC17	Employability
Project Part -2	20ADC18	Employability
<b>Open Elective – 2</b>		
Principles of Entrepreneurship	20MEO04	Entrepreneurship
Energy Conservation	20EE004	Skill development
<b>Open Elective – 3</b>		
Disaster Risk Reduction and Management	20CEO02	Skill development
<b>PG</b>		
<b>R-23 REGULATION</b>		
<b>SEM-1</b>		
<b>Professional Core</b>		
Mathematical Foundations of Data Science	23MTC101	Skill development



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Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
Artificial Intelligence	23ADC101	Skill development and Employability
<b>Professional Elective-1</b>		
Cloud Computing	23ADE102	Skill development and Employability
<b>Professional Elective-2</b>		
Big Data Analytics	23ADE119	Skill development and Employability
<b>Mandatory Course</b>		
Research Methodology and IPR	23MEM103	Skill development
<b>Audit Course-1</b>		
English for Research Paper Writing	23EGA101	Employability
<b>Laboratory</b>		
Mathematical Foundations of Data Science Lab	23MTC102	Skill development and Employability
Big Data Analytics Lab	23ADE129	Skill development and Employability
Artificial Intelligence Lab	23ADC105	Skill development and Employability
<b>SEM-2</b>		
Not yet started		



**CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)**  
**Scheme of Instructions of I Semester of B.E. – Artificial Intelligence and Data Science**  
**(Inline with AICTE Model Curriculum with effect from AY 2022-23)**

**DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**

**SEMESTER – I**

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination		Credits	
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE		SEE
<b>THEORY</b>									
1	22MTC01	Linear Algebra & Calculus	3	1	0	3	40	60	4
2	22PYC01	Optics and Semiconductor Physics	3	0	0	3	40	60	3
3	22CSC01	Problem Solving and Programming	2	1	0	3	40	60	3
4	22EGC01	English	2	0	0	3	40	60	2
<b>PRACTICAL</b>									
5	22PYC03	Optics and Semiconductor Physics Lab	0	0	3	3	50	50	1.5
6	22EGC02	English lab	0	0	2	3	50	50	1
7	22CSC02	Problem Solving and Programming Lab	0	0	3	3	50	50	1.5
8	22MEC01	CAD AND DRAFTING	0	1	3	3	50	50	2.5
9	22MEC38	Digital Fabrication Lab	0	0	3	3	50	50	1.5
<b>TOTAL</b>			<b>10</b>	<b>3</b>	<b>14</b>	<b>27</b>	<b>410</b>	<b>490</b>	<b>20</b>

**L: Lecture**

**T: Tutorial**

**D: Drawing**

**P: Practical**

**CIE - Continuous Internal Evaluation**

**SEE - Semester End Examination**





**22MTC01**

**LINEAR ALGEBRA & CALCULUS  
(AI&DS)**

Instruction	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

**COURSE OBJECTIVES:** This course aims to

1. To discuss Physical interpretations of scalar and vector functions.
2. To discuss vector line, surface and volume integrals.
3. To explain the concepts of basis, dimension of vector space and matrix representation of a linear transformation.
4. To explain the solution of system of linear equations by Matrix Methods.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Determine the extreme values of functions of two variables.
2. Apply the vector differential operator to scalar and vector functions
3. Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
4. Determine the basis and dimension of a vector space, compute linear transformation.
5. Apply the Matrix Methods to solve the system of linear equations

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	1
CO 5	3	3	3	3	-	-	-	-	-	-	-	1

**UNIT-I**

**Partial Differentiation and Its Applications:** Functions of two or more variables, Partial derivatives, Higher order partial derivatives, Total derivative, Differentiation of implicit functions, Jacobians, Taylor's expansion of functions of two variables, Maxima and minima of functions of two variables.

**UNIT-II**

**Vector Differential Calculus and multiple Integrals:** Scalar and Vector point functions, vector operator Del, Gradient, Directional derivative, Divergence, Curl, Del applied twice to point functions, Del applied to product of point functions (vector identities), Irrotational fields and Solenoidal fields, Double integral, Change of order of Integration and Triple integrals.

**UNIT-III**

**Vector Integral Calculus:** Line integral, Surface integral and Volume integral. Verification of Green's theorem in a plane (without proof), verification of Stroke's theorem (without proof) and Gauss's divergence theorem (without proof).

**UNIT-IV:**

**Vector space:** Vector space, Subspace, linear combination of vectors, linear span, row and column spaces, linear dependent, independent vectors, basis, dimension, linear transformation, invertible transformation, matrix of linear transformation, kernel and range of LT, rank and nullity of LT-rank nullity theorem(without proof), change of basis.

**UNIT-V**

**Matrices:** Rank of a matrix, Echelon form, consistency of linear System of equations, Eigen values, Eigenvectors, Properties of Eigen values, Cayley-Hamilton theorem, Quadratic forms, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic form.

**TEXT BOOKS:**

1. B.S. Grewal, "Higher Engineering Mathematics", 44<sup>th</sup> Edition, Khanna Publishers, 2017.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. Seymour Lipschutz, "Schaum's Outline of Linear Algebra", 5th Edition, McGraw Hill, 2013.
4. Gilbert Strang, "Introduction to linear algebra", 5th Edition, Wellesley - Cambridge press, 2016.

**SUGGESTED READING:**

1. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw- Hill, New Delhi, 2008.
2. R.K. Jain, S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publications, 5<sup>th</sup> edition, 2016.
3. D. Poole, "Linear Algebra: A Modern Introduction, 2nd Edition", Brooks/ Cole, 2005.
4. Kuldeep Singh, "Linear algebra: step by step". OUP Oxford, 2013.



22PYC01

**OPTICS AND SEMICONDUCTOR PHYSICS**  
(CSE, IT, CSE (AI&ML), CSE (IoT & Cyber Security including Block Chain Technology), AI&ML, AI&DS)

Instruction	3L Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

**COURSE OBJECTIVES: This course aims to**

1. Understand the fundamentals of wave nature of light
2. Acquire knowledge of lasers, holography and fiber optics
3. Familiarize with quantum mechanics
4. Learn the fundamental concepts of solids

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Demonstrate the physical properties of light.
2. Explain characteristic properties of lasers and fiber optics
3. Find the applications of quantum mechanics
4. Classify the solids depending upon electrical conductivity
5. Identify different types of semiconductors

**CO-PO Articulation Matrix**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	2	2	2	3	2	2	2	1	1	2	1	2
C02	3	3	3	3	3	3	3	3	2	2	3	2
C03	3	3	3	3	3	2	3	2	1	2	1	2
C04	2	2	2	1	2	2	2	2	1	2	2	2
C05	3	2	2	2	2	2	3	3	2	2	3	2

**UNIT-I**

**Wave Optics:** Huygen's principle – Super position of waves – Interference of light by wave front splitting and amplitude splitting – Fresnel's biprism – Interference in thin films in reflected light – Newton's rings – Fraunhofer diffraction from a single slit – Double slit diffraction – Rayleigh criterion for limit of resolution – Concept of N-slits – Diffraction grating and its resolving power.

**UNIT-II**

**Lasers & Holography:** Characteristics of lasers – Einstein's coefficients – Amplification of light by population inversion – Different types of lasers: solid-state lasers: Ruby & Nd:YAG; gas lasers: He-Ne & CO<sub>2</sub>; semiconductor laser – Applications of lasers in engineering and medicine. Holography: Principle – Recording and reconstruction – Applications.

**Fiber Optics:** Introduction – Construction – Principle – Propagation of light through an optical fiber – Numerical aperture and acceptance angle – Step-index and graded-index fibers – Pulse dispersion – Fiberlosses – Fiber optic communication system – Applications.

**UNIT-III**

**Principles of Quantum Mechanics:** Introduction – Wave nature of particles – de-Broglie hypothesis – Physical significance of  $\psi$  – Time-dependent and time-independent Schrodinger equations – Born interpretation – Probability current – Wave packets – Uncertainty principle – Particle in infinite square well potential – Scattering from potential step – Potential barrier and tunneling.

**UNIT-IV**

**Band Theory of Solids:** Salient features of free electron theory of metals (Classical and Quantum) – Fermi level – Density of states – Bloch's theorem for particles in a periodic potential – Kronig-Penney model – Classification of solids: metals, semiconductors and insulators.

**UNIT-V**

**Semiconductors:** Intrinsic and extrinsic semiconductors – Charge carrier concentration in intrinsic semiconductors – Dependence of Fermi level on carrier concentration and temperature in extrinsic semiconductors (qualitative) – Carrier generation and recombination – Carrier transport: diffusion and drift – P-N junction – Thermistor – Hall effect – LED – Solar cell.

**TEXT BOOKS:**

1. B. K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M. N. Avadhanulu and P. G. Kshirsagar, *A Text Book of Engineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S. L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

**SUGGESTD READING:**

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, Mc Graw-Hill Education Publications, 2013.
3. P. K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6<sup>th</sup> Revised edition, 2015.



**22CSC01**

**PROBLEM SOLVING AND PROGRAMMING**

Instruction	2L + 1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to:

1. Develop logical skills and basic technical skills so that students should be able to solve basic computational problems.
2. Learn any basic programming language.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Understand real world problems and develop computer solutions for those problems.
2. Understand the basics of Python.
3. Apply Python for solving basic programming solutions.
4. Create algorithms/flowcharts for solving real-time problems.
5. Build and manage dictionaries to manage data.
6. Handle data using files.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	1	1	-	1	-	-	-	-	-	-	1
2	3	1	1	-	1	-	-	-	-	-	-	1
3	3	1	1	-	1	-	-	-	-	-	-	1
4	3	1	1	-	1	-	-	-	-	-	-	1
5	3	1	1	-	1	-	-	-	-	-	-	1
6	3	1	1	-	1	-	-	-	-	-	-	1

**UNIT I**

**Introduction to Programming** - Evolution of languages: Machine, Assembly and High-level languages. Software requirements for programming: OS, compiler, linker, loader, editor. Design specification: Algorithms and Flowcharts.

**UNIT II**

**Data Types and Operators, Variable, Sequences and Iteration** - Data types, Expressions, Precedence Rules, Operators: arithmetic, relational, logical, bit-wise and miscellaneous operators; local variable, global variables, List, String, Tuples, Sequence mutation and accumulating patterns.

**UNIT III**

**Conditional Statement, Loops, Arrays and Strings, user-defined Data Types** – if, else, for, while, nested iteration, Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays, different types of user defined data types.

**UNIT IV**

**Dictionaries and Dictionary Accumulation, Functions/Methods** - Dictionary basics, operations, methods, accumulation, advantages of modularizing program into functions, function definition and function invocation. Positional parameters passing arrays to functions, recursion, library functions.

**UNIT V**

**File Handling and Memory Management** - Concepts of files and basic file operations, writing/reading data to/from a .csv file, Memory Management Operations.



**TEXT BOOKS AND REFERENCES:**

1. R.S. Salaria, “Programming for Problem Solving”, First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, “Taming Python by Programming”, Revised Edition, Khanna Book Publishing Co., Delhi.
3. Mark Lutz, “Learning Python”, 5<sup>th</sup> Edition, O'Reilly Media, Inc.
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.
5. “Programming in Python”, R.S. Salaria, Khanna Book Publishing Co., Delhi.

**NPTEL/SWAYAM Course:**

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta, IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.
3. <https://www.coursera.org/specializations/python-3-programming>.



22EGC01

**ENGLISH**

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

**Prerequisite:** Basic knowledge of English grammar and vocabulary.

**COURSE OBJECTIVES: This course aims to**

1. To the role and importance of communication while developing their basic communication skills in English.
2. To basics of writing coherent paragraphs and formal Emails.
3. To techniques of writing a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. To description, definition and classification of processes while enabling them to draft formal reports following a proper structure.
5. To gaining adequate reading comprehension techniques.

**COURSE OUTCOMES: After the completion of this course, the student will be able to**

1. Illustrate the nature, process and types of communication and communicate effectively without barriers.
2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
3. Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
5. Critique passages by applying effective reading techniques.

**CO-PO-PSO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	1	1	2	3	3	2	3
CO 2	1	1	1	1	-	1	1	1	2	2	1	2
CO 3	-	2	1	1	-	2	1	1	2	2	1	2
CO 4	1	2	1	2	1	2	2	1	2	2	1	2
CO 5	1	2	1	2	1	1	1	1	1	2	1	2

**UNIT-I**

**Understanding Communication in English:** Introduction, nature and importance of communication; Process of communication; Types of communication - verbal and non-verbal; Barriers to communication; Intrapersonal and interpersonal communication; Understanding Johari Window.

**Vocabulary & Grammar:** The concept of Word Formation; Use of appropriate prepositions and articles.

**UNIT-II**

**Developing Writing Skills I:** Paragraph writing. – Structure and features of a paragraph; Cohesion and coherence. Rearranging jumbled sentences. Email and Mobile etiquette.

**Vocabulary & Grammar:** Use of cohesive devices and correct punctuation.

**UNIT-III**

**Developing Writing Skills II:** Précis Writing; Techniques of writing precisely. Letter Writing – Structure, format of a formal letter; Letter of request and the response.

**Vocabulary and Grammar:** Subject-verb agreement. Use of prefixes and suffixes to form derivatives. Avoiding redundancies.

**UNIT-IV**

**Developing Writing Skills III:** Report writing – Importance, structure, elements of style of formal reports; Writing a formal report.

**Vocabulary and Grammar:** Avoiding ambiguity - Misplaced modifiers. Use of synonyms and antonyms.



**UNIT-V**

**Developing Reading Skills:** The reading process, purpose, different kinds of texts; Reading comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions.

**Vocabulary and Grammar:** Words often confused; Use of standard abbreviations.

**TEXT BOOKS:**

1. “Language and Life: A Skills Approach”, Board of Editors, 2018<sup>th</sup> Edition, Orient Black Swan, 2018.
2. Swan Michael, “Practical English Usage”, OUP, 1995.

**SUGGESTED READINGS:**

1. Wood F.T, “Remedial English Grammar”, Macmillan,2007.
2. Zinsser William, “On Writing Well”, Harper Resource Book, 2001.
3. Sanjay Kumar and Pushp Lata, “Communication Skills”, Oxford University Press, 2011.





22PYC03

**OPTICS AND SEMICONDUCTOR PHYSICS LAB**

(CSE, IT, CSE (AI&ML), CSE (IoT & Cyber Security including Block Chain Technology), AI&ML, AI&DS)

Instruction	3P Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1.5

**COURSE OBJECTIVES:** This course aims to

1. Apply theoretical physics knowledge in doing experiments
2. Understand the behaviour of the light experimentally
3. Analyze the conduction behaviour of semiconductor materials and optoelectronic devices

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Interpret the errors in the results of an experiment.
2. Demonstrate physical properties of light experimentally
3. Make use of lasers and optical fibers for engineering applications
4. Explain the V-I characteristics of some optoelectronic and semiconductor devices
5. Find the applications of thermistor

**CO-PO Articulation Matrix**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	2	2	3	1	3	1	3	3	2	1	2
C02	3	2	1	2	2	2	1	2	2	1	1	3
C03	3	2	3	2	3	1	2	2	3	2	1	2
C04	3	3	2	2	2	1	2	3	2	1	1	3
C05	3	1	2	3	2	1	1	2	2	2	1	2

**Experiments**

1. **Error Analysis** : Estimation of errors in the determination of time period of a torsional Pendulum
2. **Fresnel's Biprism** : Determination of wavelength of given monochromatic source
3. **Newton's Rings** : Determination of radius of curvature of a given plano-convex lens using Na vapor lamp
4. **Single Slit Diffraction** : Determination of wavelength of given monochromatic source
5. **Diffraction Grating** : Determination of wavelengths of two yellow lines of light of Mercury lamp
6. **Laser** : Determination of wavelength of given semiconductor laser
7. **Holography** : Recording and reconstruction of a hologram
8. **Optical Fiber** : Determination of numerical aperture and power losses of given optical fiber
9. **Energy Gap** : Determination of energy gap of given semiconductor
10. **P-N Junction Diode** : Study of V-I characteristics and calculation of resistance of given diode in forward bias and reverse bias
11. **Thermistor** : Determination of temperature coefficient of resistance of given thermistor
12. **Hall Effect** : Determination of Hall coefficient, carrier concentration and mobility of charge carriers of given semiconductor specimen
13. **LED** : Study of I-V characteristics of given LED
14. **Solar Cell** : Study of I-V characteristics of given solar cell and calculation of fill factor, efficiency and series resistance
15. **Planck's Constant** : Determination of Planck's constant using photo cell

**NOTE: A minimum of TWELVE experiments should be done.**



**22EGC02**

**ENGLISH LAB**  
(Common to All Branches)

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**COURSE OBJECTIVES: This course aims to**

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To listen to listening comprehension material for honing their listening skills.
4. To activities enabling them overcome their inhibitions while speaking in English with the focus being on fluency rather than accuracy.
5. To team work, role behavior while developing their ability to discuss in groups and making oral presentations.

**COURSE OUTCOMES: After the completion of this course, the student will be able to**

1. Define the speech sounds in English and understand the nuances of pronunciation in English
2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
3. Analyze listening comprehension texts to enhance their listening skills.
4. Determine the context and speak appropriately in various situations.
5. Design and present effective posters while working in teams, and discuss and participate in Group discussions.

**CO-PO-PSO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	-	-	-	1	1	-	1
CO 2	-	-	-	-	-	1	-	1	2	2	1	2
CO 3	-	-	-	-	-	1	1	1	2	1	1	2
CO 4	1	-	-	-	-	1	2	2	2	3	1	3
CO 5	1	1	1	1	1	2	2	2	3	3	2	3

**EXERCISES**

1. **Introduction to English Phonetics:** Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English:** Phonetic sounds and phonemic sounds, introduction to International Phonetic Alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.
3. **Word stress:** Primary stress, secondary stress, functional stress, rules of word stress.
4. **Rhythm & Intonation:** Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – Practice with Software available in (K-van solutions)
6. **Public speaking** – Speaking with confidence and clarity in different contexts on various issues.
7. **Group Discussions** - Dynamics of a group discussion, group discussion techniques, body language.
8. **Pictionary** – weaving an imaginative story around a given picture.
9. **Information Gap Activity** – Writing a brief report on a newspaper headline by building on the hints given
10. **Poster presentation** – Theme, poster preparation, team work and representation.

**SUGGESTED READING**

1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
3. PriyadarshiPatnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd 2011
4. ArunaKoneru, Professional Speaking Skills, Oxford University Press, 2016



**22CSC02**

**PROBLEM SOLVING AND PROGRAMMING LAB**

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

**COURSE OBJECTIVES:** This course aims to:

1. Master the fundamentals of writing Python scrips.
2. Learn Python elements such as variables, flow controls structures, and functions.
3. Discover how to work with lists and sequence data, and files.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Understand various Python program development Environments.
2. Demonstrate the concepts of Python.
3. Implement algorithms/flowcharts using Python to solve real-world problems.
4. Build and manage dictionaries to manage data.
5. Write Python functions to facilitate code reuse.
6. Use Python to handle files and memory.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	2	1	-	-	-	-	-	-	-	-	1
2	3	3	2	2	3	-	-	-	-	-	-	1
3	2	3	3	2	3	-	-	-	-	-	-	1
4	2	3	3	2	2	-	-	-	-	-	-	1
5	2	3	3	3	3	-	-	-	-	-	-	1
6	2	3	3	3	3	-	-	-	-	-	-	1

**LABORATORY / PRACTICAL EXPERIMENTS:**

1. Explore various Python Program Development Environments.
2. Demonstration of input/output operations.
3. Demonstration of operators.
4. Demonstration of selective control structures.
5. Demonstration of looping control structures.
6. Demonstration of List, Tuple and Set
7. Demonstration of Python Dictionaries.
8. Implementation of searching and sorting techniques.
9. Implementation of string manipulation operations.
10. File handling and memory management operations.

**TEXT BOOKS AND REFERENCES:**

1. R.S. Salaria, “Programming for Problem Solving”, First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, “Taming Python by Programming”, Revised Edition, Khanna Book Publishing Co., Delhi.
3. Mark Lutz, “Learning Python”, 5<sup>th</sup> Edition, , O’Reilly Media, Inc.,
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.
5. “Programming in Python”, R.S. Salaria, Khanna Book Publishing Co., Delhi.

**NPTEL/SWAYAM Course:**

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta, IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.
3. <https://www.coursera.org/specializations/python-3-programming>.



**22MEC01**

**CAD AND DRAFTING**

Instruction	1 T + 3 D Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	2.5

**COURSE OBJECTIVES:**

- To get exposure to a cad package and its utility.
- Understanding orthographic projections.
- To visualize different solids and their sections in orthographic projection
- To prepare the student to communicate effectively by using isometric projection.
- To prepare the student to use the techniques, skills, and modern tools necessary for practice.

**Outcomes:** At the end of the course, the Students are able to

- Become conversant with appropriate use of CAD software for drafting.
- Recognize BIS, ISO Standards and conventions in Engineering Drafting.
- Construct the projections of points, lines, planes, solids
- Analyse the internal details of solids through sectional views
- Create an isometric projections and views

**CO-PO-PSO Correlation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	2	1	2	2	-	1	2	3	1	3
<b>CO2</b>	3	2	2	1	2	2	-	1	2	2	1	2
<b>CO3</b>	3	3	2	1	2	2	-	1	2	2	1	2
<b>CO4</b>	3	3	3	2	2	2	-	1	2	2	1	2
<b>CO5</b>	3	2	2	1	2	2	-	1	2	2	1	2

**List of Exercises:**

- Introduction to CAD package: Settings, draw, modify tools, dimensioning and documentation
- Construction of Conic Sections by General method
- Orthographic projection: Principles, conventions, Projection of points
- Projection of straight lines: Simple position, inclined to one plane
- Projection of straight lines inclined to both the planes (without traces and mid-point)
- Projection of planes: Perpendicular planes
- Projection of planes: Oblique planes
- Projection of solids: Simple position
- Projection of solids: Inclined to one plane
- Sections of solids: Prism, pyramid in simple position
- Sections of solids: Cone and cylinder in simple position
- Isometric projections and views
- Conversion of isometric views to orthographic projections and vice-versa.

**TEXT BOOKS:**

- N.D.Bhatt, “Elementary Engineering Drawing”, Charotar Publishers, 2012.
- K.Venugopal, “Engineering Drawing and Graphics + AutoCAD”, New Age International Pvt.Ltd, 2011.
- Basanth Agrawal and C M Agrawal, “Engineering Drawing”, 2/e, McGraw-Hill Education (India) Pvt. Ltd.

**SUGGESTED READING:**

- Shaw M.B and Rana B.C., “Engineering Drawing”, 2/e, Pearson, 2009.
- K.L. Narayana and P.K. Kannaiah, “Text Book of Engineering Drawing”, Scitech Publications, 2011.

**22MEC38**

**DIGITAL FABRICATION LAB**

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

**COURSE OBJECTIVES:** This course aims to

1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive & team work attitude to get things right the first time.
3. Provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting, manufacturing, metrology, and allied skills.
5. Advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Understand safety measures to be followed in workshop to avoid accidents.
2. Identify various tools used in carpentry, house wiring and plumbing.
3. Make a given model by using workshop trades like carpentry, plumbing, House wiring and 3d modeling using solid works software for Additive Manufacturing.
4. Perform pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
5. Conceptualize and produce simple device/mechanism of their choice.

**CO-PO-PSO Correlation Matrix**

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

**List of exercises:**

**Group-1**

1. To make a lap joint on the given wooden piece according to the given dimensions.
2. To make a dove tail-joint on the given wooden piece according to the given dimensions.
3.
  - a. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch
  - b. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2-way switches.
5. To make external threads for GI pipes using die and connect the GI pipes as per the given diagram using taps, couplings & bends.

6.
  - a. A. To connect the GI pipes as per the given diagram using, couplings, unions, reducer & bends.
  - b. To connect the GI pipes as per the given diagram using shower, tap & valves and Demonstrate by giving water connection

**Group- 2**

1. To Study the method of Additive Manufacturing process using a 3D printer
2. To create a 3D CAD model of a door bracket using a modeling software
3. To Print a door bracket using an extruder type 3D Printer.
4. To create a 3D CAD model by reverse Engineering
5. To Design an innovative component using the CAD software
6. To Print the selected innovative component by the students using a 3D printer

**TEXT BOOKS:**

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop Technology, Vol. I, 2008 and Vol. II, Media promoters and publishers private limited, Mumbai, 2010.
2. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
3. Sachidanand Jha, 3D PRINTING PROJECTS: 200 3D Practice Drawings For 3D Printing On Your 3D Printer, June 7, 2019.

**SUGGESTED READING:**

1. Gowri P. Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Oliver Bothmann , 3D Printers: A Beginner's Guide , January 1, 2015





**CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)**  
**Scheme of Instructions of II Semester of B.E. – Artificial Intelligence and Data Science**  
**(Inline with AICTE Model Curriculum with effect from AY 2022-23)**

**DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**

**SEMESTER –II**

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination		Credits	
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE		SEE
<b>THEORY</b>									
1	22MTC04	Differential Equations & Numerical Methods	3	1	0	3	40	60	4
2	22CYC01	Chemistry	3	0	0	3	40	60	3
3	22EEC01	Basic Electrical Engineering	2	1	0	3	40	60	3
4	22CSC03	Object Oriented Programming	2	1	0	3	40	60	3
<b>PRACTICAL</b>									
5	22CYC02	Chemistry Lab	0	0	3	3	50	50	1.5
6	22MBC02	Community Engagement	0	0	3		50		1.5
7	22CSC04	Object-Oriented Programming Lab	0	0	2	3	50	50	1
8	22MEC37	Robotics & Drones Lab	0	2	2	3	100		3
9	22EEC02	Basic Electrical Engineering Lab	0	0	2	3	50	50	1
<b>TOTAL</b>			<b>10</b>	<b>5</b>	<b>12</b>		<b>460</b>	<b>390</b>	<b>21</b>

**L: Lecture**

**T: Tutorial**

**D: Drawing**

**P: Practical**

**CIE - Continuous Internal Evaluation**

**SEE - Semester End Examination**





22MTC04

**DIFFERENTIAL EQUATIONS & NUMERICAL METHODS  
(AI&DS)**

Instruction	3 L+1T per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

**COURSE OBJECTIVES:**

1. To explain the relevant methods to solve first order differential equations.
2. To explain the relevant methods to solve higher order differential equations.
3. To discuss numerical methods to solve algebraic and transcendental equations.
4. To discuss the interpolation and numerical differentiation.
5. To discuss convergence and divergence of Infinite series.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Calculate the solutions of first order linear differential equations.
2. Calculate the solutions of higher order linear differential equations.
3. Solve the algebraic, transcendental and system of equations.
4. Apply interpolation and numerical differentiation techniques for given data.
5. Test the convergence and divergence of Infinite series.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	2	2	2	2	-	-	-	-	-	-	-	1
CO 4	2	2	2	2	-	-	-	-	-	-	-	1
CO 5	1	1	1	1	-	-	-	-	-	-	-	1

**UNIT - I**

**Differential Equations of First Order:** Exact Differential Equations, Equations Reducible to Exact Equations, Linear Equations, Bernoulli's Equations, Riccati's and Clairaut's Equations, Orthogonal trajectories, Rate of decay of radio-active materials.

**UNIT-II**

**Higher Order Linear Differential Equations:** Higher order linear differential equations with constant coefficients, rules for finding Complementary function, Particular Integral and General solution. Method of Variation of Parameters, solution of Cauchy- Euler equation. LR and LCR circuits.

**UNIT-III**

**Numerical solution of equations:** Numerical solutions of algebraic and transcendental equations by Bisection method, Regula-falsi method and Newton-Raphson's method, Solution of system of linear equations by LU decomposition methods, Crout's method, Jacobi's method, Gauss Seidel method.

**UNIT-IV**

**Interpolation and Numerical Differentiation:** Forward, Backward and Central differences, Newton's forward and backward interpolation formulae, Gauss's forward and backward interpolation formulae, Lagrange interpolation, Numerical differentiation at the tabulated points with forward, backward and central differences.

**UNIT-V**

**Infinite Series:** Convergence of sequence and series. Series of positive terms, Necessary condition for convergence, Comparison tests, limit form comparison test, D'Alembert's Ratio test, Raabe's test, Cauchy's root test, Alternating series, Leibnitz's rule, absolutely and conditionally convergence.

**TEXT BOOKS:**

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2011.
3. M.K. Jain, S.R.K Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering and Computation", New age International Publications, 2008.

**SUGGESTED READING:**

1. R.K.Jain, S.R.K. Iyengar, "Advanced Engineering Mathematics", 5<sup>th</sup> edition, Narosa Publications, 2016.
2. Ramana B.V, "Higher Engineering Mathematics", 11<sup>th</sup> Reprint, Tata McGraw Hill New Delhi, 2010.
3. A.R. Vasishtha and R.K.Guptha, "Integral Transforms", Reprint, Krishna's Educational Publishers, 2014.



22CYC01

**CHEMISTRY**  
(Common to CSE, CSE-AIML, AIML, CSE-IOT, AIDS)

Instruction:	3L Hours per Week
Duration of SEE:	3 Hours
SEE	60 Marks
CIE:	40 Marks
Credits:	3

**COURSE OBJECTIVES:**

1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nanomaterials and basic drugs of modern chemistry is essential.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	2	-	-	2	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	3	-	-	2	2	-	-	-	-	2
CO 5	3	2	2	-	-	2	2	-	-	-	-	2

**UNIT-I**

**Atomic and molecular structure and Chemical Kinetics:**

**Atomic and molecular structure:** Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions ( $H_2$ ,  $He_2^+$ ,  $N_2$ ,  $O_2$ ,  $O_2^-$ , CO, NO). Pi- molecular orbitals of benzene and its aromaticity.

**Chemical Kinetics:** Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction-Characteristics: units of first order rate constant & its half-life period, second order reaction-Characteristics: units of second order rate constant & its half- life period. Numericals.

**UNIT-II**

**Use of free energy in chemical equilibria**

**Use of free energy in chemical equilibria:** Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials, electrode potentials, – Reference electrodes (NHE, SCE)- electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations. Numericals.

**Battery technology: Rechargeable batteries & Fuel cells.**

Lithium batteries: Introduction, construction, working and applications of Li-MnO<sub>2</sub> and Li-ion batteries.

**Fuel Cells:** Introduction, difference between conventional cell and fuel cell, limitations & advantages.

Construction, working & applications of methanol-oxygen fuel cell.

**UNIT- III**

**Stereochemistry and Organic reactions**

**Stereochemistry:** Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – conformations of n-butane (Newman and sawhorse representations), Configurational isomerism - Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid) & Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.

**Types of Organic reactions:** Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (S<sub>N</sub>1 & S<sub>N</sub>2); Free Radical Substitution (Halogenation of Alkanes)

Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds) Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides) Cyclization (Diels - Alder reaction)

**UNIT-IV**

**Water Chemistry:**

Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process), ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

**UNIT-V**

**Engineering Materials and Drugs:**

Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) & Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications.

**Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography.**

Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation- Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle).

Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

**TEXT BOOKS:**

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi, 16<sup>th</sup> edition (2015).
2. W.U. Malik, G.D. Tuli and R.D. Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7<sup>th</sup> edition (2019).
4. A Textbook of Polymer Science and Technology, Shashi Chawla, Dhanpat Rai & Co. (2014)
5. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012
6. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C. Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

**SUGGESTED READINGS:**

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3<sup>rd</sup> edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd., 46<sup>th</sup> edition (2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley, 12<sup>th</sup> edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8<sup>th</sup> edition (2006).

**22EEEC01**

**BASIC ELECTRICAL ENGINEERING**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES: This course aims to**

1. To understand the behaviour of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. To comprehend the basic principle of operation of AC and DC machines
3. To infer about different types of electrical wires and cables, domestic and industrial wiring, safety rules and methods of earthing.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Understand the concepts of Kirchoff's laws and their application various theorems to get solution of simple dc circuits.
2. Predict the steady state response of RLC circuits with AC single phase/three phase supply.
3. Infer the basics of single phase transformer
4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
5. Acquire the knowledge of electrical wires, cables, earthing, Electrical safety precautions to be followed in electrical installations and electric shock and its safety and energy calculations.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO-1	3	3	2	-	-	-	-	-	1	2	-	3
CO-2	3	3	2	-	-	-	-	-	1	2	-	3
CO-3	3	3	2	1	-	-	-	-	1	2	-	3
CO-4	2	1	-	-	-	-	-	-	1	2	-	3
CO-5	2	-	2	-	-	-	-	-	1	2	-	3

**UNIT-I**

**DC Circuits:** Electrical circuit elements (R,L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin's and Norton's Theorems.

**UNIT-II**

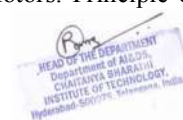
**AC Circuits:** Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, series RL and RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

**UNIT-III**

**Single Phase Transformer:** Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation

**UNIT-IV**

**DC and AC Machines:** DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt generators. DC Motors: Classification, Torque Equation, Characteristics and Speed control of DC Shunt and Series Motors, Losses and efficiency Three - Phase Induction Motors: Principle of operation, Applications



**UNIT-V**

**Electrical Installations:** Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, and first aid for electric shock, safety rules. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Earthing (Elementary Treatment only), Elementary calculations for energy consumption

**TEXT BOOKS:**

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

**SUGGESTED READING:**

1. D. P. Kothari & I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989
3. D.C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009
4. P.V. Prasad, S. Sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013



**22CSC03**

**OBJECT ORIENTED PROGRAMMING**

Instruction	2L + 1T per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to:

1. Explore the concepts object-oriented programming like classes, constructors, Polymorphism, Inheritance, and File handling.
2. Prepare student for solving real-world problems using OOPs concepts.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Understand the concepts of Object-Oriented features.
2. Apply OOPs concepts and different libraries to solve programming problems.
3. Understand the advanced concepts of Python.
4. Develop programs to access databases and web data.
5. Understand APIs and third-party libraries to be used with Python.

**CO-PO Articulation Matrix:**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	1	2	-	1	-	-	-	-	-	-	1
2	3	1	3	2	2	-	-	-	-	-	-	2
3	3	1	2	1	1	-	-	-	-	-	-	1
4	3	2	3	1	2	-	-	-	-	-	-	2
5	3	2	3	1	2	-	-	-	-	-	-	2

**UNIT I**

**Introduction to Object Oriented Programming Paradigms** - Programming paradigms, advantages of OOP, comparison of OOP with Procedural Paradigms; Classes and Objects: Prototyping, referencing the variables in functions, inline, static functions, Memory allocation for **classes and objects, arrays of objects, constructors.**

**UNIT II**

**Polymorphism and Inheritance:** Overriding methods, type conversions, base classes and derived classes, types of inheritance, various types of classes, invocation of constructors and destructors inheritance, aggregation, composition, classification hierarchies, metaclass/ abstract classes, unit testing and exceptions.

**UNIT III**

**Python Libraries** -Basics of Open Source libraries for data pre-processing, modeling and visualization.

**UNIT IV:**

**Python to access Web Data** - Regular Expressions, extracting data, sockets, using the Developer Console to Explore HTTP, Retrieving Web Page, and Passing Web Pages.

**UNIT V:**

**Using Databases with Python** - Using Databases, Single Table CRUD, Designing and representing a data model, reconstructing data with JOIN, many-to-many relationships.



**TEXT BOOKS AND REFERENCES:**

1. Allen Downey, Jeff Elkner, Chris Meyers, “How to Think Like a Computer Scientist: Learning with Python”, SoHo Books, 2009.
2. R.S. Salaria , “Mastering Object-Oriented Programming”, 6<sup>th</sup> Edition, Khanna Book Publishing Co., Delhi.
3. Jeeva Jose, “Introduction to Computing & Problem Solving with Python”, First Edition, Khanna Book Publishing, 2019.
4. Paul Barry , “Head First Python”, O’Reilly, 2010.

**NPTEL/SWAYAM Course:**

1. Python for Data Science, Prof. Raghunathan Rengasamy, IIT Madras.
2. The Joy of Computing using Python Prof. Sudarshan, Prof. Yayati Guptaingar, IIT Ropar, IIIT Dharwad.
3. <https://www.coursera.org/specializations/python-3-programming#courses>.





**22CYC02**

**CHEMISTRY LAB**

(Common to CSE, CSE-AIML, AIML, CSE-IOT, AIDS)

Instruction:	3P Hours per Week
Duration of SEE	3 Hours
SEE:	50 Marks
CIE	50 Marks
Credits:	1.5

**Course Objectives**

- To impart fundamental knowledge in handling the equipment / glassware and chemicals in Chemistry laboratory.
- To provide the knowledge in both qualitative and quantitative chemical analysis
- The student should be conversant with the principles of volumetric analysis
- To apply various instrumental methods to analyse the chemical compounds and to improve understanding of theoretical concepts.
- To interpret the theoretical concepts in the preparation of new materials like drugs and polymers.

**COURSE OUTCOMES: After the completion of this course, the student will be able to**

- Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
- Estimate the amount of chemical substances by volumetric analysis.
- Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
- Calculate the concentration and amount of various substances using instrumental techniques.
- Develop the basic drug molecules and polymeric compounds.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

**List of Experiments:**

- Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
- Estimation of metal ions ( $\text{Co}^{+2}$  &  $\text{Ni}^{+2}$ ) by EDTA method.
- Estimation of temporary and permanent hardness of water using EDTA solution
- Determination of Alkalinity of water
- Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
- Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide. (second order)
- Estimation of amount of HCl Conductometrically using NaOH solution.
- Estimation of amount of HCl and  $\text{CH}_3\text{COOH}$  present in the given mixture of acids
  - Conductometrically using NaOH solution.
- Estimation of amount of HCl Potentiometrically using NaOH solution.
- Estimation of amount of  $\text{Fe}^{+2}$  Potentiometrically using  $\text{KMnO}_4$  solution
- Preparation of Nitrobenzene from Benzene.
- Synthesis of Aspirin drug and Paracetamol drug.
- Synthesis of phenol formaldehyde resin.



**TEXT BOOKS:**

1. J. Mendham and Thomas, "Vogel's text book of quantitative chemical analysis", Pearson education Pvt.Ltd. New Delhi, 6<sup>th</sup> ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg&A.Gulati,; R. Chand & Co. : New Delhi (2011).

**SUGGESTED READINGS:**

1. Dr.Subdharani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara, "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9<sup>th</sup> revised edition, 2015.



**22MBC02**

**COMMUNITY ENGAGEMENT**

Instruction	3P Hours per week
SEE	Nil
CIE	50 Marks
Credits	1.5

**COURSE OBJECTIVES:** This course aims to

1. Develop an appreciation of Rural culture, life-style and wisdom among the Students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

**COURSE OUTCOMES:** After the completion of this Course, Student will be able to

1. Gain an understanding of Rural life, Culture and Social realities.
2. Develop a sense of empathy and bonds of mutuality with Local Communities.
3. Appreciate significant contributions of Local communities to Indian Society and Economy.
4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
5. Utilise the opportunities provided by Rural Development Programmes.

**Module I Appreciation of Rural Society**

Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community, Nature and Resources, elaboration of 'soul of India lies in villages' (Gandhi), Rural Infrastructure.

**Module II Understanding Rural Economy and Livelihood**

Agriculture, Farming, Landownership, Water management, Animal Husbandry, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

**Module III Rural Institutions**

Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees, Local Civil Society, Local Administration.

**Module IV Rural Development Programmes**

History of Rural Development in India, Current National Programmes: SarvaShiksha Abhiyan, BetiBhachao, BetiPadhao, Ayushman, Bharat, Swachh Bharat, PM Awas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.

**TEXT BOOKS:**

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

**Journals:**

1. Journal of Rural development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).



**22CSC04**

**OBJECT-ORIENTED PROGRAMMING LAB**

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**COURSE OBJECTIVES:** This course aims to:

1. Master the concepts of Object Oriented Programming.
2. Explore the OOPs features of Python and build applications.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Demonstrate the features of Object-Oriented Programming.
2. Understand APIs and third-party libraries to be used with Python.
3. Use Python libraries to solve real-world problems.
4. Write scripts to solve data science/machine learning problems using NumPy and Pandas.
5. Develop applications by accessing web data and databases.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	2	3	1	3	-	-	-	-	-	-	2
2	3	3	2	2	2	-	-	-	-	-	-	2
3	3	3	3	2	3	-	-	-	-	-	-	2
4	3	3	3	3	3	-	-	-	-	-	-	2
5	3	3	3	3	3	-	-	-	-	-	-	2

**Laboratory / Practical:**

1. Demonstration of classes and objects with referencing the class variables, instance variables and static variables.
2. Demonstration of Inheritance types with constructor and destructor invocation in inheritance.
3. Demonstration of Exception handling and unit testing.
4. Write a NumPy program to compute the cross product of two given vectors.
5. Write a NumPy program to calculate the QR decomposition of a given matrix.
6. Write a Pandas program to convert a Panda Module Series to Python list and its type.
7. Write a Pandas program to convert a NumPy array to a Pandas series.
8. Create a Python project to get the citation from Google scholar using title and year of publication and volume and pages of journal.
9. Create a Python project to get total COVID-19 cases, total deaths due to Covid-19, total Covid-19 patients recovered in the world.
10. Demonstration of database connectivity and different types of JOIN operations on tables.

Note: Programs need to be on OOPS concepts.

**Text Book:**

1. Reema Thareja, "Python Programming", First Edition, Oxford Press, 2017.

**ONLINE RESOURCES:**

1. <https://vknight.org/cfm/labsheets/04-object-oriented-programming/>
2. <http://learning-python.com/class/Workbook/x-exercises.htm>
3. <https://inst.eecs.berkeley.edu/~cs61a/fa14/lab/lab06/#inheritance>
4. [https://anandology.com/python-practice-book/object\\_oriented\\_programming.html](https://anandology.com/python-practice-book/object_oriented_programming.html)
5. <http://stanfordpython.com/>
6. <https://docs.python.org/3/>



22MEC37

**ROBOTICS AND DRONES LAB**  
(Common to All Branches)

Instruction	2T + 2P Hours per week
CIE	100 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to

- To develop the students' knowledge in various robot and drone structures and their workspace.
- To develop multidisciplinary robotics that have practical importance by participating in robotics competitions
- To develop students' skills in performing spatial transformations associated with rigid body motions, kinematic and dynamic analysis of robot systems.
- Through projects done in lab, increase the true hands-on student learning experience and enhance their conceptual understanding, increase students' ability, competence and teamwork skills on dealing with real-life engineering problems

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

- Demonstrate knowledge of the relationship between mechanical structures of robotics and their operational workspace characteristics
- Understand mechanical components, motors, sensors and electronic circuits of robots and build robots.
- Demonstrate knowledge of robot controllers.
- Use Linux environment for robotic programming.
- Write Python scripts to control robots using Python and Open CV.

**CO-PO Articulation Matrix**

PO#/CO#	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2	1	1	1	2	1	1	1	2	2	2
CO2	2	3	1	2	3	1	1	1	1	2	2	1
CO3	2	2	2	2	2	1	1	1	1	2	2	2
CO4	2	2	1	2	2	2	1	1	1	2	2	2
CO5	1	1	1	1	1	3	3	3	1	3	3	3

**Lab Experiments:**

- Assembling of robot mechanical components, mounting of motors, sensors, electronic circuits to the chassis.
- Connecting to electronic circuitry: motor drivers, incremental encoders proximity sensors, micro controller,
- Different types of batteries, selection of suitable battery for application, safety precaution.
- Introduction to Linux Command Line Interface: basic file and directory management and other useful commands
- Controlling robot using Python: i) Move robot using Python code, ii) Make robot move in patterns using Python
- Robot programming with Sensor inputs: i) Read sensor data using Python, ii) Visualize sensor data using Python, iii) Code robot to avoid obstacles by using sensor data
- Open CV: i) Create an Image and display an image; ii) Read and change pixel values; iii) Create colored shapes and save image; iv) Extract the RGB values of a pixel; v) Reading and Writing Videos
- Open CV: i) Extraction of Regions of Interest; ii) Extraction of RGB values of a pixel
- Coding robot to work with colors, follow colored objects, identifying shape of the object-oriented
- Projects: i) Making a line follower robot using a Camera; ii) Writing code for a complex function
- Assembly of a drone

**SUGGESTED READINGS:**

1. <https://www.geeksforgeeks.org/robotics-introduction/>
2. <https://www.ohio.edu/mechanical-faculty/williams/html/PDF/IntroRob.pdf>
3. <https://www.idtechex.com/en/research-report/new-robotics-and-drones-2018-2038-technologies-forecasts-players/584>
4. <https://dronebotworkshop.com/>



**22EEEC02**

**BASIC ELECTRICAL ENGINEERING LAB**

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	50 Marks
Credits	1

**COURSE OBJECTIVES: This course aims to**

- To acquire the knowledge on different types of electrical elements and to verify the basic electrical circuit laws and theorems.
- To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power & energy.
- To determine the characteristics of Transformers, dc, ac machines and switch gear components

**COURSE OUTCOMES: After the completion of this course, the student will be able to**

- Comprehend the circuit analysis techniques using various circuit laws and theorems.
- Analyse the parameters of the given coil and measurement of power and energy in AC circuits
- Determine the turns ratio/performance parameters of single-phase transformer
- Infer the characteristics of DC shunt motor different tests.
- Illustrate different parts and their function of electrical components, equipment and machines.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

**List of Laboratory Experiments/Demonstrations:**

- Verification of KCL and KVL.
- Verification of Thevenin's theorem.
- Verification of Norton's theorem.
- Charging and discharging of Capacitor.
- Determination of parameters of a choke or coil by Wattmeter Method.
- Power factor improvement of single-phase AC System.
- Active and Reactive Power measurement of a single-phase system using  
(i) 3-Ammeter method                      (ii) 3-Voltmeter method
- Measurement of 3-Phase Power in a balanced system
- Calibration of single-phase energy meter.
- Verification of Turns/voltage ratio of single-phase Transformer.
- Open Circuit and Short Circuit tests on a given single phase Transformer
- Brake test on DC Shunt Motor
- Speed control of DC Shunt Motor
- Demonstration of Measuring Instruments and Electrical Lab components.
- Demonstration of Low-Tension Switchgear Equipment/Components
- Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

**Note: TEN experiments to be conducted to cover all five Course Outcomes**





**CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)**  
**(Inline with AICTE Model Curriculum with effect from AY 2023-24)**

**B.E. (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)**

**SEMESTER – III**

S.N O	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/ D		CI E	SEE	
<b>THEORY</b>								
1.	22MTC07	Mathematical and Statistical Foundations	3	-	3	40	60	3
2.	22CSC15	Operating Systems	3	-	3	40	60	3
3.	22CSC11	Database Management Systems	3	-	3	40	60	3
4.	22ITC02	Java Programming	3	-	3	40	60	3
5.	22ITC01	Digital Logic and Computer Architecture	3	-	3	40	60	3
6.	22CSC05	Data Structures	3	-	3	40	60	3
7.	22EGM01	Indian Constitution and Fundamental Principles	2	-	2	-	50	NC
<b>PRACTICALS</b>								
8.	22CSC33	Database Management Systems Lab	-	2	3	50	50	1
9.	22ITC03	Java Programming Lab	-	2	3	50	50	1
10.	22CSC31	Data Structures Lab	-	2	3	50	50	1
11.	22ADI01	MOOCs/Training/Internship	3-4 Weeks/ 90 Hours		-	50	-	2
<b>TOTAL</b>			<b>20</b>	<b>6</b>	<b>29</b>	<b>390</b>	<b>500</b>	<b>23</b>
<b>Clock Hours Per Week: 26</b>								

**L: Lecture      T: Tutorial**  
**CIE – Continuous Internal Evaluation**

**D: Drawing      P: Practical**  
**SEE - Semester End Examination**





22MTC07

**MATHEMATICAL AND STATISTICAL FOUNDATIONS**

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:**

1. Able to learn and analysing data in using statistical tools.
2. Able to fit the hypothetical data using probability distribution.
3. Able to fit the random data using distribution function.
4. Able to understand the data using the testing of Hypothesis.
5. Able to understand the basic concepts of the Number Theory for data security.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Apply the statistical averages for identifying behaviour of the data.
2. Analyse the data using probabilistic models.
3. Apply the probability function to characterise the random phenomenon.
4. Analyse data using different methods of hypothesis testing.
5. Apply the number theory concept to cryptography domain.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	-	-	-	-	-	-	-	2	2	2	3
CO 2	3	3	2	2	-	-	-	-	-	-	-	2	2	2	2
CO 3	3	3	2	2	-	-	-	-	-	-	-	2	2	2	2
CO 4	3	3	2	2	-	-	-	-	-	-	-	2	2	2	3
CO 5	3	3	2	2	-	-	-	-	-	-	-	2	1	2	1

**UNIT-I**

**Basic Statistics:** Measures of Central Tendency, Measures of Dispersion, Skewness, Karl Pearson’s coefficient of skewness and Bowley’s coefficient of skewness for frequency distribution, Kurtosis. Correlation, linear regression, properties of regression coefficient.

**UNIT-II**

**Mathematical Expectation (One Dimensional Random variables):** Conditional Probability, Baye’s theorem. Random variable, discrete random variable, Probability Mass Function, continuous random variable, probability density function. Mathematical expectation, properties of Expectation, Variance and co-variance. Moments (Moments about the mean and moments about a point).

**UNIT-III**

**Probability Distributions :** Poisson distribution, Mean, Variance, MGF and CGF, Recurrence formula for the probabilities of Poisson distribution (Fitting of Poisson distribution). Normal distribution, Characteristics of normal distribution, Mean, Variance, MGF and CGF, Areas under normal curve. Uniform distribution, Mean, Variance and MGF, Exponential distribution, Mean, Variance, MGF and CGF.

**UNIT-IV**

**Testing of Hypothesis:** Large and Small Sample Tests: Tests of significance for large samples, for Single Proportion, difference of Proportions, Single mean and difference of means. Small sample test: t-test for single mean and differences of means. F-test for equality of two population variances.

**UNIT-V**

**Number Theory:** Greatest common divisors, The Euclidean algorithm, the fundamental theorem of arithmetic, Factorization of integers and the Fermat numbers. Introduction to Congruence, Linear congruence, The Chinese Remainder Theorem, System of linear congruences.

**TEXT BOOKS:**

1. S.C.Gupta, V.K.Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, 2014.
2. Kenneth H. Rosen, Elementary number theory & its applications, Sixth edition, Addison-wesley, ISBN978 0-321-50031-1.

**SUGGESTED READING:**

1. W. Feller, “An Introduction to Probability Theory and its Applications”, Vol. 1, 3rd Ed., Wiley, 1968.
2. Sheldon Ross, “A First Course in Probability”, 9th Edition, Pearson publications, 2014.
3. S.C.Gupta, V.K.Kapoor, “Fundamentals of Applied Statistics”, Sultan Chand and Sons, 2014.



**22CSC15**

**OPERATING SYSTEMS**  
(Common to IT and AI&DS)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Pre-requisites:** Computer Architecture and Programming Fundamentals.

**COURSE OBJECTIVES:** This course aims to:

1. Understand the basic concepts and design of an operating system.
2. Interpret the structure and organization of the file system
3. Learn Inter Process Communication mechanisms and memory management approaches.
4. Explore cloud infrastructures and technologies.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Understand the basics of Operating systems and its major components.
2. Illustrate the concepts related to process management.
3. Distinguish various memory management techniques.
4. Apply concepts of process synchronization and deadlocks to a given situation.
5. Evaluate various file allocation methods and Apply security as well as recovery features in the design Operating system.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	1	-	-	-	-	-	-	-	-	-	1	1	2
CO 2	3	3	-	3	1	-	-	-	-	-	-	-	-	2	2
CO 3	3	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO 4	3	3	1	3	-	-	-	-	-	-	-	-	-	1	2
CO 5	3	3	2	3	1	-	-	-	-	-	-	-	1	1	2

**UNIT – I**

**Introduction to Operating Systems:** Computer System overview, Components of a computer system, functions of OS, Examples, different types of OS (RTOS vs. desktop vs. mobile etc.), OS distributions and versions.

**OS architectures:** Micro-kernel, Layered, Kernel Approaches and examples.

**UNIT – II**

**Process management:** Program vs. process, process states, Process Control Block (PCB), OS services and system calls (fork, wait, exec, getpid, getppid etc.), system calls vs. System programs, Process scheduling- Process context switching, Scheduling algorithms, scheduling criteria.

**Inter Process Communication:** Linux IPC Mechanisms, RPC, RPC exception handling, Security issues.

**UNIT – III**

**Memory Management:** Memory view of a process, Process memory usage requirements, virtual and physical memory related system calls (mmap, munmap, sbrk, mprotect). Address translation mechanisms --- static mapping, segmentation, paging, page faults, page replacement algorithms, page sharing, read/write permissions, swapping.

**Secondary Memory Management:** Disk structure, disk scheduling, disk management, buffering, swap space management, RAID levels.



**UNIT – IV**

**Concurrency and Synchronization:** Introduction to threads, benefits, types and thread APIs, Synchronization, issues, hardware and software solutions for synchronization, Classical problems of synchronization.

**Deadlocks:** Introduction, necessary conditions for deadlock occurrence, RAG, deadlock handling mechanisms - prevention, avoidance, and recovery.

**UNIT - V**

**File Systems:** File concepts, file types, allocation and organization methods, file handling system calls, File system metadata, directory structure, caching optimizations File Systems case study.

**OS Security:** Types of threats in OS, basic security mechanisms, malware taxonomy, viruses, worms, and rootkits; Defense: overview, logging, auditing, and recovery, OS-level memory protection.

**TEXT BOOKS:**

1. Galvin, Silberschatz, “Operating system Concepts”, 10<sup>th</sup> Edition, John Wiley & Sons, 2018.
2. Maurice J. Bach, “Design of the UNIX Operating System”, Pearson Education India; 1<sup>st</sup> Edition, 2015.
3. Ekta Walia Khanna, “Operating System Concepts”, Publishing House; 2<sup>nd</sup> Edition, 2019.
4. Dhananjay Dhamdhare, “Operating Systems-A Concept Based Approach”, 3<sup>rd</sup> Edition, McGraw Hill Education, 2017.

**SUGGESTED READING:**

1. W. Richard Stevens, Stephen A. Rago, “Advanced Programming in the UNIX® Environment” Pearson Education India; 3<sup>rd</sup> Edition, 2013.

**ONLINE RESOURCES:**

1. Remzi H. Arpaci-Dusseau and Andrea C. , “Three Easy Pieces”, Arpaci-Dusseau Arpaci-Dusseau Books, LLC <https://pages.cs.wisc.edu/~remzi/OSTEP/> (online version)
2. Frans Kaashoek, Robert Morris, and Russ Cox, Xv6, a simple Unix-like teaching operating system [T4-R] <https://github.com/mit-pdos/xv6-riscv> (RISC-V version) [T4-X] <https://github.com/mit-pdos/xv6-public> (x86 version)



22CSC11

**DATA BASE MANAGEMENT SYSTEMS**  
(Common to AI&DS, AI&ML, CSE(AI&ML and CET)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Pre-requisites:** Discrete mathematics of computer science, Programming and Data Structures.

**COURSE OBJECTIVES:** This course aims to:

1. Familiarize students with fundamental concepts of database management. These concepts include aspects of database design, database languages and database-system implementation.
2. Understand about data storage techniques and indexing.
3. Impart knowledge in transaction management, concurrency control techniques and recovery procedures.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Design database schema for an application using RDBMS concepts.
2. Write SQL queries for tasks of various complexities.
3. Build applications using database system as backend.
4. Understand internal working of a DBMS including data storage, indexing, query processing, transaction processing, concurrency control and recovery mechanisms.
5. Analyze non-relational and parallel/distributed data management systems with a focus on scalability.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	2	3	-	-	-	-	-	-	1	1	2	2
CO 2	2	3	2	2	3	-	-	-	-	-	-	1	2	2	2
CO 3	2	1	2	1	3	-	-	-	-	-	-	-	2	2	3
CO 4	2	1	1	-	-	-	-	-	-	-	-	-	1	2	3
CO 5	2	1	-	1	-	-	-	-	-	-	-	-	2	2	3

**UNIT - I**

**Introduction:** Motivation, Introduction to Data Models (Relational, Semi structured, ER).

**Relational Data Bases:** Relational Data Model, Relational Algebra, Relational Calculus.

**UNIT - II**

**SQL + Interaction with Database:** SQL Data Types, Basic Structure of SQL Queries, Modification of the Database, Set Operations, Aggregate Functions, Data-Definition Language, Integrity Constraints, Null Values, Views, Join Expression. Index Definition in SQL. Simple Queries (select/project/join/ aggregate queries), Complex queries (With Clause, Nested Subqueries, Views), Programming in a standard language and interfacing with a DB backend.

**UNIT- III**

**Big Data:** Key-value Stores and Semi structured Data, using JSON and MongoDB, or other combinations

**Database Design:** Introduction to ER model, Mapping from ER to relational model, Functional Dependencies, Normalization.

**UNIT - IV**

**Physical Design:** Overview of Physical Storage (Hard Disks, Flash/SSD/RAM), sequential vs random I/O, Reliability via RAID, Storage Organization (Records, Pages and Files), Database Buffers, Database Metadata, Indexing, B+-Trees.



**UNIT - V**

**Query Processing and Optimization:** Query Processing, External sort, Joins using nested loops, indexed nested loops.

**Overview of Query Optimization:** Equivalent expressions and concept of cost based optimization.

**Transaction Processing:** Concept of transactions and schedules, ACID properties, Conflict-serializability,

**Concurrency control:** locks, 2PL, Strict 2PL, optional: isolation levels, Recovery using undo and redo logs.

**TEXT BOOKS:**

1. Silberschatz, Korth and Sudarshan, "Database System Concepts", 7<sup>th</sup> Edition, McGraw-Hill. Indian Edition, 2021
2. Elmasri and Navathe, "Fundamentals of Database Systems", 7<sup>th</sup> Edition, Pearson Pubs, 2017
3. Lemahieu, Broucke and Baesens, "Principles of Database Management", Cambridge University Press, 2018
4. RP Mahapatra, "Database Management Systems", Khanna Publishing House, 2020.
5. Krishnan, "Database Management Systems", McGraw Hill.

**SUGGESTED READING:**

1. MySQL Explained: Your Step By Step Guide To Database Design
2. Pro SQL Server 2008 Relational Database Design and Implementation (Expert's Voice in SQL Server) 1<sup>st</sup> Edition

**ONLINE RESOURCES:**

1. <http://www.nptelvideos.in/2012/11/database-managementsystem.html>.
2. <https://www.oracle.com/news/connect/json-database-semistructured-sql.html>



22ITC01

**DIGITAL LOGIC AND COMPUTER ARCHITECTURE**  
(Common to IT, AI&DS and CET)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to:

1. Familiarize with logic gates, combinational and Sequential logic circuits.
2. Provide understanding of Digital Counters, registers and Data representation.
3. Present the operation of the Central Processing Unit.
4. Facilitate the techniques that computers use to communicate with input and output devices.
5. Introduce the concept of memory hierarchy and memory management.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Apply Boolean algebra for simplification and learn representation of data using numbers.
2. Understand fundamentals of combinational & sequential logic gates, registers and counters.
3. Infer the architecture and functionality of the central processing unit.
4. Explore the techniques that computers use to communicate with I/O devices for data transfer.
5. Comprehend memory hierarchy, cache memory and virtual memory.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	0	1	0	0	0	1	0	0	1	-	-	1
CO 2	2	1	1	0	1	0	0	0	0	0	0	1	1	-	1
CO 3	2	2	1	0	0	0	0	0	0	0	2	2	-	-	1
CO 4	2	1	0	0	0	0	0	0	0	0	0	2	-	-	1
CO 5	2	2	1	0	0	0	1	0	1	0	2	2	1	-	1

**UNIT-I**

**Data Representation:** Number Systems, Octal and Hexadecimal Numbers, Decimal Representation, Complements: (r-1)'s Complement, r's Complement, Subtraction of Unsigned Numbers, Fixed-Point Representation, and Floating-Point Representation.

**Digital Logic Circuits :** Digital Computers, Logic Gates, Boolean Algebra, Map simplification, Product -of-sums Simplification, Don't -Care Conditions.

**UNIT-II**

**Combinational Circuits:** Decoders, Encoders, Multiplexers, Half-Adder, Full-Adders, **Flip-Flops:** SR, D, JK, T Flip-Flops, Edge triggered Flip-Flops, Excitation Tables.

**Registers:** Register with Parallel load, Bidirectional Shift Register with Parallel load, 4-bit Synchronous Binary Counter.

**UNIT-III**

**Central Processing Unit:** General register Organization, Instruction Formats: Three Address Instructions, Two-Address Instructions, One-Address Instructions, and Zero-Address Instructions. Addressing Modes: Data Transfer and Manipulation, Program Control, Multi core Processors and their Performance.424286

**UNIT-IV**

**Input-Output Organization:** Peripheral Devices: ASCII Alphanumeric Characters, Input-output Interface: I/O Bus and Interface Modules, Asynchronous Data Transfer: Strobe Control, Handshaking, Asynchronous Communication Interface, First-In- First-Out Buffer, Modes of Transfer: Interrupt-Initiated I/O, Priority Interrupt: Daisy Chaining, Parallel Priority Interrupt, Priority Encoder, Direct Memory Access (DMA): DMA Controller.

**UNIT-V**

**Memory Organization:** Memory Hierarchy, Main Memory: RAM and ROM Chips, Memory Address Map, Memory Connection to CPU, Auxiliary memory: Magnetic Disks, Solid State Drive, Associative Memory: Hardware Organization, Read and Write Operations, Cache Memory: Associative Mapping, Direct Mapping, Set-Associative Mapping, Virtual Memory: Address Space and Memory Space, Address Mapping using Pages, Associative Memory Page Table.

**TEXT BOOK:**

1. M.Morris Mano, “Computer System Architecture”, 3<sup>rd</sup> Edition, Pearson Education. 2016.

**SUGGESTED READING:**

1. Stephen Brown, Zvonko Vranesic, “Fundamentals of Digital Logic with VHDL design”, 2<sup>nd</sup> Edition, McGraw Hill, 2009.
2. ZVI Kohavi, “Switching and Finite Automata Theory”, 2<sup>nd</sup> Edition, Tata McGraw Hill, 1995.
3. William Stallings, “Computer Organization and Architecture”, 8<sup>th</sup> Edition, PHI.2010
4. Carl Hamacher, Vranesic, Zaky, “Computer Organization”, 5<sup>th</sup> Edition, McGraw Hill.2002.

**WEB RESOURCES:**

1. <https://nptel.ac.in/courses/117106114/Week1%20Slides1.1/Introduction.pdf>
2. [https://ece.gmu.edu/coursewebpages/ECE/ECE545/F10/viewgraphs/ECE545\\_lecture1\\_digital\\_logic\\_review.ppt](https://ece.gmu.edu/coursewebpages/ECE/ECE545/F10/viewgraphs/ECE545_lecture1_digital_logic_review.ppt)
3. <http://www.nptelvideos.in/2012/11/computer-organization.html>





22ITC02

**JAVA PROGRAMMING**  
(Common to IT and AI&DS)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:**

1. Deliver the Object-oriented programming features and principles for code development.
2. Explore the reusability of the code, coupling and cohesion.
3. Handle the exceptions and multiple flow of the execution.
4. Understand the collection framework.
5. Develop the database applications.

**COURSE OUTCOMES: After the completion of this course, the student will be able to**

1. Apply the concept of OOP to design, implement and execute programs.
2. Use the strings, interfaces, packages and inner classes for application development.
3. Apply the exception handling mechanisms and multithreading for the development.
4. Develop applications using collection framework.
5. Develop database applications using SQL package.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	3	3	2	2	-	1	2	1	2	2	2	2	2
CO 2	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO 3	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO 4	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO 5	2	2	3	2	3	1	-	1	2	1	2	2	2	3	3

**UNIT-I**

**Introduction to Java:** Procedural and object-oriented programming paradigms, Principles, Features, Basic structure a java program, Java Primitive Data Types, Basic Operators, Flow-control statements, Defining Classes, Adding Instance Fields and Methods, Object Creation, Constructors, Access Modifiers, Method Overloading and Constructor Overloading, Use of static and final keyword, Arrays, Strings and String Tokenizer.

**UNIT-II**

**Inheritances and Packages:** Types of Inheritance, super keyword, preventing inheritance, the Object class, method overriding and dynamic method dispatch, abstract classes and methods. Interfaces, Interfaces vs. Abstract classes, Inner classes and types, Packages, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

**UNIT-III**

**Exception Handling and Threading:** What are exceptions, Error vs. Exception, usage of try, catch, throw, throws and finally clauses. Multithreading in Java, Life cycle of Thread, how to create threads, Thread class in java, Thread priorities, Thread Synchronization. Introduction to Generics.

**UNIT-IV**

**Collections:** Overview of Java Collection Framework, Collection Interfaces – Collection, Set, List, Map, Collection classes – Array List, Linked List, Hash Set, Tree Set, Hash Map, Tree Map, legacy and class, Iteration over Collections – Iterator and List Iterator, Enumeration interfaces, differentiate Comparable and Comparator interface, Introduction to Java 8 Features.



**UNIT-V**

**Servlets, JSP and Databases:** Introduction to Servlets , Servlet Life cycle, Request and Response methods- Servlet Collaboration. Servlet Config vs. Servlet Context, JSP, Databases: Connecting to Database - JDBC, Drivers, Connection, Statement and its types, Result set, CRUD operations.

**TEXT BOOKS:**

1. Herbert Schildt, “Java: The Complete Reference”, 12th Edition, Tata McGraw Hill Publications, 2020.
2. K Somasundaram “Advanced Programming in Java2” Jaico Publishing House, 2008.
3. Bruce W.perry “Java Servlet and JSP Cookbook”, O’reilly Media Inc., 2004.

**SUGGESTED READING:**

1. Sachin Malhotra, Saurabh Choudhary, “Programming in Java”, Oxford University Press, 2nd Edition, 2014.
2. C.ThomasWu, “An Introduction to Object-Oriented Programming with Java”, TataMcGraw-Hill, 4th Edition, 2010.
3. E Balaguruswamy “Programming with Java”, TataMcGraw-Hill, 6<sup>th</sup> Edition, 2019.
4. Cay S. Horstmann, Gary Cornell, “Core Java, Volume I— Fundamentals”, 8th Edition, Prentice Hall, 2008.
5. K Somasundaram “Introduction to Java Programming”, Jaico Publishing House, 2016.
6. Paul Deitel and Harvey Deitel “Java How to Program, Early Objects”, 11<sup>th</sup> Edition., 2018.

**WEB RESOURCES:**

1. [https://www.cse.iitb.ac.in/~nlp-ai/javalect\\_august2004.html](https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html)
2. <https://nptel.ac.in/courses/106106147/2>



22CSC05

**DATA STRUCTURES**

(Common to CSE, IT, AI&DS, AI&ML, CSE(AI&ML) and CET)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Pre-requisites:** Basic knowledge of programming language such as python.

**COURSE OBJECTIVES:** This course aims to:

1. Study various linear and non-linear data structures.
2. Understand the performance of operations on data structures.
3. Explore various searching and sorting techniques.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Understand the basic concepts and types of data structures.
2. Analyze various linear and nonlinear data structures.
3. Identify the applications of linear and nonlinear data structures and significance of balanced search trees, hashing.
4. Evaluate various searching and sorting techniques.
5. Use appropriate data structures to design efficient algorithms.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	2	3	3
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 5	3	3	1	-	-	-	-	-	-	-	-	-	3	3	3

**UNIT-I**

**Introduction:** Data structures, Classification of data structures, Abstract Data Types, Analysis of Algorithms;

**Recursion:** Examples illustrating Recursion (Factorial, Binary Search), Analyzing Recursive Algorithms; **Sorting:** Quick sort, Merge Sort, Selection Sort, Radix sort, Comparison of Sorting Algorithms.

**UNIT-II**

**Stacks:** Stack ADT, Applications of stack, Array based stack implementation; **Queues:** Queue ADT, applications of queues, Array based queue implementation, Double Ended Queues, Circular queues.

**UNIT-III**

**Linked Lists:** Introduction, Linked lists, Representation of linked list, types of linked list, singly linked lists, implementing stack with a singly linked list and Queue, Circular linked lists, doubly linked lists, Applications of linked lists.

**UNIT-IV**

**Trees:** General Trees, Binary Trees, Implementing Trees, Tree traversals; **Search Trees:** Binary Search Trees, Balanced search trees- AVL trees, B- trees; **Priority Queue and Heaps:** Priority queue ADT, Priority queue applications, Heap Trees, implementing a priority queue with a Heap, Heap Sort.

**UNIT-V**

**Graphs:** Introduction, Applications of graphs, Graph representations, graph traversals.

**Hashing:** Introduction, Hash Functions-Modulo, Middle of Square, Folding, Collision Resolution Techniques- Separate Chaining, Open addressing,- Linear Probing, Quadratic Probing, Double Hashing.

**TEXT BOOKS:**

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structure and Algorithms in Python”, Wiley, 2021.
2. Narasimha karumanchi, “Data Structures and Algorithms Made Easy”, Career Monk Publications, 2020
3. S. Sahni and Susan Anderson-Freed, “Fundamentals of Data structures in C”, E. Horowitz, Universities Press, 2<sup>nd</sup> Edition, .
4. Reema Thareja, “Data Structures using C”, Oxford University Press, 2<sup>nd</sup> Edition, 2014.

**SUGGESTED READING:**

1. D. S. Kushwaha and A K. Misra, “Data structures A Programming Approach with C”, PHI, 2<sup>nd</sup> edition, 2014.
2. Seymour Lipschutz, “Data Structures with C”, Schaums Outlines, MGH, Kindle Edition, 2017.
3. Kenneth A. Lambert, " Fundamentals of Python: Data Structures", Cengage Learning, 2018
4. D. Samantha, “Classic Data Structures”, Prentice Hall India, 2<sup>nd</sup> Edition, 2013

**ONLINE RESOURCES:**

1. [https://www.tutorialspoint.com/data\\_structures\\_algorithms/index.htm](https://www.tutorialspoint.com/data_structures_algorithms/index.htm)
2. <https://www.edx.org/course/foundations-of-data-structures>
3. <https://sites.google.com/site/merasemester/data-structures/data-structures-#DS>
4. <https://www.cs.usfca.edu/~galles/visualization/Algorithms>
5. <https://www.coursera.org/specializations/data-structures-algorithms>



**22EGM01**

**INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES**

Instruction	2 L Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	-
Credits	0

**Prerequisite:** Basic Awareness of Indian Constitution and Government.

**COURSE OBJECTIVES: This course aims to**

1. Understand the history of framing of the Indian Constitution.
2. Awareness on Fundamental Rights, Duties and Directive Principles of State Policy.
3. Explore the organization of Union Government, and functions of President and Prime Minister.
4. Gain an insight into the inter-functionality of Union Legislature and Judiciary
5. Educate on the local governance and problems in development of rural and urban areas.

**COURSE OUTCOMES: After the completion of this course, the student will be able to**

1. Understand the history of framing of the Indian Constitution and its features.
2. Assess the realization of Fundamental Rights and Directive Principles of State Policy.
3. Analyze the challenges to federal system and position of the President and the Prime Minister in the Union Government.
4. Underline the role of the Legislature and the Judiciary in Union Government and their mutual relations.
5. Evolve the development of the local governments in India and assess the role of Collector in district administration.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	1	-	-	1	1	1	1	-	-	-	-	-	-
CO 2	-	-	2	-	-	3	2	2	1	-	-	-	-	-	-
CO 3	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-
CO 4	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-
CO 5	-	-	2	-	-	3	2	1	1	-	-	-	-	-	-

**UNIT-I**

**Constitutional History and Framing of Indian Constitution:** East India Company rule (1757-1857): Social, Economic, Political and Administrative impact of Company rule in India. British Rule (1858-1947): Indian National Movement, Government of India Acts 1909, 1919 and 1935, and Indian Independence Act 1947. Framing of the Indian Constitution: Constituent Assembly, Preamble and Salient Features.

**UNIT-II**

**Fundamental Rights, Duties and Directive Principles of State Policy:** The Fundamental Rights: Features and significance of Rights. Fundamental Duties: Importance and the legal status of Duties. Directive Principles of State Policy: Socialist, Gandhian and Liberal-intellectual principles, importance and relevance.

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**Union Government and its Administration:** Federalism: Division of legislative and financial powers between the Union and the State. Union Executive: Role and position of President, Prime Minister and Council of Ministers. Emergency Provisions: National Emergency, Constitutional Emergency and Financial Emergency.

**UNIT-IV**

**Union Legislature and Judiciary:** Union Legislature: Parliament of India-Composition and functions of Parliament, and Parliamentary Committees. Union Judiciary: Supreme Court of India-Composition and Functions.

**UNIT-V**



**Local Self Governments :** Rural Local Governments: Zilla Parishad- CEO and functions of Zilla Parishad, Mandal Parishad- Role of Elected and Officials, Gram Panchayat- Sarpanch, Secretary and Gram Sabha. Urban Local Governments: Structure and functions of Municipalities and Municipal Corporations. District Collector: Powers and functions of Collector.

**TEXT BOOKS:**

1. Sastry Ravindra, (Ed), “Indian Government & Politics”, Telugu Akademy, 2nd edition, 2018.
2. “Indian Constitution at Work”, NCERT, First edition 2006, Reprinted in 2022.

**SUGGESTED READING:**

1. D.D. Basu, “Introduction to the Constitution of India”, Lexis Nexis, 2015.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, “Framing of Indian Constitution”, 1<sup>st</sup> Edition, 2015.
3. Granville Austin, “The Indian Constitution: The Cornerstone of a Nation”, OUP, 2<sup>nd</sup> Edition, 1999.
4. M.V. Pylee, “India’s Constitution”, S. Chand Publishing, 16<sup>th</sup> Edition, 2017.
5. Rajeev Bhargava (ed), “Politics and Ethics of the Indian Constitution”, OUP, 2008.

**ONLINE RESOURCES:**

1. <http://www.nptel.ac.in/courses/103107084/Script.pdf>



22CSC33

**DATA BASE MANAGEMENT SYSTEMS LAB**  
(Common to AI&DS, AI&ML, CSE(AI&ML) and CET)

Instruction	2 P Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**COURSE OBJECTIVES:** This course aims to:

1. Become familiar with the concepts of structured query language.
2. Understand about programming language / structured query language (PL/SQL).
3. Become familiar with generation of form and open database connectivity.
4. Add constraints on Databases implement DCL, TCL and advanced SQL commands.
5. Develop programs using cursors, triggers, exceptions, procedures and functions in PL/SQL.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Outline the built-in functions of SQL and apply these functions to write simple and complex queries using SQL operators.
2. Demonstrate Queries to Retrieve and Change Data using Select, Insert, Delete and Update. Construct Queries using Group By, Order By and Having Clauses.
3. Demonstrate Commit, Rollback, Save point commands, SQL Plus Reports and formulate the Queries for Creating, Dropping and Altering Tables, Views, constraints.
4. Develop queries using Joins, Sub-Queries and Working with Index, Sequence, Synonym, Controlling Access and Locking Rows for Update, Creating Password and Security features.
5. Develop PL/SQL code using Cursors, Exception, Composite Data Types and Procedures, Functions and Packages.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	3	-	-	-	2	-	1	3	1	2	2
CO 2	3	3	2	3	3	-	-	-	2	-	1	3	2	2	2
CO 3	3	2	2	2	3	-	-	-	2	-	1	1	2	2	3
CO 4	3	1	1	1	-	-	-	-	2	-	1	-	1	2	3
CO 5	3	1	-	1	-	-	-	-	1	-	1	-	2	2	3

**List of Experiments**

**SQL:**

1. Queries using Built-In functions, like aggregate functions, String Functions, Numeric Functions, Data Functions, Conversion Functions and other miscellaneous.
2. Queries using operators in SQL.
3. Queries to Retrieve and Change Data: Select Insert, Delete and Update.
4. Queries using Group By, Order By and Having Clauses.
5. Queries on Controlling Data: Commit, Rollback and Save point.
6. Queries to Build Report in SQL \*PLUS.
7. Queries for Creating, Dropping and Altering Tables, Views and Constraints.
8. Queries on Joins and Correlated Sub-Queries.
9. Queries on Working with Index, Sequence, Synonym, Controlling Access and Locking Rows for Update,
10. Creating Password and Security features.
11. Querying in NoSql



**PL/SQL:**

1. Write a PL/SQL code using Basic Variable, Anchored Declarations and Usage of Assignment Operation.
2. Write a PL/SQL code Bind and Substitution Variables, Printing in PL/SQL.
3. Write a PL/SQL block using SQL and Control Structures in PL/SQL.
4. Write a PL/SQL code using Cursors, Exception and Composite Data Types.
5. Write a PL/SQL code using Procedures, Functions and Packages.

**Note:** The creation of sample database for the purpose of the experiments is expected to be pre-decided by the instructor.

**TEXT BOOKS / SUGGESTED READING:**

1. "Oracle: The complete Reference", by Oracle Press.
2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007.
3. Rick F Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007.





22ITC03

**JAVA PROGRAMMING LAB**  
(Common to IT and AI&DS)

Instruction	2 P Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**COURSE OBJECTIVES:** This course aims to:

1. Deliver the basic principles of OOP.
2. Explore the object-orientation process in creating classes, object, etc.,
3. Demonstrate the inheritances and polymorphism.
4. Handle the exceptions in runtime and multithreading.
5. Develop the database applications.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Practice the basics of OOPs to develop java applications.
2. Use the inheritance and interfaces for application development.
3. Apply the exception handling and multithreading to handle multiple flows of execution.
4. Develop applications using collection framework.
5. Apply the SQL concepts for application development.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	3	3	2	2	-	1	2	1	2	2	2	2	2
CO 2	3	3	3	2	2	1	-	1	2	2	2	3	2	2	2
CO 3	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO 4	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO 5	3	3	3	2	3	1	-	1	2	2	2	3	2	3	3

**LIST OF EXPERIMENTS**

1. Implement the program(s) to handle the various data types, operators, expressions, control-flow, and strings.
2. Develop a java program(s) for dynamic method dispatch and constructor.
3. Develop a java program(s) to deal with different types of inheritances and interfaces.
4. Implement the program(s) to demonstrate the packages.
5. Develop a java program(s) to handle user defined exceptions with multiple catch blocks.
6. Implement program(s) to demonstrate Multithreading and thread synchronization.
7. Implement the collection framework classes with Iterator/ListIterator/Enum Interface.
8. Develop a java program(s) to implement the features of JDK8.
9. Implement a java program(s) to implement the concept of Servlets and JSP.
10. Create a web application to implement CRUD operations using Servlets, JSP and Databases.

**TEXT BOOKS:**

1. Herbert Schildt, “Java: The Complete Reference”, 12th Edition, Tata McGraw Hill Publications, 2020.
2. K Somasundaram “Advanced Programming in Java2” Jaico Publishing House, 2008.
3. Bruce W.perry “Java Servlet and JSP Cookbook”, O’reilly Media Inc., 2004.



**SUGGESTED READING:**

1. Sachin Malhotra, Saurabh Choudhary, “Programming in Java”, Oxford University Press, 2nd Edition, 2014.
2. C.ThomasWu, “An Introduction to Object-Oriented Programming with Java”, TataMcGraw-Hill, 4th Edition, 2010.
3. E Balaguruswamy “Programming with Java”, TataMcGraw-Hill, 6<sup>th</sup> Edition, 2019.
4. Cay S. Horstmann, Gary Cornell,” Core Java, Volume I— Fundamentals”, 8th Edition, Prentice Hall, 2008.
5. K Somasundaram “Introduction to Java Programming” , Jaico Publishing House, 2016.
6. Paul Deitel and Harvey Deitel “Java How to Program, Early Objects”, 11<sup>th</sup> Edition., 2018.

**WEB RESOURCES:**

1. [https://www.cse.iitb.ac.in/~nlp-ai/javalect\\_august2004.html](https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html)
2. <https://nptel.ac.in/courses/106106147/2>



22CSC31

**DATA STRUCTURES LAB**  
(Common to IT, AI&DS, AI&ML, CSE(AI&ML) and CET)

Instruction	2 P Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**Pre-requisites:** Any Programming Language.

**COURSE OBJECTIVES:** This course aims to:

1. Understand the basic concepts of data structures and abstract data types.
2. Explore linear and non-linear data structures.
3. Study various searching, sorting and hashing techniques.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Implement the abstract data type.
2. Implement linear and non-linear data structures.
3. Evaluate various sorting techniques.
4. Analyze various algorithms of linear and nonlinear data structures.
5. Choose or create appropriate data structures to solve real world problems.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 3	2	3	-	-	-	-	-	-	-	-	-	-	2	3	3
CO 4	2	3	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 5	2	3	1	-	-	-	-	-	-	-	-	-	3	3	3

**List of Experiments**

1. Implementation of Quick sort, Merge sort and Selection sort.
2. Implementing Stack using array.
3. Conversion of Infix expression to Postfix expression.
4. Implement the algorithm for Evaluation of Postfix.
5. Implementing Queues using array
6. Implementation of Insert, Delete and Display operations on Single Linked List.
7. Implementation of Stack and Queue using linked list.
8. Implementation of Insert, Delete and Display operations on doubly Linked List.
9. Implementation of Binary Search Tree operations.
10. Implementation of Heap Sort.

**TEXT BOOKS:**

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structure and Algorithms in Python”, Wiley, 2021.
2. Narasimha karumanchi, “Data Structures and Algorithms Made Easy”, Career Monk Publications, 2020.



**22ADI01**

**MOOCS / TRAINING / INTERNSHIP**

Instruction / Demonstration / Training	3-4 Weeks / 90 Hours
Duration of Semester End Presentation	--
Semester End Evaluation	--
Mid Term Evaluation	50 Marks
Credits	2

**COURSE OBJECTIVES:** This course aims to:

1. Exposing the students to the industrial environment and technologies
2. Provide possible opportunities to learn, make them to understand and sharpen them to the real time technical/ managerial skills required at the job
3. Expose with the current technological developments relevant to program domain
4. Understand Engineer’s responsibilities and ethics and provide opportunity to interact with the people of industry/society to understand the real conditions.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Learn new technologies and solve real time projects.
2. Expose to the industrial environment problems and technologies
3. Gain knowledge on contemporary technologies industrial requirements.
4. Identify, Design and Develop solutions for real world problems
5. Communicate their ideas and learning experiences through reports and presentation.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
<b>CO 1</b>	3	3	3	3	2	2	1	1	3	2	3	3	3	2	3
<b>CO 2</b>	2	2	2	1	1	2	2	1	3	2	3	3	3	2	3
<b>CO 3</b>	3	2	1	1	1	2	2	1	2	2	3	3	3	2	2
<b>CO 4</b>	2	3	3	3	1	2	1	-	3	3	3	3	3	2	3
<b>CO 5</b>	1	1	1	1	1	1	-	-	2	3	3	3	2	2	3

**Process to be followed for carrying out Instructions to Students:**

1. Students may apply for **internships** through the AICTE Portal or through CDC of the institute by filling the application form IAP-101.
2. Industry shall scrutinize the students based on their criteria and communicate a provisional offer or confirmation letter to the student.
3. If students apply through CDC, then CDC shall nominate the students for various opportunities accordingly by issuing NOC (IAP-104).
4. The respective head of the department shall assign a faculty mentor.
5. Student shall undergo internship/industrial training at the concerned Industry/Organization by submitting the form, IAP-103.
6. During the internship, Faculty Mentor will evaluate the performance of students twice either by visiting the Industry/Organization or through obtaining periodic reports from students.
7. Student shall submit internship report to the industry/organization at the end of internship program.
8. On successful completion of the Internship, Industry/Organization shall issue Internship Certificate to the students
9. All the students should maintain discipline, professional ethics and follow the health and safety precautions during internship
10. Students should get approval for **MOOCS** and **Training Programs** and same evaluation process will be followed.

Student shall maintain diary during the internship and submit the internship report at the end of the internship. The report will be evaluated by the supervisor on the basis of the following criteria:

- Originality
- Adequacy and purposeful write-up
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience
- Practical applications, relationships with basic theory and concepts taught in the course

**Evaluation of Internship:** The internship of the students will be evaluated in three stages:

- a. Evaluation by the Industry ( in the scale of 1 to **10** where 1-Unsatisfactory; 10-Excellent)
- b. Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (**15** marks)
- c. Evaluation through seminar presentation/Viva-Voce at the Institute(This can be reflected through marks assigned by Faculty Mentor (**25 marks**))

For further details regarding templates, assessment guidelines please refer to the document from page number 16 onwards available at: <https://www.cbit.ac.in/wp-content/uploads/2019/04/R22-Rules-with-internship-guidelines-10-11-2022..pdf>





**CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)  
(Inline with AICTE Model Curriculum with effect from AY 2023-24)**

**B.E. (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)**

**SEMESTER – IV**

NO	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>THEORY</b>								
1.	22MTC16	Stochastic Process and Queueing Theory	3	-	3	40	60	3
2.	22ECC39	Systems and Signal Processing	3	-	3	40	60	3
3.	22CSC14	Design and Analysis of Algorithms	3	-	3	40	60	3
4.	22ADC01	Fundamentals of Machine Learning	3	-	3	40	60	3
5.		Professional Elective – I	3	-	3	40	60	3
6.	22MBC01	Engineering Economics and Accountancy	3	-	3	40	60	3
7.	22CEM01	Environmental Science	2	-	2	-	50	NC
<b>PRACTICAL</b>								
8.	22MTC17	Stochastic Process and Queueing Theory Lab	-	2	3	50	50	1
9.	22CSC34	Design and Analysis of Algorithms Lab	-	2	3	50	50	1
10.	22ADC02	Machine Learning Lab	-	2	3	50	50	1
11.	22ADC04	Linux and Latex Lab	-	2	3	50	50	1
			<b>20</b>	<b>8</b>	<b>32</b>	<b>440</b>	<b>550</b>	<b>22</b>
<b>Clock Hours Per Week: 28</b>								

**L: Lecture      T: Tutorial**  
**CIE – Continuous Internal Evaluation**

**D: Drawing      P: Practical**  
**SEE - Semester End Examination**

<b>Professional Elective #1</b>	Digital Image Processing (22ITE02)	Web Technologies (22ITC17)	Mobile Application Development (22ITE04)	Data Analysis and Visualization (22ADE01)	Data Warehousing and Data Mining (22ADE02)
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22MTC16

**STOCHASTIC PROCESS AND QUEUEING THEORY**

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to:

1. Learn methods to solve bivariate probability functions.
2. Know characterizing the random process.
3. Identify the tools for interpreting the random process.
4. Know the statistical techniques for random process.
5. Analyses the queuing models.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Estimate the marginal probabilities of statistical averages.
2. Distinguish the random process of auto correlation and cross correlation.
3. Characterize the random process of ensemble averages.
4. Analyze the effect the thermal noise in the system.
5. Analyze the queuing behavior of different queuing models.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 2	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 3	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 4	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 5	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2

**UNIT-I**

**Two-Dimensional Random Variables:** Two-dimensional or Joint Probability Mass Function, Two-dimensional Distribution Function, Marginal Distribution Functions, Joint Density Function, Marginal Density Function, The Conditional Distribution Function and Conditional Probability Density Function, Stochastic Independence, Generalization of n dimensional random variable, transformation of One-dimensional Random variable, transformation of Two-dimensional random variable.

**UNIT-II**

**Random Processes:** Classification of Random Processes, Methods of Description of a Random Process, Special classes of Random Processes, Average values of Random Process, Stationarity, Strict Strong Stationary process, Analytical Representation of a Random process, Autocorrelation Function and Its properties of R(t), Cross-Correlation Function and its Properties wide sense stationary process.

**UNIT-III**

**Discrete Time Process:** Ergodicity, Mean-Ergodic Process, Mean Ergodic Theorem, Correlation Ergodic Process, Distribution Ergodic Process, Power Spectral density function, Properties of power spectral Density function, Properties of Power Spectral Density Function, System in the Form of Convolution, Unit Impulse Response of the System, Properties.



**UNIT-IV**

**Applications of Random Process:** Definition of Gaussian process, Properties, Band Pass Process, Narrow-Band Gaussian process, Property, Noise, Thermal noise, Filters, Poisson process, Probability law of Poisson process, Mean and Autocorrelation of the Poisson process, Properties of Poisson process, Markov process, Definition of a Markov chain and Transition Probabilities.

**UNIT-V**

**Queueing Theory:** Introduction-Queueing system-The arrival pattern-The service pattern-The queue discipline, Symbolic Representation of a Queueing Model –Characteristics of Infinite Capacity, Single server Poisson Queue Model Queueing problem-Pure Birth and Death Process-Probability Distribution of Departures(pure death process)-Basic queueing Models-Measures of the  $(M/M/1):(\infty/FIFO)$  model-Characteristic of Finite Capacity, Single Server Poisson Queue Model III  $(M/M/1):(N/FCFS)$  Model.

**TEXT BOOKS**

1. “Probability Statistics and Random Processes” by T Veerarajan, 2<sup>nd</sup> Edition Tata McGraw-Hill.
2. “Fundamentals of Mathematical Statistics” by V.K.Kapoor & S.C.Gupta 11<sup>th</sup> revised Edition Sultan chand & Sons.

**SUGGESTED READING:**

1. “Stochastic Process and Queueing Theory” by Randolph Nelson 1995, 1<sup>st</sup> edition, Springer- verlag Newyork.





22ECC39

**SYSTEMS AND SIGNAL PROCESSING**  
(Common to CSE and AI&DS)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisite:** Knowledge of Differential and Integral Calculus.

**COURSE OBJECTIVES:** This course aims to

1. Know Signals and systems representation/classification and also the time and frequency domain analysis of continuous time signals with Fourier series, Fourier transforms and Laplace transforms.
2. Understand Sampling, time and frequency domain analysis of discrete time signals with DTFT, DFT and Z-Transforms.
3. Understand concepts of convolution integrals.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Classify signals, analyse the signals using Transform techniques.
2. Evaluate signal characteristics in frequency domain.
3. Assess the system stability and causality using ROC and Pole-Zero Plot.
4. Classify systems and analyse the signals using Transform techniques
5. Describe and analyse the DT Signal/systems using DFT, DCT, DWT, FFT and Z-Transform.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	3	-	-	-	-	-	-	-	1	-	-	-
CO 2	3	3	3	3	-	-	-	-	-	-	-	1	-	-	-
CO 3	3	3	3	3	-	-	-	-	-	-	-	1	-	-	-
CO 4	3	3	3	2	-	-	-	-	-	-	-	1	-	-	-
CO 5	3	2	1	2	-	-	-	-	-	-	-	1	-	-	-

**UNIT-I**

**Continuous Time Signals:** Introduction to signals, signal representations and classification.

**Fourier Series:** Exponential Fourier series, Amplitude and Phase spectra. Power Spectral Density.

**UNIT-II**

**Fourier Transforms:** Direct Fourier transforms, Inverse Fourier transforms, Existence, Frequency spectrum and properties of Fourier Transforms, FT of basic signals, Energy Spectral Density.

**UNIT-III**

**Laplace Transforms:** Laplace transforms. Region of convergence and its properties. Properties of Laplace transform, Inverse Laplace transform, Laplace transform of periodic signals.

**UNIT-IV**

**Z-Transform:** Direct Z-Transform, Region of convergence and its properties. Z-Transform properties. Inverse Z-Transform, Discrete Fourier Transform, Properties of Discrete Fourier Transform, FFT, DCT and DWT

**UNIT-V**

**Continuous & Discrete Systems:** Introduction to systems, System classifications-Linear, Causal, Stable, Time-invariant, Impulse response, System transfer function, Distortion less system, Non-linear systems- Filters

**TEXT BOOKS:**

1. B. P. Lathi, “Signals, Systems and Communications”, BS Publications, 3<sup>rd</sup> Edition, 2008.
2. Simon Haykin, “Signals and Systems”, Wiley India, 5<sup>th</sup> Edition, 2009.

**SUGGESTED READING:**

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawad, “Signals and Systems”, PHI 2<sup>nd</sup> Edition, 2015.
2. M. J. Robert, “Fundamentals of signals and systems”, McGraw Hill, 2008.



22CSC14

**DESIGN AND ANALYSIS OF ALGORITHMS**  
(Common to IT, AI&DS and CET)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Pre-requisites:** Basics of Data structures and algorithms.

**COURSE OBJECTIVES:** This course aims to:

1. Provide an introduction to formalisms to understand, analyze and denote time complexities of algorithms.
2. Introduce the different algorithmic approaches for problem solving through numerous example problems.
3. Provide some theoretical grounding in terms of finding the lower bounds of algorithms and the NP-completeness.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Analyzing performance of algorithms using asymptotic notations.
2. Demonstrate familiarity with major algorithms and importance of algorithm design techniques.
3. Apply algorithm design techniques on different problems.
4. Analyze the efficiency of the algorithms.
5. Understanding limits of efficient computation with the help of complexity classes.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO 2	3	3	2	-	1	-	-	-	1	-	1	1	1	2	3
CO 3	3	2	2	2	2	-	-	-	1	-	1	-	1	2	3
CO 4	3	3	2	2	2	-	1	-	1	-	-	-	1	2	3
CO 5	3	2	2	2	2	1	1	-	1	-	-	-	1	2	3

**UNIT-I**

**Introduction:** Characteristics of algorithm. **Analysis of algorithm:** Asymptotic analysis of complexity bounds—best, average and worst-case behavior. Performance measurements of Algorithm, Time and space trade-offs. **Divide and Conquer:** The general method. **Analysis of recursive algorithms through recurrence relations:** Substitution method, Recursion tree method and Masters’ theorem, Randomized Quicksort.

**UNIT-II**

**Greedy Algorithms:** The general method, Knapsack Problem, Huffman Codes, Job Scheduling with Deadlines. **Dynamic Programming:** The general method, 0/1 Knapsack, Travelling Salesman Problem, Matrix Chain Multiplication, Longest Common Subsequence, Optimal Binary Search Tree.

**UNIT-III**

**Backtracking:** The general Method, 8-Queens Problem, Graph Coloring, Hamiltonian Cycle. **Branch-and-Bound:** The general method, FIFO Branch and Bound, LC Branch and Bound, 0/1 Knapsack Problem, Travelling Salesperson problem.

**UNIT-IV**

**Graph Algorithms:** **Applications of DFS:** Bi-Connected components, Strongly Connected Components, Topological Sorting. **Shortest Path Algorithms:** Dijkstra’s, Bellman-Ford, Floyd-Warshall and Johnson’s algorithms. **Minimum Spanning Tree Algorithms:** Prims and Kruskal.



**UNIT-V**

**Theory of NP-Completeness:** Polynomial Time, Polynomial Time Verification, P, NP, NP-Hard and NP-Complete Classes, NP-Completeness and Reducibility. **Standard NP-Complete Problems and Reduction Techniques:** The Clique Problem, Vertex-Cover and Subset Sum Problem.

**TEXT BOOKS:**

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, “Introduction to Algorithms”, MIT Press/McGraw-Hill, 3<sup>rd</sup> Edition, 2009.
2. E. Horowitz, sartaj sahani and sanguthevar Rajasekaran, “Fundamentals of Computer Algorithms”, Universities Press, 2008.

**SUGGESTED READING:**

1. Michael T Goodrich and Roberto Tamassia, “Algorithm Design: Foundations, Analysis”, and Internet Examples, Wiley Second Edition.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/106101060/>



**22ADC01**

**FUNDAMENTALS OF MACHINE LEARNING**

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to:

1. Impart knowledge on the basic concepts of machine learning.
2. Familiarize different machine learning techniques.
3. Learn various Classification and Regression algorithms.
4. Familiarize various Kernels, SVMs and Ensemble methods.
5. Facilitate Dimensionality Reduction and Clustering.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Explain the types of machine learning and handle the challenges of machine learning.
2. Construct Decision Trees, Measure performance of classifiers.
3. Apply Regression, Logistic Regression and gradient descent to solve problems.
4. Design solutions using Bayesian classifier, SVMs and Ensemble methods.
5. Perform Dimensionality reduction and clustering of data.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	1	-	2	-	-	-	-	-	-	-	1	2	2	3
CO 2	1	1	1	1	-	-	-	-	-	-	-	1	2	3	3
CO 3	2	2	1	2	1	-	-	-	-	-	1	1	2	3	3
CO 4	2	2	1	2	1	-	-	-	-	-	1	1	2	3	3
CO 5	2	2	1	2	1	-	-	-	-	-	1	1	2	3	3

**UNIT - I**

**The Machine Learning Landscape:** What Is Machine Learning, Why Use Machine Learning, Examples of Applications, **Types of Machine Learning Systems:** Supervised/Unsupervised Learning, Batch and Online Learning, Instance-Based Versus Model-Based Learning, **Main Challenges of Machine Learning:** Insufficient Quantity of Training Data, Non representative Training Data, Poor-Quality Data, Irrelevant Features, Overfitting the Training Data, Under fitting the Training Data, Stepping Back, **Testing and Validation:** Hyper parameters Tuning and Model Selection , Data Mismatch.

**UNIT - II**

**Classification:** Training a Classifier, **Performance Measures:** Measuring Accuracy Using Cross-Validation, Confusion Matrix, Precision and Recall, Precision/Recall Trade-off, the ROC Curve, Multiclass Classification. **Decision Trees:** Training and Visualizing a Decision Tree, Making Predictions, Estimating Class Probabilities, The CART Training Algorithm, Computational Complexity, Gini Impurity or Entropy? Regularization Hyper parameters, Regression, Instability.

**UNIT - III**

**Support Vector Machines:** Linear SVM Classification, Soft Margin Classification, **Nonlinear SVM Classification:** Polynomial Kernel, Similarity Features, Gaussian RBF Kernel, Computational Complexity, SVM Regression, **Under the Hood:** Decision Function and Predictions, Training Objective, Kernelized SVMs. **Bayes Classification:** Maximum Posteriori, Bayes Belief Networks.



**UNIT - IV**

**Regression: Linear Regression:** The Normal Equation, Computational Complexity, **Gradient Descent:** Batch Gradient Descent, Stochastic Gradient Descent, Mini-batch Gradient Descent, Polynomial Regression, Learning Curves, **Regularized Linear Models:** Ridge Regression, Lasso Regression, Elastic Net, Early Stopping, **Logistic Regression:** Estimating Probabilities, Training and Cost Function, Decision Boundaries, Softmax Regression.

**UNIT - V**

**Dimensionality Reduction:** The Curse of Dimensionality, PCA, Randomized PCA, Incremental PCA, Kernel PCA, LLE. **Unsupervised Learning Techniques: Clustering:** K-Means, Limits of K-Means, Using Clustering for Image Segmentation, DBSCAN, Other Clustering Algorithms, Gaussian Mixtures. **Ensemble Learning and Random Forests:** Voting Classifiers, Bagging and Pasting, Random Patches and Random Subspaces, Random Forests, Boosting.

**TEXT BOOKS:**

1. Aurelien Geron, “Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow”- Concepts, Tools, and Techniques to Build Intelligent Systems, 2<sup>nd</sup> edition, O’Reilly,2019

**SUGGESTED READING:**

1. Tom Mitchel, “Machine Learning”, Tata McGraW Hill, 2017.
2. Stephen Marshland, “Machine Learning: An Algorithmic Perspective”, CRC Press Taylor & Francis, 2<sup>nd</sup> Edition, 2015

**WEB RESOURCES:**

1. <https://www.coursera.org/specializations/machine-learning>



**22MBC01**

**ENGINEERING ECONOMICS AND ACCOUNTANCY**

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to:

1. Demonstrate the importance of Managerial Economics in Decision Making.
2. Explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3. Understand the importance of Project Evaluation in achieving a firm’s Objective.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Apply fundamental knowledge of Managerial Economics concepts and tools.
2. Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
3. Understand Production and Cost relationships to make best use of resources available.
4. Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
5. Evaluate Capital and Capital Budgeting decision based on any technique.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	3	1	1	1	1	1	1	1	-	-	-	-	-
CO 2	2	2	2	2	-	1	1	1	-	1	-	1	1	-	1
CO 3	1	2	1	2	2	-	2	1	-	1	-	-	-	-	1
CO 4	2	2	1	2	2	1	1	3	-	1	-	-	-	-	1
CO 5	1	3	1	2	1	1	2	-	-	1	2	1	-	-	1

**UNIT - I**

**Introduction to Managerial Economics:** Introduction to **Economics and its evolution** - Managerial Economics - its Nature and Scope, Importance; Relationship with other Subjects. Its usefulness to Engineers; Basic concepts of Managerial economics - Incremental, Time perspective, Discounting Principle, Opportunity Cost, Equimarginal Principle, Contribution, Negotiation Principle.

**UNIT - II**

**Demand and Supply Analysis:** Demand Analysis - Concept of Demand, Determinants, Law of demand - Assumptions and Exceptions; Elasticity of demand - Price, Income and Cross elasticity - simple numerical problems; Concept of Supply - Determinants of Supply, Law of Supply; Demand Forecasting - Methods.

**UNIT - III**

**Production and Cost Analysis:** Theory of Production - Production function - Isoquants and Isocosts, MRTS, Input-Output Relations; Laws of returns.

Cost Analysis: Cost concepts – Types of Costs, Cost-Output Relationship – Short Run and Long Run; Market structures – Types of Competition, Features of Perfect Competition, Price Output Determination under Perfect Competition, Features of Monopoly Competition, Price Output Determination under Monopoly Competition Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.



**Unit - IV**

**Accountancy:** Book-keeping, Principles and Significance of Double Entry Bookkeeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments.

**Unit - V Capital and Capital Budgeting:** Capital and its Significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance. Capital Budgeting, Methods: Traditional and Discounted Cash Flow Methods - Numerical problems.

**TEXT BOOKS:**

1. Mehta P.L., "Managerial Economics: Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2016.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 12th Edition, 2018.

**SUGGESTED READINGS:**

1. Panday I.M. "Financial Management", 11th edition, Vikas Publishing House, 2016.
2. Varshney and K L Maheswari, Managerial Economics, Sultan Chand, 2014.
3. M. Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
4. A. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2018.





**22CEM01**

**ENVIRONMENTAL SCIENCE (MANDATORY COURSE)**

Instruction	2 L Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	-
Credits	0

**COURSE OBJECTIVES:** This course aims to

1. To equip the students with inputs on the environment, natural resources and their conservation.
2. To study the interrelationship between the living organisms and the natural environment and also to enable the students to understand the structure and functioning of the ecosystems. To understand the importance of biodiversity and create awareness on its threats and conservation strategies.
3. To enable the students become aware of pollution of various environmental segments including their causes, effects, and control measures. To create awareness about environmental legislations in the context of national conventions.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and effects of over utilisation.
2. Understand the concept of ecosystems and realise the importance of interlinking of food chains.
3. Contribute for the conservation of bio-diversity.
4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	-	3	-	-	-	-	1	-	-	-
CO 2	1	-	-	-	-	-	2	1	-	-	-	1	-	-	-
CO 3	1	-	-	-	-	-	2	1	-	-	-	1	-	-	-
CO 4	1	-	-	-	-	1	2	1	-	-	-	1	-	-	-
CO 5	1	-	-	-	-	1	2	1	-	-	-	1	-	-	-

**UNIT- I**

**Environmental Studies:** Definition, Scope and importance, need for public awareness.

**Natural resources:** Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

**UNIT – II**

**Ecosystems:** Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

**UNIT – III**

**Biodiversity:** Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.



**UNIT – IV**

**Environmental Pollution:** Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

**Environmental Legislations:** Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

**UNIT – V**

**Social issues and the environment:** Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

**TEXT BOOKS:**

1. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria & Sons, 2009.

**SUGGESTED READING:**

1. C. S. Rao, "Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry & Pollution Control", S. Chand Limited, 2006



**22ADE01**

**DATA ANALYSIS AND VISUALIZATION**

**(Professional Elective – I)**

(Common to IT and AI&DS)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to:

1. Introduce the Numpy library in Python to support storage and operations on large multi-dimensional arrays and matrices
2. Introduce large collection of mathematical functions to operate on multidimensional sequential data structures
3. Demonstrate the functionality of the Pandas library in Python for open source data analysis and manipulation
4. Demonstrate Data Aggregation, Grouping and Time Series analysis with Pandas
5. Introduce the Matplotlib library in Python for resting static, animated and interactive visualizations

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Use Numpy library utilities for various numerical operations.
2. Apply pandas library functions for handling data frames.
3. Perform various preprocessing operations on datasets using Pandas Series and DataFrame objects.
4. Analyze the given dataset and derive conclusions using inferential statistics.
5. Apply 2-D and 3-D plotting techniques on datasets using matplotlib and seaborn

**CO-PO Articulation Matrix**

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-	3	-	-	2
CO 2	3	2	-	1	1	-	-	-	-	-	-	3	-	-	2
CO 3	3	1	-	3	1	-	-	-	-	1	-	3	3	3	3
CO 4	3	2	1	3	1	-	-	-	-	3	-	3	3	3	3
CO 5	2	2	-	2	1	-	-	-	-	3	-	3	2	-	2

**UNIT - I**

**Introduction to Numpy:** Data types in Python - Fixed type arrays, creating arrays, array indexing, array slicing, reshaping arrays, array concatenation and splitting, Universal Functions, Aggregations, Broadcasting rules, Comparisons, Boolean Arrays, Masks Fancy Indexing, Fast Sorting using np.sort and np.argsort, partial sorting Creating Structured Arrays, Compound types and Record Arrays.

**UNIT - II**

**Introduction to Pandas:** Series Object, DataFrame Object, Data Indexing and Selecting for Series and DataFrames, Universal Functions for Index Preservation, Index Alignment and Operations between Series and DataFrames, Handling missing data, operating on Null values, Hierarchical Indexing.

**UNIT - III**

**Combining Datasets:** Concat, Append, Merge and Joins, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series, High-Performance functions - query() and eval()

**UNIT – IV**

**Inferential Statistics** - Normal distribution, Poisson distribution, Bernoulli distribution, z-score, p-score, One-tailed and two-tailed, Type 1 and Type-2 errors, Confidence interval, Correlation, Z-test vs T-test, F- distribution, Chi-square distribution, the chi-square test of independence, ANOVA, data mining, titanic survivors dataset analysis

**UNIT - V**

**Visualization with Matplotlib** : Simple Line plots, Scatter plots, Visualizing errors, Density and Contour plots, Histograms, Binnings, Multiple subplots, Three-dimensional plotting with Matplotlib, Geographic data with Basemap, Visualization with Seaborn.

**TEXT BOOKS:**

1. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly Media, 2016.
2. Samir Madhavan, “Mastering Python for Data Science”, Packt Publishing, 2015.

**WEB RESOURCES:**

1. <https://www.coursera.org/learn/python-data-analysis?specialization=data-science-python>
2. <https://www.coursera.org/learn/python-plotting>





# CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of V Semester of B.E. – Artificial Intelligence and Data Science  
as per AICTE Model Curriculum, with effective from 2022-23

## SEMESTER - V

S. No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>THEORY</b>								
1	20ADC06	Artificial Intelligence	3	-	3	40	60	3
2	20ITC24	Embedded Systems and IoT	3	-	3	40	60	3
3	20ITC19	Operating Systems	3	-	3	40	60	3
4	20ADC07	Full Stack Development	3	-	3	40	60	3
5	20ITC20	Computer Networks	3	-	3	40	60	3
6		Professional Elective – 2	3	-	3	40	60	3
<b>PRACTICALS</b>								
7	20ADC08	Artificial Intelligence Lab	-	2	3	50	50	1
8	20ITC26	Embedded Systems and IoT Lab	-	3	3	50	50	1.5
9	20ADC09	Minor Project - I (Full Stack Development)	-	3	-	50	-	1.5
10		Industrial / Rural Internship	90 Hours		-	-	-	2
<b>TOTAL</b>			<b>18</b>	<b>8</b>	<b>24</b>	<b>390</b>	<b>460</b>	<b>24</b>

**L: Lecture      T: Tutorial**  
**CIE – Continuous Internal Evaluation**

**D: Drawing      P: Practical**  
**SEE - Semester End Examination**

<b>Professional Elective #2</b>	Natural Language Processing 20ADE03	NoSQL Databases 20ADE04	Computer Vision 20ITE13	Cyber Security 20ITE08	Compiler Design 20ADE05	Augmented Reality and Virtual Reality 20ITE07
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20ADC06

## ARTIFICIAL INTELLIGENCE

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisite:** Concepts of Semiconductor Physics and Applied Physics.

**Course Objectives:**

1. To understand problem solving through search techniques.
2. To familiarize with knowledge representation and logical reasoning techniques in AI.
3. To learn the knowledge representation techniques.
4. To learn probabilistic reasoning models on uncertain data.
5. To acquaint with reinforcement learning.

**Course Outcomes:**

Students who complete this course should be able to

1. Solve problems using Exhaustive and Heuristic Search Techniques.
2. Apply inference methods in propositional logic to prove statements.
3. Construct knowledge representation models.
4. Inspect probabilistic reasoning models on uncertain data.
5. Appraise the learning techniques on data.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

### UNIT-I

**Introduction:** The Foundations of AI, History of AI. Intelligent agents – Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

**Solving problems by searching:** Problem Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed Search Strategies, Heuristic Functions.

### UNIT-II

**Adversarial search:** Games, Optimal decisions in games, Alpha-Beta Pruning. Constraint Satisfaction Problems-Defining constraint satisfaction Problems.

**Logic Concepts and Logic Programming:** Introduction, Propositional Calculus, Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau System in Propositional Logic, Resolution Refutation in Propositional Logic, Predicate Logic, Logic Programming.

### UNIT-III

**Knowledge Representation:** Introduction, Approaches to Knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

**Quantifying Uncertainty:** Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and its Use.

### UNIT-IV

**Probabilistic Reasoning:** Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks.

**Probabilistic Reasoning over Time:** Time and Uncertainty, Inference in Temporal Models, Hidden Markov Models, Kalman Filters.  
**UNIT-V**

**Learning with hidden variables:** The EM Algorithm. **Reinforcement Learning:** Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search, Applications of Reinforcement Learning.

**Text Books:**

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, 3rd Edition.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.

**Suggested Reading:**

1. Nilsson, N., —Artificial Intelligence: A New Synthesisl, San Francisco, Morgan Kaufmann, 1998.
2. Rich, Knight, Nair: —Artificial intelligencel, Tata McGraw Hill, Third Edition, 2009.
3. Tom M. Mitchell, —Machine Learningl, McGraw Hill, 1997.
4. Kulkarni, Parag, Joshi, Prachi, l Artificial Intelligence: Building Intelligent Systemsl, PHI, 2015.
5. Peter Jackson, —Introduction to Expert Systems, Third Edition, Pearson Addison Wesley, 1998

**Web Resources:**

1. <https://nptel.ac.in/courses/106106126>
2. <https://www.coursera.org/learn/ai-for-everyo>



**20ITC24****EMBEDDED SYSTEMS AND IOT**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To understand the embedded systems, control-driven Architectures
2. To understand the fundamental of IoT and appreciate the importance of communication between machines with reference to IoT.
3. See the design methodology and mechanism of IoT and acquire knowledge of Raspberry Pi device, its interfaces
4. To understand, appreciate and develop ability to use various contemporary IOT applications.
5. To understand the software systems for Industrial IoT and the utilities of IoT through case studies.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Develop and design for Embedded computing using 8051 Microcontroller.
2. Describe the role of things and Internet in IoT and determine the IoT levels designing an IoT Systems.
3. Learn the methodology for IoT system design and interface with Raspberry Pi.
4. Design and Develop IoT computing and its applications.
5. Implement standard IoT to build large systems for industries.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Embedded Computing:** Introduction Embedded System Design Process, Characteristics and Challenges of Embedded Systems. **The 8051 Architecture:** Introduction, 8051 Micro controller Hardware. Data Transfer and Logical Instructions, Arithmetic Operations, Decimal Arithmetic, Jump and Call Instructions Applications: Interfacing with Keyboards, Displays, D/A and A/D Conversions.

**UNIT-II**

**Introduction to Internet of Things:** Definitions & Characteristics of IoT, Physical Design of IOT- Things in IoT, IoT Protocols, Logical Design of IOT-IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IOT Enabling Technologies-Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IOT Levels & Deployment Templates.

**UNIT-III**

**IoT Platforms Design Methodology:** Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.

**IoT Physical Devices and End Points:** Basic building blocks of an IoT device, Raspberry Pi About the board, Raspberry Pi interfaces-Serial, SPI, I2C. Python Web Application Framework: Django Framework-Roles of Model, Template and View.



## UNIT-IV

**Domain Specific IOTs:** Various types of IoT Applications in Home Automation- smart lighting, Smart appliance, smoke and gas detectors, Cities, Environment, Energy, Retail, Logistics Agriculture, Industry, Health & Life Style- Wearable Electronics. **IoT and M2M** – Introduction, M2M, Differences between IoT and M2M, Software Defined Networking, Network Function Virtualization.

## UNIT-V

**Industrial IoT:** Introduction to Industrial IoT, IIoT Communication, Industry 4.0 Globalization and Emerging Issues, The Fourth Revolution, Security and Fog Computing.

### Real case studies:

Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries

### Text Books:

1. Wayne Wolf, “Computers as Components”, 1<sup>st</sup> Edition, Academic press, 2001.
2. Kenneth J. Ayala, “The 8051 Microcontroller”, 3<sup>rd</sup> Edition, Thomson, 2014.
3. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press, 2014.
4. Misra, C. Roy, and A. Mukherjee, 2020 “Introduction to Industrial Internet of Things and Industry 4.0”. CRC Press.

### Suggested Reading:

1. Raj Kamal, “Embedded Systems”, 2<sup>nd</sup> Edition, McGraw Hill, 2015.
2. Samuel Greengard, “The Internet of Things”, 1<sup>st</sup> Edition, MIT Press, 2015.
3. Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, “IoT: Building Arduino-Based Projects”, 1<sup>st</sup> Edition, Packt Publishing Ltd, 2016.
4. Jeeva Jose, “Internet of Things”, Khanna Book Publishing Company,

### Web resources:

1. <http://ee.sharif.edu/~sakhtar3/books/The%208051%20Microcontroller%20Ayala/The%208051%20Microcontroller%20Architecture,%20Programming%20and%20Applications%201991.pdf>
2. <https://slideplayer.com/slide/3944480/>.
3. [https://nptel.ac.in/noc/individual\\_course.php?id=noc17-cs05](https://nptel.ac.in/noc/individual_course.php?id=noc17-cs05).
4. <https://slideplayer.com/slide/5740917/>.
5. [https://onlinecourses.nptel.ac.in/noc20\\_cs69/preview](https://onlinecourses.nptel.ac.in/noc20_cs69/preview)



**20ITC19****OPERATING SYSTEMS**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To familiarize students with various services provided by an operating system.
2. To introduce the concepts of process, process synchronization and process scheduling.
3. To deal with different approaches of memory management.
4. To facilitate understanding of the structure and organization of the file system.
5. To provide understanding of Protection and security aspects of operating systems

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Demonstrate operating system services, inter process communication and multithreaded Programming.
2. Apply suitable process scheduling, deadlocks handling algorithms and solve process-synchronization.
3. Make use of advanced techniques such as paging, segmentation and virtual memory for memory management.
4. Illustrate file system interfaces and its implementation.
5. Identify the Operating System Security problems and Threats.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

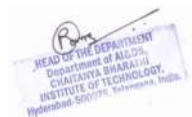
**Introduction:** Definition of Operating System, Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Open-Source Operating Systems. **Operating System Structures:** Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating-System Structure, System Boot. **Process:** Process Concept, Process Scheduling, Operations on Processes, Inter process Communication **Threads:** Overview, Multicore Programming, Multithreading Models, Threading Issues.

**UNIT-II**

**Process Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling. **Synchronization:** Background, The Critical-Section Problem, Peterson 's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors. **Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

**UNIT-III**

**Memory Management Strategies:** Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table. **Virtual Memory Management:** Background, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory.



## UNIT-IV

**File-System:** File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing Protection. **Implementing File Systems:** File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance. **Mass-Storage Structure:** Overview of Mass-Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap-Space Management.

## UNIT-V

**System Protection:** Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of the Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems

**System Security:** The Security Problem, Program Threats, System and Network Threats, Cryptography as a Security Tool, User Authentication.

### Text Book:

1. Abraham Silberschatz, Peter Galvin, Greg Gagne, —Operating System Concepts, 10th Edition, John Wiley and Sons Pvt Ltd, 2018.

### Suggested Reading:

1. A.Tanenbaum, —Modern Operation Systems, 3<sup>rd</sup> Edition, Pearson Education, 2008.
2. William Stallings, —Operating Systems, 5<sup>th</sup> Edition, Pearson Education, 2005.
3. Ida M.Flynn, —Understanding Operating Systems, 6<sup>th</sup> Edition, Cengage, 2011.
4. D.M.Dhamdhere, Operating systems a concept-based approach, 2<sup>nd</sup> Edition, McGraw-Hill, 2007.

### Web Resources:

1. <https://www.os-book.com/OS10/>
2. <http://nptel.ac.in/downloads/106108101/>
3. <http://www2.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/>
4. <http://www.cs.kent.edu/~farrell/osf03/oldnotes/>



**20ADC07****FULL STACK DEVELOPMENT**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To provide knowledge about web pages design and development.
2. To understand how the HTML, CSS and JavaScript components of Bootstrap work.
3. To explore the basic architecture of a React application and develop applications in agile mode
4. To gain the basics of front-end and back-end application development using Node Js.
5. To understand the basics of MongoDB and its Data Model

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Create web pages with good aesthetic sense of design using HTML and CSS
2. Create real-world React web applications and related tools.
3. Become an agile practitioner with the ability to quickly complete projects
4. Build an end-to-end application from scratch using NODE JS
5. Understand and build logical relationships between documents using MongoDB

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Introduction:** Web Fundamentals, **HTML 5.0:** basic tags, Images, Tables, Lists, Forms, Layout, Graphics, span and div tags. **Introduction to Cascading Style Sheets:** Types of CSS, **text and font, color, CSS Selectors, CSS BOX Model, CSS Positioning, and CSS floating.**

**UNIT-II**

**Java Script:** Data Types & Type Conversion, JSON, Events, String and Date Functions, Object Oriented Programming (OOP) in JS, Document Object Model, JavaScript Regular Expressions. **Bootstrap:** Introduction of Bootstrap, Container and Container-fluid, Connectivity of Bootstrap in page. **Bootstrap Component:** Jumbotron, Button, Grid, Table, Form, Alert, Panels, Image, Progress Bar, Tabs/Pill, Navbar, Modals

**UNIT-III**

**React Js:** Basics, State, Props, Components, Lifecycle, Events, Router, Forms, Tables, Portals, ES6, CSS, Hook, and Back End Integration. **Express JS:** The model-view-controller pattern, Defining EJS template Engine Building a front-end controller, defining routes, creating actions, Configuring Express to use EJS, Using REST, Reading POST data Adding middleware

**UNIT-IV**

**Node JS Modules:** Functions, Buffer, Module, Modules Types, Core Module, Local Modules and Modules Exports  
**Node Package Manager:** What is NPM? Installing Packages Locally, installing package globally, adding dependency in package Json and Updating packages. **Creating Web Server:** Creating Web Server, Sending Requests and Handling HTTP requests. **File System:** Read File, writing a File, opening a File Deleting a File, Writing a file asynchronously and Other I/O Operations. **Events:** Event Emitter class, Inheriting Events and Returning event emitter

**UNIT-V**

**MongoDB:** Introduction, Importance of NoSQL databases, JSON features, Data types and examples. CRUD Operations, **Data Modelling & Schema Design**, Indexing and Aggregation, Mongo Import/Export and Master/Slave Replication.

**Text Books:**

1. Vasan Subramanian, "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node", second Edition, Apress Publications, 2019.
2. David Hows, Peter Membrey, Eelco Plugge – "MongoDB Basics", Apress, 2014.

**Suggested Reading:**

1. Ethan Brown, "Web Development with Node and Express", O'Reilly Publishers, First Edition, 2014.

**Web Resources:**

1. <https://web.stanford.edu/class/cs142/index.html>
2. <https://nodejs.org/en/docs/>
3. <https://www.mongodb.com/>
4. <https://reactjs.org/>
5. <https://getbootstrap.com/docs/5.0/utilities/api/>
6. <https://edu.anarchocopy.org/Programming%20Languages/Node/Pro%20MERN%20Stack,%202nd%20Edition.pdf>



**20ITC20****COMPUTER NETWORKS**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Familiarize students with the basics of Layering of services, data transmission, transmission media, data Communications System and its components.
2. Provide state-of-the-art knowledge on Network Layer issues including Routing, Addressing.
3. Give an overview of how Networks differ and how they can be interconnected.
4. Introduce IP based transport protocols TCP and UDP.
5. Give an insight into the working principles of popular Internet Applications including Email, Domain Name System, WWW, Streaming audio and video.

**Course Outcomes:**

Upon successful completion of this course, student will be able to

1. Summarize functions of each layer in the OSI and TCP/IP reference models and demonstrate the systematic understanding of data communication Techniques.
2. Solve problems related to Addressing, Routing, Interoperability among heterogeneous networks.
3. Identify issues in Internetwork Routing issues and Congestion in computer networks.
4. Appraise the functions and performance of Internet Transport Protocols TCP and UDP.
5. Analyze the operating principles of Domain Name System and Electronic Mail, WWW.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Introduction:** Concept of layering, Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, **The Data Link Layer:** Framing, Error Control – Flow Control, Error Detection and Correction – Error-Correcting Codes – Error Detecting Codes, Sliding Window Protocols. **Channel allocation methods:** Assumptions for dynamic channel allocation, Carrier Sense Multiple access protocols, Collision free protocols. **Ethernet:** MAC Sublayer Protocol, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet

**UNIT-II**

**Network layer Routing Algorithms:** Design Issues, Routing Algorithms-Shortest path, Flooding, Flow based Distance vector, Link state Routing. **The Network Layer in The Internet:** The IP Version 4 Protocol, IP Addresses, IP Version 6, Internet Control Protocols, Label Switching and MPLS, Internet Multicasting, **Internetworking:** Different networks, Connection of networks, Tunneling, Packet Fragmentation

**UNIT-III**

**The Transport Layer:** Berkeley Sockets, Elements of transport protocols – Addressing, Connection Establishment, Connection Release, Error Control and Flow Control, Multiplexing, **Crash Recovery**, **Congestion Control:** Desirable Bandwidth Allocation, Regulating the Sending Rate.

**UNIT-IV**

**The Internet Transport Protocols: UDP:** Introduction to UDP. **The Internet Transport Protocols: TCP-** Introduction to TCP, **The TCP Service Model**, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release, TCP Connection Management Modeling, TCP Sliding Window, TCP Timer Management, TCP Congestion Control.

#### **UNIT-V**

**Application Layer: DNS**—The Domain Name System, The DNS Name Space, Domain Resource Records, Name Servers. **Electronic MAIL:** Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery. **The World Wide Web** - Architectural Overview. **Streaming Audio and Video:** Streaming Stored Media, Streaming Live Media. Content Delivery.

#### **Text Books:**

1. Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks”, 5th Edition, Pearson Education, 2014.
2. W. Richard Stevens, Unix Network Programming, Prentice Hall/Pearson Education, 2009.

#### **Suggested Reading:**

1. Chwan-Hwa (John) Wu, J. David Irwin, “Introduction to Computer Networks and Cyber Security”, CRC Press, 2013.
2. James F. Kurose and Keith W. Ross, “Computer Networking: A Top-Down Approach Featuring the Internet”, 5th Edition, Addison-Wesley, 2012.

#### **Web Resources:**

1. <https://nptel.ac.in/courses/117105148>
2. <https://www.ibm.com/docs/en/i/7.1?topic=communications-socket-programming>



20ADE03

**NATURAL LANGUAGE PROCESSING**  
(Professional Elective #2)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To understand the steps involved in Natural language processing
2. To learn about the lexical, syntactic and semantic analysis of natural language processing
3. To explore the various parsing techniques for natural languages
4. To understand the statistical models for Natural language processing
5. To learn about the various applications involved in Natural language processing

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Justify the various steps necessary for processing natural language
2. Suggest appropriate semantic modeling and sequence labeling techniques for a particular application.
3. Apply appropriate neural network-based models for a contextual application
4. Analyze existing encoder-decoder models and information extraction techniques.
5. Identify the significance of word net and analyze the applications of Natural Language Processing such as Question Answering and chatbots.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Introduction Regular Expressions**, Text Normalization, Edit Distance, **N-gram Language Models**: N-Grams, Evaluating Language Models, Sampling sentences from a language model, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing

**UNIT-II**

**Vector Semantics and Embeddings**: Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, **TF-IDF**: Weighing terms in the vector, Pointwise Mutual Information (PMI), Applications of the tf-idf or PPMI vector models, Word2vec, Visualizing Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Models. **Sequence Labeling for Parts of Speech and Named Entities**: English Word Classes, Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition.





### UNIT-III

**Deep Learning Architectures for Sequence Processing:** Language Models Revisited, Recurrent Neural Networks, RNNs as Language Models, RNNs for other NLP tasks, Stacked and Bidirectional RNN architectures, The LSTM, Self-Attention Networks: Transformers, Transformers as Language Models, Contextual Generation and Summarization. Case study in NLP. **Machine Translation and Encoder-Decoder Models:** Language Divergences and Typology, The Encoder-Decoder Model, Encoder-Decoder with RNNs, Attention, Beam Search, Encoder-Decoder with Transformers, Some practical details on building MT systems, MT Evaluation, Bias and Ethical Issues

### UNIT-IV

**Constituency Grammars-Constituency,** Context-Free Grammars, Some Grammar Rules for English. Some Grammar Rules for English, Grammar Equivalence and Normal, Lexicalized Grammars. **Constituency Parsing-Ambiguity,** CKY Parsing: A Dynamic Programming Approach, Span-Based Neural Constituency Parsing, Evaluating Parsers, Partial Parsing, CCG Parsing. **Dependency Parsing-Dependency Relations,** Dependency Formalisms, Dependency Treebanks, Transition-Based Dependency Parsing, **Graph-Based Dependency Parsing, Evaluation**

### UNIT-V

**Word Senses and WordNet:** Word Senses, Relations Between Senses, **WordNet: A Database of Lexical Relations,** Word Sense Disambiguation, Alternate WSD algorithms and Tasks, Using Thesauruses to Improve Embeddings, Word Sense Induction. **Question Answering:** Information Retrieval, IR-based Factoid Question Answering, Entity Linking, Knowledge-based Question Answering, Using Language Models to do QA, Classic QA Models, Evaluation of Factoid Answers. **Introduction to Chatbots-Chatbots, GUS:** Simple Frame-based Dialogue Systems, The Dialogue-State Architecture, Evaluating Dialogue Systems, Dialogue System Design

#### Text Books:

1. Jurafsky Daniel, Martin James, "Speech and Language Processing", Third Edition, Pearson Education, 2021.
2. Christopher Manning, Schutze Heinrich, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.

#### Suggested Reading:

1. Allen James, "Natural Language Understanding", Second Edition, Benjamin Cumming, 1995.
2. Charniack Eugene, "Statistical Language Learning", MIT Press, 1993.

#### Web Resources:

1. <http://archive.nptel.ac.in/courses/106/105/106105158/>
2. <http://archive.nptel.ac.in/courses/106/106/106106211/>



20ADE04

**NO SQL DATABASES  
(Professional Elective #2)**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.
2. Understand the architectures and common features of Key Value databases.
3. Understand the architectures and common features of Document databases.
4. Understand the architectures and common features of column-family stores, graph databases
5. Understand the architectures and common features of graph databases and discuss the criteria that decision makers should consider when choosing between different NoSQL databases that best addresses specific use cases.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Define, compare and use the four types of NoSQL Databases.
2. Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Key-Value Pair NoSQL databases.
3. Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.
4. Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.
5. Explain the detailed architecture, define objects, load data, query data and performance tune Graph NoSQL databases.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

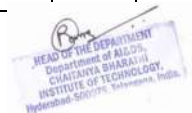
**Why NoSQL:** The Value of Relational Databases, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Motivations for Not Just/NoSQL Databases. **Variety of NoSQL Databases:** Data Management with Distributed Databases, ACID and BASE, Types of NoSQL Databases.

**UNIT-II**

**Key-Value Databases:** Introduction to Key-Value Databases From Arrays to Key-Value Databases, Essential Features of Key-Value Databases, Keys, Values, Key-Value Database Data Modeling Terms, Key-Value Architecture Terms, Key-Value Implementation Terms. **Designing for Key-Value Databases:** Key Design and Partitioning Keys Designing Structured Values, Limitations of Key-Value Databases Comparable to SQL for Relational Databases Design Patterns for Key-Value Databases, Case Study: Key-Value Databases for Mobile Application Configuration.

**UNIT-III**

**Document Databases:** Introduction to Document Databases, what is a Document? Avoid Explicit Schema Definitions, Basic Operations on Document Databases, **Document Database Terminology:** Document and Collection Terms, Types of Partitions, Data Modeling and Query Processing. **Designing for Document Databases:**



Normalization, Denormalization, and the Search for Proper Balance Planning for Mutable Documents, The Goldilocks Zone of Indexes, Modeling Common Relations, Case Study: Customer Manifests.

#### UNIT-IV

**Column Family Databases:** Introduction to Column Family Databases in the Beginning, There Was Google Big-Table Differences and Similarities to Key-Value and Document Databases, Architectures Used in Column Family Databases, When to Use Column Family Databases, **Column Family Database Terminology:** Basic Components of Column Family Databases, Structures and Processes: Implementing Column Family Databases, Processes and Protocols. **Designing for Column Family Databases:** Guidelines for Designing Tables, Guidelines for Indexing, Tools for Working with Big Data. Case Study: Customer Data Analysis.

#### UNIT-V

**Graph Databases:** Introduction to Graph Databases: What Is a Graph, Graphs and Network Modeling, Advantages of Graph Databases. **Graph Database Terminology:** Elements of Graphs Operations on Graphs, Properties of Graphs and Nodes, Types of Graphs. **Designing for Graph Databases** Getting Started with Graph Design, Querying a Graph, Tips and Traps of Graph Database Design. Case Study: Optimizing Transportation Routes. **Choosing your database:** Programmer Productivity, Data-Access Performance, Sticking with the Default.

#### Text Books:

1. Sullivan. NoSQL for Mere Mortals, 1st ed. Addison-Wesley Professional, 2015.
2. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications, 1st Edition, 2012.

#### Suggested Reading:

1. Meier & Kaufmann. SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management, 1st ed. Springer, 2019

#### Web Resources:

1. <https://www.ibm.com/cloud/learn/nosql-databases>
2. <https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRN>
3. <https://www.geeksforgeeks.org/introduction-to-nosql/>
4. <https://www.javatpoint.com/nosql-databa>



20ITE13

**COMPUTER VISION  
(Professional Elective # 2)**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Pre-requisites**

Image Processing (20ITE01), Data Analysis and Visualization (20ADE01)

**Course Objectives:**

1. To understand the Fundamental Concepts related to Computer Vision and Image formation
2. To understand Feature Extraction algorithms.
3. To define the structure of an image based on motion.
4. To provide knowledge about object recognition and scene recognition algorithms.
5. To impart the knowledge about 3D Reconstruction techniques.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Summarize the fundamentals of Image formation and describe the Geometric primitives and Transformations.
2. Describe different approaches to recognition of objects.
3. Inspect algorithms for feature detection and feature alignment.
4. Analyze images and videos for problems such as tracking and structure from motion.
5. Design recovered 3D structure for ill-posed scenes.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Introduction to Computer Vision and Image Formation:** Introduction, Photometric image formation, Digital Camera image formation. **Image Processing:** Point operators, Linear filtering, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations.

**UNIT-II**

**Feature detection and matching:** Points and patches, Edges, Lines. Segmentation: Active contours, Split and merge, Mean shift and mode finding, Normalized cuts. **Feature-based alignment:** 2D and 3D feature-based alignment, Pose estimation.

**UNIT-III**

**Structure from motion:** Triangulation, Two-frame structure from motion, Factorization, Bundle adjustment, Constrained structure and motion. **Dense motion estimation:** Translational alignment, Parametric motion, Spline-based motion, Optical flow, Layered motion.

**UNIT-IV**

**Recognition:** Object detection-Face detection, Pedestrian detection, **Face recognition:** Eigenfaces, Active appearance and 3D shape models, Application: Personal photo collections, Instance recognition : Geometric alignment, Large

databases, Application: Location recognition, Category recognition : Bag of words, Part-based models, Recognition with segmentation, Application: **Intelligent photo editing**, Context and scene understanding : Learning and large image collections, Application: Image search.

## UNIT-V

**3D Reconstruction:** Shape from X: Shape from shading and photometric stereo, Shape from texture, Shape from focus, Active range finding: Range data merging, Application: Digital heritage, Surface representations: Surface interpolation, Surface simplification, Geometry images, Point-based representations, volumetric representations: Implicit surfaces and level sets, Model-based reconstruction: Architecture, Heads and faces, Application: **Facial animation, Recovering texture maps: Estimating BRDFs, Application: 3D photography**

### Text Book:

1. Richard Szeliski “Computer Vision: Algorithms and Applications”, Springer-Verlag London Limited, 2011.

### Suggested Reading:

1. Robert J. Schalkoff, “Pattern Recognition: Statistical. Structural and Neural Approaches”, John Wiley and Sons; 1992+.
2. D. A. Forsyth and J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.
3. R. Hartley and A. Zisserman, “Multiple View geometry”, Cambridge university Press, 2002.
4. Richard Hartley and Andrew Zisserman, “Multiple View Geometry in Computer Vision”, Second Edition, Cambridge University Press, March 2004.
5. K. Fukunaga; “Introduction to Statistical Pattern Recognition”, Second Edition, Academic Press, Morgan Kaufmann, 1990.

### Web Resources:

1. CV online: <http://homepages.inf.ed.ac.uk/rbf/CVonline>
2. Computer Vision Homepage: <http://www2.cs.cmu.edu/afs/cs/project/cil/ftp/html/vision.html>



20ITE08

**CYBER SECURITY**  
**(Professional Elective #2)**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To present basic concepts of Cybercrime and Cyberattacks.
2. To impart knowledge on Tools and Methods used in Cybercrime.
3. To familiarize the legal perspectives and Organizational implications of Cyber Security.
4. To present fundamentals concepts in Cyber Forensics.
5. To familiarize about regulatory framework for Cybersecurity.

**Course Outcomes:**

Upon completion of this course, students will be able to:

1. Describe legal frameworks to handle cybercrimes.
2. Identify the functioning of different kinds of malware used in cybercrimes.
3. Examine the legal perspectives of cybercrimes in Indian and international context.
4. Describe the need of Digital Forensics and the importance of digital evidence in prosecution
5. Interpret the commercial activities in the event of significant information security incidents in the Organization.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Introduction to Cybercrime:** Definition and origins of the word, Cybercrime and Information security, Classification of Cybercrimes, Legal Perspectives, Indian Perspective, **Cybercrime and the Indian ITA 2000**, A Global Perspective on Cybercrimes.

**UNIT-II**

**Cyber offenses:** Introduction, How Criminals plan the attacks, Social Engineering, CyberStalking, Cybercafé and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector.

**Tools and Methods Used in Cybercrime:** Introduction, Proxy servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDos Attacks, SQL Injection, Buffer Overflow,

**UNIT-III**

**Cyber Security:** The Legal Perspectives: Cyber Crime and the Legal Landscape around the World, Need of Cyber laws: the Indian Context, The Indian IT Act, Challenges to Indian Law and Cyber Crime Scenario in India, Digital Signatures and the Indian IT Act, Cyber Crime and Punishment, **Cyber Law, Technology** and Students: The Indian Scenario.

#### UNIT-IV

**Understanding Cyber Forensics:** Introduction, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Cyber Forensics Investigation, Challenges in Computer Forensics

#### UNIT-V

**Cyber Security:** Organizational Implications: Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

**Text Books:**

1. Nina Godbole, Sunit Belapure, "Cyber Security Understanding Cyber Crimes, Computer forensics and Legal Perspectives", Wiley India Pvt.Ltd., 2013.
2. Harsh Bothra, "Hacking Be A Hacker with Ethics", Khanna Publishers 2017.

**Suggested Reading:**

1. John R Vaca "Computer Forensics: Computer crime scene Investigation " 2017.
2. Ferrera, Reder, Bird, Darrow, Aresty, Klosek, Lichtenstein " Cyber Laws Text & Cases" 3rd edition.
3. Tony Sammes Brian Jenkinson "Forensic Computing: A practitioner's Guide", Second Edition Springer International Edition.
4. Bill Nelson, Amelia Phillips, Christopher Steuart "Guide to Computer Forensics and Investigations" Fourth Edition.

**Web Resources:**

1. <https://www.nist.gov/>
2. <https://www.sans.org/>
3. <https://www.udemy.com/the-complete-cyber-security-course-end-point-protection/>



20ADE05

**COMPILER DESIGN**  
**(Professional Elective #2)**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisites:** Data Structures and Algorithms, Theory of Automata.

**Course Objectives:**

1. To Analyze the basic steps involved in converting a source language to target code.
2. To Design Scanner and Parsers.
3. To Develop Intermediate code and generate code for target machines.
4. To impart knowledge in generation of target code.
5. To apply machine independent optimizations and error recovery strategies.

**Course Outcomes:**

Upon successful completion of this course, the students should be able to

1. Identify the concepts related to translator, tokens, bootstrapping, porting and phases of the compiler and develop Lexical-Analyzer for Source Language.
2. Construct Top-down parsers and Bottom-up parsers.
3. Develop Syntax Directed Translation scheme and Generate Intermediate code for a language.
4. Translate Intermediate code into Target code.
5. Understand Data flow Analysis and apply the optimization techniques.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Introduction:** Programs related to compilers, Translation process, Major data structures, Other issues in compiler structure, Bootstrapping and porting. **Lexical analysis:** The role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, The Lexical-Analyzer Generator LEX.

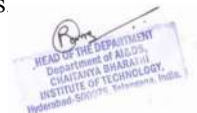
**UNIT-II**

**Syntax Analysis:** Introduction, Context-Free Grammars, writing a Grammar, Top-Down parsing, Bottom-Up parsing, Introduction to LR Parsing, more powerful LR parsers, Using Ambiguous Grammars, Parser Generators

**UNIT-III**

**Syntax Directed Translation:** Syntax Directed Definitions, Evaluation Orders for SDDs, Applications of Syntax Directed Translation.

**Intermediate code generation:** Variants of Syntax Trees, Three-Address Code, Types and Declarations, Translation of Expressions, Type Checking, Control Flow.





#### UNIT-IV

**Runtime Environments:** Storage Organization, Stack Allocation of Space, Access to Non local Data on the Stack, Heap Management, Introduction to Garbage Collection.

**Code Generation:** Issues in the Design of a Code Generator, The Target Language, Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Peephole Optimization, Register Allocation and Assignment.

#### UNIT-V

**Machine Independent Optimizations:** The Principal Sources of Optimizations, Introduction to data flow analysis, Foundation of data flow analysis.

#### Text Books:

1. Alfred V Aho, Monica S Lam, Ravi Sethi, Jeffrey D Ullman, “Compilers: Principles, Techniques &Tools”, Pearson Education, Second Edition, 2014.
2. Kenneth C Loudon, “Compiler Construction: Principles and Practice”, Cengage Learning.

#### Suggested Reading:

1. Keith D Cooper & Linda Torczon, “Engineering a Compiler”, Morgan Kaufman, Second Edition.
2. Dick Grune, Kees van Reeuwijk, Henri E. Bal , Cerial J.H. Jacobs, Koen Langendoen ,” Modern Compiler Design”, Springer, Second Edition.

#### Web Resources:

1. <http://nptel.ac.in/courses/106108113>
2. <https://web.stanford.edu/class/archive/cs/cs143/cs143.1128/>
3. [http://en.wikibooks.org/wiki/Compiler\\_Construction](http://en.wikibooks.org/wiki/Compiler_Construction)
4. <http://dinosaur.compilertools.net/>
5. <http://epaperpress.com/lexand yacc/>



20 ITE07

**AUGMENTED AND VIRTUAL REALITY**  
(Professional Elective #2)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To familiarize the students with the fundamentals of Virtual Reality.
2. To impart the knowledge of 3D orientation for understanding the behavior of VR system with the environment.
3. To deal with the Development Tools and Frameworks in Virtual Reality.
4. To introduce the applications of Virtual Reality Systems.
5. To introduce technology and features of augmented reality

**Course Outcomes:**

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

1. Describe the basic concepts of Virtual Reality and 3D Computer Graphics.
2. Apply 3D manipulation techniques in Virtual Reality.
3. Analyze Development Tools and Frameworks in Virtual Reality.
4. Develop a Virtual Reality application.
5. Evaluate Augmented Reality Systems

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Introduction to VR and AR:** History of VR and AR, Technology and Features of Augmented Reality, Comparison of AR and VR, Challenges with AR, AR Systems and Functionality, Human factors, Human visual system, Perception of depth, color, contrast, resolution, Stereo Rendering, VR Hardware: Head-coupled displays etc. VR Software, Geometric Modelling: From 2D to 3D, 3D space curves, 3D boundary representation. The Graphics Pipeline and OpenGL, Overview and Transformations, Rotation, translation, scaling, mode view matrix, projection matrix, Lighting and Shading, OpenGL Shading Language (GLSL), GLSL vertex and fragment shaders.

**UNIT-II**

**Visual computation in virtual reality:** 3D Interaction Techniques: 3D Manipulation Techniques and Input Devices, 3D Travel Tasks, Travel Techniques, Theoretical Foundations of Wayfinding, Types of Centred-Wayfinding Support, Evaluating Wayfinding Aids, System Control, Classification, Graphical Menus, Voice Commands, Gestural Commands, Tools, Multi-modal System Control Techniques, Case Study: Mixing System Control Methods, Symbolic Input Tasks.

**UNIT-III**

**Framing using 3D virtual reality:** Development Tools and Frameworks in Virtual Reality: VR. X3D Standard; Vega, MultiGen, Virtools etc., World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Graphical User Interface, Control Panel, 2D Controls.

**UNIT-IV**

**VR applications:** Pose Tracking I, Tracking with light house, Pose Tracking II, Advanced positional tracking, Panoramic Imaging and Cinematic, VR Spatial Sound and the Vestibular System, VR Engines and Other Aspects of



VR, Latency, eye tracking, post-rendering warp. The Future: Virtual environment, modes of interaction Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games, Demonstration of Digital, Entertainment by VR

## UNIT- V

**Augmented and Mixed Reality:** Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

### Text Books:

1. LaValle "Virtual Reality", Cambridge University Press, 2016.
2. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.

### Suggested Reading:

1. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013
3. Ange Anderson, Virtual Reality, Augmented Reality and Artificial Intelligence in Special Education, 2019

### Web Resource:

1. <https://nptel.ac.in/courses/106/106/106106138/>
2. <https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-ge08/>
3. <https://www.coursera.org/learn/ar?>
4. <https://www.coursera.org/specializations/virtual-reality>



20ADC08

## ARTIFICIAL INTELLIGENCE LAB

Instruction	2 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**Course Objectives:**

1. Familiarize with Uninformed and Informed search strategies.
2. Understand the game search to solve real-life problems.
3. Introduce logic programming concepts through Prolog.
4. Learn probabilistic reasoning on uncertain data.
5. Outline the Q-learning algorithm.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the types of informed and uninformed problems and apply search strategies to solve them.
2. Demonstrate Basic Prolog programming
3. Solve real-life problems using AI techniques like game search.
4. Apply probabilistic reasoning on data.
5. Analyze the Q-learning Algorithm.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**List of Programs**

1. Implementation of Breadth First Search uninformed search technique.
2. Implementation of Depth First Search technique.
3. Implementation of Uniform Cost Search technique.
4. Implementation of Iterative Deepening DFS Search technique.
5. Implementation of Bidirectional Search technique.
6. Implementation of Best First Search technique.
7. Implementation of A\* Search technique.
8. Implementation of Hill Climbing Algorithm.
9. Implementation of game search Algorithm.
  - a. Mini-Max Algorithm
  - b. Alpha-beta pruning
10. Installation of prolog and implementation of the basic programs in Prolog.
11. Design of a Bayesian network from given data.
  - a. Monty Hall Problem
  - b. Burglary and earthquake alarm program
12. Implementation of Q-learning Algorithm.

**Text Books:**

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.
2. Russell, Norvig, —Artificial intelligence - A Modern Approach, Pearson Education, 3<sup>rd</sup> Edition, 2015.

**Suggested Reading:**

1. Rich, Knight, Nair: —Artificial intelligencel, Tata McGraw Hill, 3<sup>rd</sup> Edition, 2009.
2. Nicole Bauerle, Ulrich Rieder, —Markov Decision Process with Applications to Financel, Springer, 2011.
3. Nilsson, N., —Artificial Intelligence: A New Synthesisl, Morgan Kaufmann, 1<sup>st</sup> Edition, 1998.

**Web Resources:**

1. [https://ai.berkeley.edu/project\\_overview.html](https://ai.berkeley.edu/project_overview.html)
2. <http://aima.cs.berkeley.edu>



**20ITC26****EMBEDDED SYSTEMS AND IoT LAB**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

**Course Objectives:**

1. Understanding Raspberry Pi / Arduino fundamentals.
2. On-Boarding Raspberry Pi / Arduino.
3. Programming with Raspberry Pi Pins / Arduino Pins.
4. Make students to do simple Applications.
5. Understand about IoT Applications using smart sensors.

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Program using Raspberry Pi.
2. Develop python programs that run on Raspberry Pi/Arduino
3. Write basic IoT Programs using Raspberry Pi/Arduino.
4. Implement Applications using Raspberry Pi / Arduino.
6. Develop simple IoT systems of different Case studies.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**LIST OF PROGRAMS**

1. Interface Input-Output and other units such as: Relays, LEDs, Switches, Stepper Motors using 8051 Micro controllers.
2. Study and Configure Raspberry Pi.
3. Write programs using Raspberry Pi to blink LED.
  - a. using loops
  - b. using conditional & control statements
4. Write program using Raspberry Pi to interface LEDs, Switch and Buzzer.
5. Interface different Sensors using Raspberry Pi.
  - a. Temperature & Humidity
  - b. PIR
  - c. GAS
  - d. LDR
  - d. Rain
  - e. Soil moisture.
6. Write a program to monitor temperature and humidity using DHT (Digital Humidity and Temperature) sensor using Raspberry Pi / Arduino.
7. Uploading and reading the Cloud data using Thingspeak platform.
8. Study the Use Cases:
  - a. Home Automation (e.g., Smart Lighting),
  - b. City Applications (e.g., Smart Parking, Traffic Lighting)
  - c. Environment (e.g., Pollution Monitoring, Weather Monitoring)
  - d. Agriculture (e.g., Smart Irrigation) etc.



**Text Books:**

1. Kenneth J. Ayala, "The 8051 Microcontroller", 3rd Edition, Thomson, 2014.
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.
3. Misra, C. Roy, and A. Mukherjee, 2020 "Introduction to Industrial Internet of Things and Industry 4.0". CRC Press.

**Suggested Reading:**

1. Raj Kamal, "Embedded Systems", 2nd Edition, McGraw Hill, 2015.
2. Samuel Greengard, "The Internet of Things", 1st Edition, MIT Press, 2015.
3. Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, "IoT: Building Arduino-Based Projects", 1st Edition, Packt Publishing Ltd, 2016.
4. Jeeva Jose, "Internet of Things", Khanna Book Publishing Company



**20ADC09****MINOR PROJECT-I  
(Full Stack Development)**

Instruction	3 Hours per Week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	1.5

**Course Objectives:**

1. To enable students to learn by doing.
2. To develop capability to analyze and solve real world problems.
3. To inculcate innovative ideas of the students.
4. To impart team building and management skills among students.
5. To instill writing and presentation skills for completing the project.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Interpret Literature with the purpose of formulating a project proposal.
2. Plan, analyze, Design and implement a project.
3. Find the solution of identified problem with the help of modern Technology and give priority to real time scenarios.
4. Plan to work as a team and to focus on getting a working project done and submit a report within a stipulated period of time.
5. Prepare and submit the Report and deliver a presentation before the departmental Committee.

Minor Project is aimed to enable the students to develop a product/application based on the course **FULL STACK DEVELOPMENT** with course code- **20ADC07**. The student has to implement and present the project as per the given schedule. During the implementation of the project, Personnel Software Process (PSP) has to be followed. Report of the project work has to be submitted for evaluation.

**SCHEDULE**

S No	Description	Duration
1.	Problem Identification / Selection	1 week
2.	Preparation of Abstract	1 week
3.	Design the Web Pages using advanced HTML Form tags input–date, time, number, email, HTML5 Header and Footer, spell check and editable areas.	1 week
4.	Demonstrate the CSS tags Inline, Internal and External Style sheets using advanced CSS in web pages	1 week
5.	Demonstrate JavaScript to perform validation and Bootstrap in Front-End Design.	1 week
6.	Implement React JS, MVC Pattern and Node JS Features in the application.	2 weeks
7.	Implement CRUD operations/DB Replication in MongoDB.	2 weeks
8.	Implementation and inferences	2 weeks
9.	Documentation and Project Presentation	2 weeks



**Guidelines for the Award of marks**

<b>S No</b>	<b>Description</b>	<b>Max. Marks</b>
Final Assessment		
1.	PPT Preparation	10
2.	Technical Content	10
3.	Question and Answers	5
4.	Report Preparation	5
Total		<b>30</b>

Final Minor Project demonstration and PPT presentation is to be evaluated for the entire class together by the entire faculty handling Minor Project for that class.





# CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of VI Semester of B.E. – Artificial Intelligence and Data Science  
as per AICTE Model Curriculum, with effective from 2022-23

## SEMESTER – VI

S.No	Course code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>THEORY</b>								
1.	20ITC13	Software Engineering	3	-	3	40	60	3
2.	20ADC10	Deep Learning	3/1		3	40	60	4
3.	20ADC11	Data Science with R	3	-	3	40	60	3
4.	20ITC25	Cloud Computing	3		3	40	60	3
5.		Professional Elective – 3	3	-	3	40	60	3
<b>PRACTICALS</b>								
6.	20ITC16	Software Engineering Lab	-	3	3	50	50	1.5
7.	20ADC12	Deep Learning Lab	-	3	3	50	50	1.5
8.	20ADC13	Minor Project -II (Data Science)	-	3	-	50	-	1.5
9.	20EGC03	Employability Skills	-	2	-	50	50	1
<b>TOTAL</b>			<b>16</b>	<b>11</b>	<b>21</b>	<b>400</b>	<b>450</b>	<b>21.5</b>

**L: Lecture    T: Tutorial    D: Drawing    P: Practical**  
**CIE – Continuous Internal Evaluation    SEE - Semester End Examination**

<b>Professional Elective #3</b>	Micro Services with Springboot 20ADE06	Explainable AI 20ADE07	Applied Predictive Analytics 20ITE14	Fundamentals of Block Chain Technology 20ITE16	Agile Project Management 20ADE08	Social Network Analytics 20ADE09
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**20ITC13****SOFTWARE ENGINEERING**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Describe the various software life cycle models.
2. Explain the concepts of Agile software development concepts.
3. Define the basic structural modeling concepts in UML.
4. Enable the students with UML notations.
5. Acquaint the students with Risk management and Product metrics.

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Identify the minimum requirements for the development of application.
2. Build a system, component, or process to meet desired needs of a customer.
3. Involve in analysis and design of UML models for various case studies.
4. Acquire thorough knowledge of standard UML notations.
5. Know the risks, formulate and implement software projects.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	2	2	1	-	1	-	-	-	1	-	-	1	1	-	-
<b>CO2</b>	2	1	1	-	1	-	-	-	-	-	-	1	-	2	-
<b>CO3</b>	1	1	1	-	-	-	-	-	-	-	2	1	1	-	-
<b>CO4</b>	2	1	0	-	-	-	-	-	-	-	-	-	1	-	-
<b>CO5</b>	2	1	1	-	-	-	1		1	-	-	1	-	-	2

**UNIT-I**

**Software and Software Engineering:** The Nature of Software, Software Engineering. The Software Process, Software Engineering Practice. **A Generic view of Process:** Software Engineering -A Layered Technology, A Process framework, Process Models- Waterfall model, spiral model, The Unified Process, Product and Process, Process Assessment and Improvement, The CMMI, Introduction to Agile Development-Extreme programming. **Understanding Requirements:** Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Building the Requirements Model, Negotiating Requirements, Validating Requirements. **Requirements Modeling:** Requirements Analysis, Scenario-Based Modelling, Problem Analysis, Software Requirement and specifications.

**UNIT-II**

**UML Introduction:** Why we Model, Introducing the UML, Elements of UML-Things Relationships and Diagrams. **Basic Behavioural Modelling:** Interactions, Use Cases, Use Case Diagrams, Interaction Diagrams-Sequence diagrams-components of Sequence diagrams, collaboration diagrams-Components of Collaboration diagrams, Activity Diagrams-components of activity diagrams, swim lane diagrams, Case studies on Use Case diagrams, Interaction diagrams. **Advanced Behavioural Modelling:** State Chart Diagrams-components of statechart diagrams, Case studies on State chart diagrams.

### UNIT-III

**Basic Structural Modelling:** Classes, Relationships, Diagrams, Class Diagrams. **Advanced Structural Modelling:** Advanced Classes, Advanced Relationships, Interfaces, Components, Case studies on class diagrams. **Quality Concepts:** Software Quality, Achieving Software Quality. **Software Quality Assurance:** Background Issues, Elements of Software Quality Assurance, SQA Tasks, The ISO 9000 Quality Standards.

### UNIT-IV

**Software Testing Strategies:** A Strategic Approach to Software Testing, Strategic Issues, Validation Testing, System Testing. Testing Tools–Rational functional tester, Selenium software testing tool. **Testing Conventional Applications:** Software Testing Fundamentals, White-Box Testing, Basis Path Testing, Black-Box Testing, Alpha testing, Beta testing.

### UNIT-V

**Product Metrics:** A Framework for Product Metrics, Size Metrics like LOC, Function points, **Risk Management:** Software Risks, Reactive versus Proactive Risk Strategies, Risk Mitigation, Monitoring, and Management, The RMMM Plan.

#### Text Books:

1. Roger S.Pressman, “Software Engineering: A Practitioner's Approach”, 7<sup>th</sup> edition, McGrawHill, 2017.
2. Grady Booch, James Rumbaugh, Ivor Jacobson, “The Unified Modelling Language-User Guide (Covering UML 2.0)”, Third Edition, Pearson Education, India, 2017.
3. Pankaj Jalote “An Integrated Approach to Software Engineering “, 3rd edition, Narosa Publishing house, 2008.

#### Suggested Reading:

1. Martin Fowler, Kendall Scott , “UML Distilled: A Brief Guide to the Standard Object Modelling Language” Addison Wesley, 4<sup>th</sup> Edition, 2011.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, “Fundamentals of Software Engineering”, PHI, 2<sup>nd</sup> edition.
3. James F.Peters, WitoldPedrycz, “Software Engineering-An engineering Approach”.

#### Web Resources:

1. SEweb - Software Engineering Education Home Page: <http://tuvalu.cs.flinders.edu.au/seweb/se-ed/>
2. IBM Rational <http://www-306.ibm.com/software/rational/uml/>
3. Practical UML - A Hands-On Introduction for Developers, [http://www.togethersoft.com/services/practical\\_guides/umlonlinecourse](http://www.togethersoft.com/services/practical_guides/umlonlinecourse)



20ADC10

**DEEP LEARNING**

Instruction	4 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

**Course Objectives:**

1. To impart knowledge on the basic concepts of Neural Networks and Deep learning.
2. To familiarize various neural network architectures
3. To learn usage of neural networks for problem solving.
4. To familiarize various deep learning models.
5. To facilitate usage of deep learning applications in societal context.

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Explain the basic principles of neural networks and deep learning.
2. Implement simple neural network algorithms.
3. Compare modeling aspects of various neural network architectures.
4. Evaluate Convolutional Neural Network models on real data sets.
5. Analyze and optimize Recurrent Neural Network models for various applications.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Introduction to Artificial Neural Networks:** From Biological to Artificial Neurons, Implementing MLP, Fine-Tuning Neural Network Hyper parameters, **Training Deep Neural Networks:** The Vanishing/Exploding Gradients Problems, Reusing Pre trained Layers, Faster Optimizers and Avoiding Overfitting through Regularization.

**UNIT-II**

**Linear Neural Networks:** Linear Regression, **Linear Regression Implementation from Scratch,** Concise Implementation of Linear Regression, Softmax Regression, The Image Classification Dataset, Implementation of Softmax Regression from Scratch, Concise Implementation of Softmax Regression.

**UNIT-III**

**Deep Learning Computation:** Layers and Blocks, Parameter Management, Deferred Initialization, Custom Layers, File I/O, GPUs Convolutional Neural Networks: From Fully-Connected Layers to Convolutions, Convolutions for Images, Padding and Stride, Multiple Input and Multiple Output Channels, Pooling, **Convolutional Neural Networks (LeNet).**

**UNIT-IV**

**Modern Convolutional Neural Networks:** Deep Convolutional Neural Networks (AlexNet), Networks Using Blocks (VGG), Network in Network (NiN), Networks with Parallel Concatenations (GoogLeNet), Batch Normalization, Residual Networks (ResNet), Densely Connected Networks (DenseNet), **Recurrent Neural Networks:** Sequence Models, Recurrent Neural Networks, Implementation of Recurrent Neural Networks from Scratch, Concise Implementation of Recurrent Neural Networks.

## UNIT-V

**Modern Recurrent Neural Networks:** Gated Recurrent UNITS (GRU), Long Short-Term Memory (LSTM), Deep Recurrent Neural Networks, Bidirectional Recurrent Neural Networks, Machine Translation and the Dataset, Encoder-Decoder Architecture, Sequence to Sequence Learning. **Optimization Algorithms:** Optimization and Deep Learning, Convexity, Gradient Descent, Stochastic Gradient Descent.

### Text Books:

1. Aurélien Géron , "Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow", Orielly, 2<sup>nd</sup> edition, 2019.
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", d2l.ai, 2021

### Suggested Reading:

1. Levitin A, "Introduction to the Design And Analysis of Algorithms", Pearson Education, 2008.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
3. Indra den Bakker, "Python Deep Learning Cookbook", PACKT publisher, 2017
4. Wei Di, Anurag Bhardwaj, Jianing Wei, "Deep Learning Essentials", Packt publishers, 2018

### Web Resources:

1. <http://nptel.ac.in/courses>



20ADC11

## DATA SCIENCE WITH 'R'

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To introduce Data Science with R.
2. To impart knowledge on the concepts of Exploring and Cleaning data.
3. To familiarize Supervised and Unsupervised Techniques.
4. To introduce documentation and deployment using R
5. To familiarize text mining with R.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Explore data operations on files and databases using R programming.
2. Understand deployment of models on different datasets.
3. Apply supervised, unsupervised, ensembling and NLP models on different datasets.
4. Perform Sentiment analysis.
6. Build and evaluate the models.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I:**

**Introduction to data science:** The Data Science Process: Roles in a data science project, Stages of a data science project, Setting expectations. **Starting with R and data:** Starting with R, working with data from files, Working with relational databases. **Exploring data:** Using Summary Statistics to spot problems, Spotting problems with graphics and visualization.

**UNIT-II**

**Managing data:** cleaning data, Data transformations, Sampling for modeling and validation. **Choosing and evaluating models:** Mapping problems to machine learning tasks, evaluating models, Local interpretable model-agnostic explanations (LIME) for explaining model predictions.

**UNIT-III**

**Supervised Learning:** Using Linear Regression, Using Logistic Regression. **Unsupervised methods:** Cluster Analysis, Association rules. **Exploring Advanced Methods:** Using bagging and random forest, using generalized additive models, using kernel methods to increase data separation.

**UNIT-IV**

**Documentation and Deployment:** Predicting buzz, Using R markdown to produce milestone documentation, Using comments and version control for running documentation, Deploying models. **Text Mining with R: The tidy text format:** Contrasting tidy text with other data structures, the unnest\_tokens function, tidying the works of Jane Austen, Word Frequencies.



## UNIT-V

**Sentiment analysis with Tidy data:** The sentiments datasets, Comparing the three sentiment dictionaries, Most common positive and negative words, Word clouds, Looking at units beyond just words, **Analyzing word and document frequency:** tf-idf, Term frequency in Jane Austen's novels, Zipf's law, The `bind_tf_idf()` function.

### Text Books:

1. Zumel, N., Mount, J., & Porzak, J., "Practical data science with R", 2<sup>nd</sup> edition. Shelter Island, NY: Manning, 2019.
2. Julia Silge and David Robinson. "Text Mining with R: A Tidy Approach", 1st. edition. O'Reilly Media, Inc., 2017

### Suggested Reading:

1. Garrett Golemund and Hadley Wickham, "R for data science: import, tidy, transform, visualize, and model data" O'Reilly Media, Inc., 2016.
2. Roger D. Peng, "R programming for data science" (pp. 86-181). Lean pub, 2016.

### Web Resources:

1. <https://blog.rstudio.com/>
2. <https://r4ds.had.co.nz/index.html>
2. <https://www.dataquest.io/blog/learn-r-for-data-science/>





**20ITC25**

**CLOUD COMPUTING**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Learn the fundamentals of cloud computing paradigm.
2. Learn various deployment and development models.
3. Learn various security concerns related to cloud.
4. Learn about various offerings of cloud service providers.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the basic ideas of Cloud Computing and its services.
2. Analyze the architecture, deployment models, and infrastructure models of Cloud Computing.
3. Realize distributed storage and performance for implementing virtualization.
4. Analyze cloud computing security, federation, presence, identity, and privacy.
5. Use IaaS / PaaS service offered by cloud service providers

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Introduction to Cloud Computing:** Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Cloud, Features of a cloud, Software-as-a-Service, Platform-as-a-Service, Infrastructure-as-a-Service, Challenges and Risks. **Cloud Computing Platforms:** Infrastructure as service: Amazon EC2, Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing.

**UNIT-II**

**Service and Deployment Models:** The promise of the cloud, the cloud service offerings and Deployment model, Challenges in the cloud, **Broad Approaches to Migrating into Cloud:** Why Migrate? Deciding on cloud migration. **The Seven Step Model of Migration into Cloud:** Migration Risks and Mitigation. **Managing Cloud Services:** Organizational Issues **Administering Cloud Services:** Service Level Agreements (SLA) and Monitoring Support, Billing and Accounting, Technical Interface, Managing Cloud Resources, Maintaining Connections.

**UNIT-III**

**Web Services:** SOAP/WSDL web services, REST web services, SOAP v/s REST **AJAX:** Asynchronous 'rich' interfaces **Mashups:** user interface services **Cloud Technologies:** Study of Hypervisor **Virtualization Technology:** Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization **Multitenant Software:** Multi-entity support, multi-schema approach, multi-tenance using cloud data stores, Data access control for enterprise applications.

**UNIT-IV**

**Cloud Security Fundamentals:** Vulnerability assessment tool for cloud, Privacy and Security in cloud **Cloud Computing Security Architecture:** Architectural Considerations- General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro-architectures; Identity Management and Access control Identity management, Access control, Autonomic Security **Cloud Computing Security Challenges:** Virtualization security management virtual threats, VM Security Recommendations, VM-Specific Security techniques.



## UNIT-V

**Enterprise Cloud Computing Ecosystem:** Introduction, Public Cloud Providers, Cloud Management Platforms and Tools, Tools for **Building Private Cloud**; IaaS using Eucalyptus, PaaS on IaaS –AppScale. **Roadmap for Enterprise Cloud Computing:** Introduction, Quick wins using Public Clouds, Future of Enterprise Cloud Computing: Commoditization of the data center, Inter-operating Virtualized Data Centers, **Convergence of private and public clouds, Generalized ‘cloud’ services.**

### Text Books:

1. RajkumarBuyya, “Cloud Computing: Principles and Paradigms”, John Wiley & Sons, First Edition
2. Gautam Shroff, “Enterprise Cloud Computing: Technology, Architecture, Applications”, Cambridge University Press, First Edition

### Suggested Reading:

1. Barrie Sosinsky, “Cloud Computing Bible”, Wiley India, First Edition
2. Tim Malhar, S.Kumaraswamy, S.Latif, “Cloud Security & Privacy”, O’Really Publications, First Edition



20ADE06

**MICROSERVICES WITH SPRING BOOT**  
(Professional Elective –3)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisite:** Students should have a good understanding of the Java programming language and SQL

**Course Objectives:**

1. To Understand the basic concepts of the Spring Framework
2. To provide basic knowledge of Web Application Development with Spring Boot and Restful APIs
3. To explore data access with Spring's DAO Module
4. To acquire Knowledge of Spring transaction management
5. To study Spring's unit testing framework and Introduce Spring Security with Rest API

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Gain the basic concepts of the Spring Framework
2. Interact with databases using Spring's support for JDBC and JPA.
3. Build spring boot applications using Dependency Injection concept
4. Apply Transaction Management concepts of spring in Enterprise Application Development and develop the Spring-MVC based Applications to solve the real-world problems.
5. Use Spring Unit testing framework and configure security on Spring MVC Applications

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Spring Overview:** Introduction to Spring Framework, The DI Container, Evolution of Spring Framework

**Java Configuration:** Java configuration and the Spring application context, @Configuration and @Bean annotations, @Import: working with multiple configuration files, defining bean scopes, launching a Spring Application and obtaining Beans, External properties & Property sources, Environment abstraction, Using bean profiles, Spring Expression Language (SpEL) **Annotation and Component Scanning:** Component scanning, Autowiring using @Autowired, Java configuration versus annotations mixing Lifecycle annotations: @PostConstruct and @PreDestroy, Stereotypes and meta-annotations

**UNIT-II**

**Web Applications with Spring Boot:** Introduction to Spring MVC and request processing, Controller method signatures, Using @Controller, @RestController and @GetMapping annotations and Configuring Spring MVC with Spring Boot. **RESful Application with Spring Boot:** An introduction to the REST architectural style, Controlling HTTP response codes with @ResponseStatus, Implementing REST with Spring MVC, @RequestMapping, @RequestBody and @ResponseBody, Spring MVC's HttpResponseMessageConverters and automatic content negotiation and Jackson library

**UNIT-III**

**Spring Boot Feature Introduction:** Introduction to Spring Boot Features, Value Proposition of Spring Boot and Creating a simple Boot application using Spring Initializer website **Spring Boot – Dependency Management:**



Dependency management using Spring Boot starters, how auto-configuration works, Configuration properties, overriding auto-configuration and Using CommandLineRunner

#### UNIT-IV

**JDBC Simplification with JdbcTemplate:** How Spring integrates with existing data access technologies, Spring's JdbcTemplate and DataAccessException hierarchy **Spring Boot – Spring Data JPA:** Quick introduction to ORM with JPA, Benefits of using Spring with JPA, JPA configuration in Spring, Configuring Spring JPA using Spring Boot, Spring Data JPA dynamic repositories **Transaction Management with Spring:** Transaction overview, Transaction management with Spring, Transaction propagation and rollback rules and Transactions and integration testing

#### UNIT-V

**Testing a Spring-based Application:** Spring and Test-Driven Development, Spring 5 integration testing with JUnit 5, Application context caching and the @DirtiesContext annotation, Profile selection with @ActiveProfiles, Easy test data setup with @Sql **Securing REST Application with Spring Security:** What problems does Spring Security solve? , Configuring authentication, implementing authorization by intercepting URLs, Authorization at the Java method level, Understanding the Spring Security filter chain and Spring security testing. **Actuators, Metrics and Health Indicators:** Exposing Spring Boot Actuator endpoints, Custom Metrics, Health Indicators, **Creating custom Health Indicators and External monitoring systems**

#### Text Books:

1. Mark Heckler, "Spring Boot Up and Running, 1<sup>st</sup> Edition", Oreilly, 2021.
2. Iuliana Cosmina, Rob Harrop, Chris Schaefer, Clarence Ho "Pro Spring 5", Fifth Edition, Apress, 2019

#### Suggested Reading:

1. Raja CSP Raman, Ludovic Dewailly, "Building A RESTful Web Service with Spring 5", Packt Publishing, 2018.

#### Web Resources:

1. <https://spring.io/guides/gs/spring-boot/>
2. <https://docs.spring.io/spring-framework/docs/current/reference/html/index.html>



20ADE07

**EXPLAINABLE ARTIFICIAL INTELLIGENCE  
(Professional Elective #3)**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To Understand the concepts within Explainable AI and interpretable machine learning
2. To Demonstrate comprehension of current techniques for generating explanations from black-box machine learning methods
3. To Demonstrate the ability to select and assess Explainable AI methods
4. To Demonstrate comprehension of current ethical, social and legal challenges related to Explainable AI

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Describe the context of the machine learning application and why explainability would help, but also scrutinize which kind of explainability technique is necessary.
2. Understand the concepts that are important in model validation, evaluation, and performance visualization for both supervised and unsupervised learning.
3. Install and set up one or more post hoc explain ability techniques through a self-chosen set of programming platforms.
4. Critically reflect on the results from Explainable deep learning techniques and suggest how it helps the problem context.
5. Demonstrate comprehension of challenges and future related to Explainable AI

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Introduction:** Black-Box problem, Goals, Brief History, Purpose, Societal Impact, Types of Explanations, Trade-offs, Taxonomy, Flowchart for Interpretable and Explainable Techniques. **Pre-model Interpretability and Explainability:** Data Science Process and EDA, Exploratory Data Analysis, Feature Engineering

**UNIT-II**

**Model Visualization Techniques and Traditional Interpretable Algorithms:** Model Validation, Evaluation, and Hyperparameters, Model Selection and Visualization, Classification Model Visualization, Regression Model Visualization, Clustering Model Visualization, Interpretable Machine Learning Properties, Traditional Interpretable Algorithms

**UNIT-III**

**Model Interpretability:** Advances in Interpretable Machine Learning: Interpretable vs. Explainable Algorithms, Tools and Libraries, Ensemble-Based, Decision Tree-Based, Rule-Based Techniques, Scoring System. **Post-Hoc Interpretability and Explanations:** Tools and Libraries, Visual Explanation, Feature Importance, Example-Based



#### UNIT-IV

**Explainable Deep Learning:** Applications, Tools and Libraries, Intrinsic, Perturbation, Gradient / Backpropagation

#### UNIT-V

**Explainability:** Time Series Forecasting, Natural Language Processing, and Computer Vision **XAI: Challenges:** Properties of Explanation, Categories of Explanation, Taxonomy of Explanation **Evaluation. XAI: Future:** Formalization of Explanation Techniques and Evaluations, Adoption of Interpretable Techniques, Human-Machine Collaboration, Collective Intelligence from Multiple Disciplines, Responsible AI (RAI), XAI and Security, Causality and XAI

#### **Text Books:**

1. Uday Kamath and John Liu “Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning”, Springer Cham, First Edition, 2021.

#### **Suggested Reading:**

1. Leonida Gianfagna and Antonio Di Cecco, “Explainable AI with Python”, Springer International Publishing, First Edition, 2021.
2. Denis Rothman, “Hands-On Explainable AI (XAI) with Python”, Packt Publishing, First Edition, 2020

#### **Web Resources:**

1. <https://www.ibm.com/in-en/watson/explainable-ai>
2. <https://sites.google.com/view/explainable-ai-tutorial>
3. <https://cloud.google.com/explainable-ai>



20ITE14

**APPLIED PREDICTIVE ANALYTICS**  
**(Professional Elective #3)**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To introduce Predictive Modeling.
2. To familiarize Regression and Classification Techniques.
3. To impart knowledge on the concepts of Support vector machines and Neural Networks.
4. To explore tree-based classifiers and ensemble methods
5. To introduce Topic modeling.

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Comprehend predictive modeling and assess the performance
2. Apply regression techniques and analyze the performance
3. Demonstrate Support Vector Machines and build an efficient networking model
4. Analyze ensemble methods by choosing Tree based classifiers
5. Select appropriate probabilistic Graphical models and identify topics through topic modeling

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Gearing Up for Predictive Modeling: Models, Types of models :** Supervised, unsupervised, semi-supervised, and reinforcement learning models, Parametric and nonparametric models, Regression and classification models, Real-time and batch machine learning models, **The process of Predictive Modeling:** Defining the model's objective, Collecting the data, Picking a model, Preprocessing the data, Exploratory data analysis, Feature transformations, Encoding categorical features, Missing data, Outliers, Removing problematic features, Feature engineering and dimensionality reduction, Training and assessing the model, Repeating with different models and final model selection, Deploying the model, **Performance metrics:** Assessing regression models, Assessing classification models, Assessing binary classification models.

**UNIT-II**

**Linear Regression:** Introduction to linear regression, Simple linear regression, Multiple linear regression, Assessing linear regression models, Problems with linear regression, Feature selection, Regularization, Ridge regression.

**Logistic Regression:** Classifying with linear regression, Assessing logistic regression models, Regularization with the lasso, Classification metrics, Extensions of the binary and Multinomial logistic classifier

**UNIT-III**

**Support Vector Machines:** Maximal margin classification, Support vector classification, Inner products, Kernels and support vector machines, Cross-validation.



**Neural Networks:** Stochastic gradient descent: Gradient descent and local minima, The perceptron algorithm, Linear separation, The logistic neuron, **Multilayer perceptron networks:** Training multilayer perceptron networks.

#### UNIT-IV

**Tree-based Methods:** The intuition for tree models, Algorithms for training decision trees- Classification and regression trees, CART regression trees, Tree pruning, Missing data, Regression model trees, CART classification trees, C5.0, Predicting complex skill learning, Variable importance in tree models, **Ensemble Methods:** **Bagging** - Margins and out-of-bag observations, **Predicting heart disease with bagging**, Limitations of bagging, **Boosting** – AdaBoost, Limitations of boosting, **Random forests-** The importance of variables in random forests

#### UNIT-V

**Probabilistic Graphical Models:** A little graph theory, Bayes' Theorem, Conditional independence, Bayesian networks, The Naïve Bayes classifier. Hidden Markov models- Predicting letter patterns in English words. **Topic Modeling:** An overview of topic modeling, Latent Dirichlet Allocation, The Dirichlet distribution, The generative process, Fitting an LDA model, Modeling the topics of online news stories, Model stability, Finding the number of topics, Topic distributions, Word distributions, LDA extensions.

#### Text Books:

1. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publishing Ltd, 2015.
2. Roger D. Peng, “R Programming for Data Science”, Lean Publishing, 2015.

#### Suggested Reading:

1. Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Dean Abbott, 2014, Wiley.
2. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Tom Fawcett, O’Reilly, 1st edition, 2013.

#### Web Resources:

1. <https://data-flair.training/blogs/r-predictive-and-descriptive-analytics/>
2. <https://www.littlemissdata.com/blog/predictive-analytics-tutorial-part-1>
3. <http://uc-r.github.io/mars>
4. <https://www.coursera.org/learn/design-thinking-predictive-analytics-data-products>
5. <https://www.coursera.org/learn/meaningful-predictive-modeling>





20ITE16

**FUNDAMENTALS OF BLOCK CHAIN TECHNOLOGY**  
(Professional Elective #3)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To Familiarize the basic concepts of blockchain.
2. To provide the significance of the bitcoin ecosystem.
3. To Explore the consensus mechanisms and technologies that support ethereum.
4. To introduce Hyperledger Fabric and its architecture.
5. To familiarize blockchain use cases in various domains.

**Course outcomes:**

Upon completing this course, students will be able to

1. Describe the concepts of distributed systems and blockchain properties.
2. Identify the significance of the bitcoin ecosystem.
3. Examine the consensus mechanisms and technologies that support ethereum.
4. Inspect Hyperledger Fabric and its architecture.
5. Analyze blockchain use cases in various domains.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT I**

**Introduction:** Overview of distributed systems, Introduction to Blockchain, Generic elements of a blockchain, Features of Blockchain, Applications of Blockchain.

**Cryptocurrency And Blockchain :** Hash Functions and Merkle Trees, Components of Blockchain Ecosystem, Cryptography and Consensus Algorithms; Types of Blockchain, Blockchain Platforms.

**UNIT II**

**Bitcoin Platform:** Bitcoin definition, Keys and addresses , Public keys and Private keys in bitcoin, The transaction life cycle, The transaction structure, Bitcoin payments, Bitcoin investment and buying and selling bitcoins. Consensus mechanism in bitcoin

**Wallets:** Wallet types, Non-deterministic wallets, Deterministic wallets, Alternative Coins- Namecoin, Litecoin, Zcash

**UNIT III**

**Smart contracts and Ethereum:** Introducing Smart Contracts, Ethereum blockchain , The Ethereum stack, Ethereum virtual machine (EVM), Consensus mechanism in Ethereum, The Ethereum network, Ethereum Development, Setting up a development environment, Development tools and clients, Applications developed on Ethereum

**UNIT IV**

**Hyperledger Fabric:** Introduction to Hyperledger Fabric, Hyperledger Fabric architecture, Membership services Blockchain services, Hyperledger Projects- Fabric, Sawtooth lake, Iroha , Components of the Fabric, Peers or nodes, Applications on Blockchain, Alternate Blockchains- Ripple, Corda



## UNIT V

**Applications of Blockchain:** Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade — Trade Finance Network, Supply Chain Financing, Identity on Block chain

### Text Books:

1. Imran Bashir “Mastering Blockchain” 2<sup>nd</sup> Edition Packt Publishers, 2018.
2. Melanie Swan, "Block Chain: Blueprint for a New Economy", 1<sup>st</sup> Edition O'Reilly, 2018.

### Suggested Reading:

1. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, 1<sup>st</sup> Edition, Apress, 2017.
2. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to BuildSmart Contracts for Ethereum and BlockChain”, Packt Publishing, 2019.

### Web Resources:

1. <https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html>
2. <https://www.hyperledger.org/projects/fabric>
3. <https://www.packtpub.com/big-data-and-business-intelligence/hands-blockchain-hyperledger>
4. <https://www.amazon.com/Hands-Blockchain-Hyperledger-decentralized-applications/dp/1788994523>
5. <https://github.com/HyperledgerHandsOn/trade-finance-logistics>



20ADE08

**AGILE PROJECT MANAGEMENT**  
**(Professional Elective #3)**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course objectives:**

1. To familiarize with Agile Life cycle models.
2. To provide insight into the Agile waterfall model and develop scope for requirements.
3. To explore the planning and scheduling mechanisms for Agile project development.
4. To introduce Quality principles in Agile space.
5. To familiarize with matrix management in Agile development.

**Course outcomes:**

Upon completing this course, students will be able to

1. Describe the Agile Life cycle models.
2. Identify the scope and requirements for Agile project development
3. Appraise the Agile Planning and scheduling mechanisms for an enterprise Agile project.
4. Describe the Quality Principles in the Agile space.
5. Analyze Matrix Management in the Agile Space

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT I**

**Agile Manifesto:** Agile Principles, Traditional Lifecycle, Agile Lifecycle, Scaling for Enterprise Agile, Four Agile Methodologies-Representative Agile Methods, Advantages and Disadvantages of Agile Methods.

**The Agile Business Case-** Adding Value with the Business Case, Business Value Models Models for the Business Case, Building the Business Case by Levels

**UNIT II**

**Agile in the Waterfall-** First Principles and Requisite Conditions, The Black Box, Interfaces, and Connectivity, Milestone Planning, Monitoring, and Controlling, Change Management, Risk Management. **Developing the Scope and Requirements-** Agile Scope ,Evolving, Emerging, and Adaptive, Scope as a Best Value, Envisioning , Process for Requirements.

**UNIT III**

**Planning and Scheduling-** Planning in the Enterprise Context, Agile Planning Portfolio, Scheduling-Rhythm of the Schedule, Time Box Timelines and Calendars, Other Plans in the Enterprise Agile Project -Planning for Architecture and Nonfunctional Deliverables, Planning for Uncertainty.

**UNIT IV**

**Quality in the Agile Space-** Quality Values and Principles, Quality: Values, Principles, and Practices, Quality Values and Principles Are Planned into Agile Methods. **Sampling for Quality Validation-** Sampling, Process Limits and Benchmarks, Quality Measures from Users



## UNIT V

**Groups as the Genesis of Teams**-Teams from Groups ,Principles of Successful Teams, Operating Model of the Agile Team,Managing the Team Network ,Team-of-Teams. **Matrix Management in the Agile Space**-Matrix Attributes,Matrix as an Agile Management Tool,Agile Teams Recruit Their Members

### Text Books:

1. John C. Goodpasture, “Project Management the Agile Way -Making it Work in the Enterprise” , 2<sup>nd</sup> edition , JRoss Publishers 2016.
2. Alistair Cockburn, Agile Software Development: The Cooperative Game, Addison Wesley 2017.

### Suggested Readings:

1. Robert C. Martin, “Agile Software Development, Principles, Patterns and Practices”, Prentice Hall,2015.
2. Mike Cohn, “User Stories Applied: For Agile Software”, Addison Wesley,2015.

### Web Resources:

1. <https://www.scrum.org/>
2. <https://www.udemy.com/course/agile-with-scrum-from-beginner-to-advanced-project-management-agile>
3. <https://www.coursera.org/learn/agile-project-management>
4. <https://www.coursera.org/learn/agile-atlassian-jira>



20ADE09

**SOCIAL NETWORK ANALYSIS**  
**(Professional Elective #3)**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To Describe about the current web development and emergence of social web
2. To Design modeling, aggregating and knowledge representation of semantic web
3. To Describe Association rule mining algorithms
4. To Summarize knowledge on extraction and analyzing of social web
5. To know the application in real time systems.

**Course Outcomes:**

Upon completing this course, student will be able to:

1. Understand the basics of social network analysis.
2. Analyze Ontology representation of social network data.
3. Apply supervised and unsupervised algorithms on social networks.
4. Interpret the semantic content of social media data.
5. Build social network model for real time applications.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**INTRODUCTION:** Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks - **Network analysis** - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

**UNIT-II**

**MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION:** Ontology and their role in the Semantic Web: **Ontology-based knowledge Representation** – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modeling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.

**UNIT-III**

**ALGORITHMS AND TECHNIQUES:** Association Rule Mining, Supervised Learning, Unsupervised Learning, Semi-supervised Learning, Markov models, K-Nearest Neighboring, Content-based Recommendation, Collaborative Filtering Recommendation, Social Network Analysis, Detecting Community Structure in Networks, the Evolution of Social Networks.

**UNIT-IV**

**EXTRACTING AND ANALYZING WEB SOCIAL NETWORKS:** **Extracting Evolution of Web Community from a Series of Web Archive,** Temporal Analysis on Semantic Graph using Three-Way Tensor, Decomposition, Analysis of Communities and their Evolutions in Dynamic Networks.



## UNIT- V

**APPLICATIONS:** A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.

### Text Books:

1. Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.
2. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2012.
3. Przemyslaw Kazienko, Nitesh Chawla, "Applications of Social Media and Social Network Analysis", Springer, 2015.

### Suggested Reading:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2012
2. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1 st edition, 2011
3. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2014
4. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.

### Web Resource:

1. [https://swayam.gov.in/nd1\\_noc19\\_cs66/preview](https://swayam.gov.in/nd1_noc19_cs66/preview)



**20ITC16****SOFTWARE ENGINEERING LAB**

Instruction  
Duration of SEE  
SEE  
CIE  
Credits

3 Hours per Week  
3 Hours  
50 Marks  
50 Marks  
1.5

**Course Objectives:**

1. Describe use case models that capture requirements of a software system.
2. Illustrate Dynamic models of a software system.
3. Build class diagrams that model a software system.
4. Acquaint with Activity and swimlane models.
5. Familiarize with analysis and design models.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Interpret user requirements using the UML notation.
2. Illustrate Dynamic models of a software system.
3. Analyze and develop class diagrams that model a software system.
4. Develop Activity and swimlane models.
5. Outline analysis and design models.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**List of Programs**

1. Construct Use case diagrams for the following
  - a. Diagram editor.
  - b. Library information system.
  - c. Banking system.
2. Construct Sequence diagrams for the following.
  - a. Mobile phone.
  - b. Use case student register for a course.
  - c. Diagram editor.
3. Construct Collaboration diagrams for the following
  - a. Use case librarians issue books to students.
  - b. Mobile phone.
  - c. Diagram editor.
4. Construct class diagrams for the following
  - a. Diagram editor.
  - b. Library information system.
  - c. Banking system
5. Construct Activity diagrams for the following.
  - a. ATM transaction.
  - b. Ticket machine.
  - c. Sales order processing.
6. Construct Swim lane diagrams for the following.
  - d. Account.
  - e. CD player.
  - c. ATM machine
- 7 **Case Studies:**
  - f. Prepare SRS, develop Analysis and design models for
  - f. Passport automation system



- g. Credit card processing
  - h. BPO management system
  - i. E-book management system
  - j. Recruitment system
- 8 **Study of selenium web testing tools.**
- k. Selenium IDE
  - l. Selenium RC
- 9 **Creating test cases for GUI based desktop applications.**

**Text Books:**

1. Grady Booch, RobertA. Maksimchuk, “Object - Oriented Analysis and Design with Applications”, Addison-Wesley, 3 rd Edition, ISBN No: 9780201895513, 2007.
2. Martina Seidl , Marion Scholz , Christian Huemer, GertiKappel ”UML @ Classroom: An Introduction to Object-Oriented Modeling”, Springer; 2015th edition, ISBN-10: 3319127411, (March 9, 2015)

**Suggested Reading:**

1. Martin Fowler, Kendall Scott, “UML Distilled: A Brief Guide to the Standard Object Modeling Language” Addison Wesley, 4<sup>th</sup> Edition, 2011.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, “Fundamentals of Software Engineering”, PHI, 2<sup>nd</sup> Edition.
3. Unmesh Gundecha , Carl Cocchiaro ,” Learn Selenium: Build data-driven test frameworks for mobile and web applications with Selenium Web Driver 3”, ISBN : 183898304X, Packt Publishing (July 18, 2019)

**Web Resources:**

1. SEweb - Software Engineering Education Home Page:<http://tuvalu.cs.flinders.edu.au/seweb/se-ed/>
2. IBM Rational<http://www-306.ibm.com/software/rational/uml/>
3. Practical UML - A Hands-On Introduction for Developers  
[http://www.togethersoft.com/services/practical\\_guides/umlonlinecourse](http://www.togethersoft.com/services/practical_guides/umlonlinecourse)
4. <https://www.udemy.com/course/selenium-automation-testing-for-beginner>





**20ADC12****DEEP LEARNING LAB**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

**Course Objectives:**

1. To impart knowledge on image data representation techniques.
2. To introduce the concept of Regression.
3. To familiarize with MLP and CNNs.
4. To familiarize with various CNN architectures.
5. To introduce the concept of RNNs.

**Course Outcomes:**

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

1. Preprocess the data to train on Neural Networks
2. Design and Implement Multilayer Perceptron Networks.
3. Identify suitable Neural Network topology to solve a problem.
4. Evaluate and Tune the Convolutional Neural Network models on real dataset(s)
5. Analyze and Tune the Recurrent Neural Network models on real dataset(s)

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**List of Programs**

1. Implement Linear Regression, Softmax Regression
2. Implement Multilayer Perceptron Networks
3. Train and Model the Deep Convolutional Neural Networks (AlexNet)
4. Use Networks - Blocks in Networks(VGG)
5. Use Networks with Parallel Concatenations in GoogLeNet
6. Apply Batch Normalization in LeNet.
7. Implement Residual Networks (ResNet)
8. Model the Densely Connected Networks (DenseNet)
9. Use LSTM on document dataset
10. Use Encoder-Decoder on speech recognition dataset

**Text Books:**

1. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", d2l.ai, 2021
2. Aurelien Geron, "Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow", O'Reilly Media, 2<sup>nd</sup> Edition, 2019.

**Suggested Reading:**

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
2. Indra den Bakker, "Python Deep Learning Cookbook", PACKT publisher, 2017
3. Wei Di, Anurag Bhardwaj, Jianing Wei, "Deep Learning Essentials", Packt publishers, 2018

**Datasets:**

1. <https://www.kaggle.com/datasets>
2. <https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007>

**Web Resources:**

1. <https://www.coursera.org/specializations/machine-learning>
2. <http://nptel.ac.in/courses>



20ADC13

**MINOR PROJECT-II  
(Data Science)**

Instruction	3 Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1.5

**Course Objectives:**

1. To enable students learning by doing.
2. To develop capability to analyse and solve real world problems.
3. To apply innovative ideas of the students.
4. To learn the ability to build a data science project
5. To impart team building and management skills among students and instill writing and presentation skills for completing the project.

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Interpret Literature with the purpose of formulating a project proposal.
2. Develop the ability to identify and formulate problems by applying diverse technical knowledge skills.
3. Apply the fundamental knowledge gained in the curriculum to model, design and implement a Data Science project.
4. Build a prototype by choosing appropriate technologies to meet the identified requirements.
5. Plan to work as a team and to focus on getting a working project done and submit a report within a stipulated period of time to the departmental Committee.

Minor Project is aimed to enable the students to develop a product/application based on the course Data Science with R, Course code - 20ADC11. The student has to implement and present the project as per the given schedule. During the implementation of the project, Personnel Software Process (PSP) has to be followed. Report of the project work has to be submitted for evaluation.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**Schedule**

S No	Description	Duration
1.	Problem Identification / Selection	2 weeks
2.	Preparation of Abstract	1 week
3.	Data Collection and exploratory data analysis	2 weeks
4.	Data Modeling Techniques	3 weeks
5.	Implementation and inferences	2 weeks
6.	Documentation and Project Presentation	3 weeks

### Guidelines for the Award of marks

S. No.	Description	Max. Marks
Final Assessment		30
1.	PPT Preparation	10
2.	Technical Content	10
3.	Question and Answers	5
4.	Report Preparation	5

- The CIE evaluation is based on the rubrics for evaluation on weekly basis.
- Final Minor Project demonstration and PPT presentation is to be evaluated for the entire class together by the entire faculty handling Minor Project for that class.



**20EGC03****EMPLOYABILITY SKILLS**

Instruction	2 Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

**Course Objectives:**

1. To Learn the art of communication, participate in group discussions and case studies with confidence and to make effective presentations.
2. To With- resume packaging, preparing them to face interviews.
3. To Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. To Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

**Course Outcomes:**

Upon completing this course, students will be able to

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals, learn to manage time effectively and deal with stress.
4. Make the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT 1**

**Verbal Aptitude:** Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences-Jumbled Words/Sentences- Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word/Sentence/Text Completion- Reading Comprehension.

**UNIT 2**

**Group Discussion & Presentation Skills:** Dynamics of Group Discussion-Case Studies- Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence. Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language - Preparing an Effective PPT

**UNIT 3**

**Behavioural Skills:** Personal strength analysis-Effective Time Management- Goal Setting- Stress management- **Corporate Culture** – Grooming and etiquette-Statement of Purpose (SOP).

**UNIT 4**

Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writing an Abstract –Technical Report Writing-Plagiarism-Project Seminar.

## **UNIT 5**

**Interview Skills:** Cover Letter and Résumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

### **Suggested Reading:**

1. Leena Sen, “Communication Skills”, Prentice-Hall of India, 2005
2. Dr. Shalini Verma, “Body Language - Your Success Mantra”, S Chand, 2006
3. Edgar Thorpe and ShowickThorpe , “Objective English”, 2<sup>nd</sup> edition, Pearson Education, 2007
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, “The ACE of Soft Skills”, New Delhi: Pearson, 2010
5. Gulati and Sarvesh, “ Corporate Soft Skills”, New Delhi: Rupa and Co. , 2006
6. Van Emden, Joan, and Lucinda Becker, “Presentation Skills for Students”, New York: Palgrave Macmillan, 2004
7. A Modern Approach to Verbal & Non-Verbal Reasoning by R S Aggarwal, 2018
8. Covey and Stephen R, “The Habits of Highly Effective People”, New York: Free Press, 1989



**R-20**  
**B.E. (AI&DS)**  
**Scheme and Syllabus of**  
**VII-VIII Semesters**  
**w.e.f. 2022-23**



1.



## CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of VII Semester of B.E. – Artificial Intelligence and Data Science  
as per AICTE Model Curriculum, with effective from 2022-23

### DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

#### SEMESTER –VII

S. No	Course code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>THEORY</b>								
1	20ADC14	Big Data Analytics	3		3	40	60	3
2		Professional Elective – 4	3	-	3	40	60	3
3		Open Elective – 1	3	-	3	40	60	3
4	20EGM03	Universal Human Values II: Understanding Harmony	3	-	3	40	60	3
5	20EGMO4	Gender Sensitization	2	-	2	-	50	NC
<b>PRACTICALS</b>								
1	20ADC15	Big Data Analytics Lab		3	3	50	50	1.5
2	20ADC16	Project Part – 1	-	4	-	50	-	2
3		Internship	4-6 Weeks 135 Hours		-	-	-	3
<b>TOTAL</b>			<b>14</b>	<b>7</b>	<b>17</b>	<b>260</b>	<b>340</b>	<b>18.5</b>

L: Lecture

T: Tutorial

D: Drawing

P: Practical

CIE – Continuous Internal Evaluation

SEE - Semester End Examination

Professional Elective #4	Unmanned Aerial Vehicles 20ITE15	Robotic Process Automation 20ADE10	Business Intelligence 20ADE11	Server Less Computing 20ADE12	Digital Forensics 20ITE26	Reinforcement Learning 20ADE13
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Open Elective- 1 (VII Semester)		
S.No.	Course Code	Course Name
1.	20MEO03	Research Methodologies
2.	20MEO12	3D Printing
3.	20ME O15	Principles of Industry 4.0
4.	20ECO14	Neural Networks and Fuzzy Logic
5.	20EGO01	Technical Writing Skills



20ADC14

## BIG DATA ANALYTICS

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To introduce the importance of big data, role of Hadoop framework in analyzing large datasets by writing mapper and reducer for a given problem.
2. To familiarize writing queries in Pig and Hive to process big data
3. To present latest big data frameworks and applications using Spark and Scala.
4. To discuss the concept and writing applications using SparkSQL
5. To provide the concepts of NoSQL databases and study the working mechanisms of MongoDB.

**Course Outcomes:**

Upon completing this course, students will be able to:

1. Understand the processing large datasets in Hadoop framework and Apply MapReduce architecture to solve real world problems.
2. Develop scripts using Pig over large datasets and query using Hive.
3. Understand the fundamentals of Spark and the Scala programming.
4. Expertise in using Resilient Distributed Datasets (RDD) for creating applications in Spark and query using SparkSQL.
5. Understand NoSQL databases and Develop data models using MongoDB.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**What is Big Data?** Why is Big Data Important: When to consider a Big data solution, Big Data use cases  
**The Hadoop Distributed Files system:** The Design of HDFS, HDFS Concepts, HDFS Federation, HDFS High Availability, Basic File system Operations, Hadoop File systems, Anatomy of a File Read, Anatomy of a File Write.  
**Map Reduce:** What is Map reduce, Architecture of map reduce. **How Map Reduce Works:** Anatomy of a Map Reduce Job Run, Failures in Map Reduce. **Map Reduce Types and Formats:** Map Reduce Types, The Default Map Reduce Job, Input Formats, Input Splits and Records, Text Input, Output Formats, Text Output, Developing a Map Reduce Application

**UNIT-II**

**Pig:** Installing and **Running Pig**, an Example, Generating Examples, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators, Pig in Practice. **Hive:** Installing Hive, The Hive Shell, An Example, Running Hive, Comparison with Traditional Databases, Hive QL, Tables, **Querying Data**, User-Defined Functions, Writing a User Defined Functions, Writing a User Defined Aggregate Function

**UNIT-III**

**Introduction to Spark:** What is Apache Spark, History of Spark, The Present and Future of Spark, Running Spark, Spark's Basic Architecture Spark Applications Spark's Language APIs Spark's APIs Starting Spark, The Spark Session Data Frames, Partitions, Transformations, Lazy Evaluation, Actions, Spark UI, An End-to-End Example, Data Frames and SQL. **Spark's Toolset:** Running Production Applications, Datasets: Type-Safe Structured APIs, Structured Streaming, Machine Learning and Advanced Analytics, Lower-Level APIs, Spark R, Spark's Ecosystem and Packages.



#### UNIT-IV

**Spark SQL:** What Is SQL?, Big Data and SQL: Apache Hive, Spark SQL, Spark's Relationship to Hive, How to Run Spark SQL Queries, Catalog, Tables, Views, Databases, Select Statements, **Datasets:** When to Use Datasets, Creating Datasets, Actions, Transformations **Resilient Distributed Datasets:** Introduction to RDDs, Creating RDDs, Manipulating RDDs, Transformations, Actions, Saving Files, Caching, Check pointing, Pipe RDDs to System Commands

#### UNIT-V

**No SQL Databases:** Review of traditional Databases, Need for NoSQL Databases, Columnar Databases, Failover and reliability principles, CAP Theorem, Differences between SQL and NoSQL databases, **Working mechanisms of Mongo DB:** Overview, Advantages, Environment, Data Modelling, Create Database, Drop Database, Create collection, Drop collection, Data types, Insert, Query, Update and Delete operations, Limiting and Sorting records, Indexing, Aggregation.

#### Text Books:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. Bill Chambers, Matei Zaharia, "Spark: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2018

#### Suggested Reading:

1. Thilina Gunarathne Hadoop MapReduce v2 Cookbook – 2<sup>nd</sup> Edition, Packet Publishing, 2015.
2. Chuck Lam, Mark Davis, Ajit Gaddam, "Hadoop in Action", Manning Publications Company, 2016.
3. Alex Holmes, "Hadoop in Practice", Manning Publications Company, 2012.
4. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.
5. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.

#### Web Resources:

1. <http://www.planetcassandra.org/what-is-nosql>
2. <http://www.iitr.ac.in/media/facspace/patelfec/16Bit/index.html>
3. <https://class.coursera.org/datasci-001/lecture>
4. <http://bigdatauniversity.com>



## Unit 2: Understanding Harmony in the Human Being - Harmony in Myself

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

## Unit 3: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co -existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

## Unit 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self- regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all - pervasive space
- Holistic perception of harmony at all levels of existence.

## Unit 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order:
  - a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
  - b. At the level of society: as mutually enriching institutions and organizations

### Assessment:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation. Example:

Assessment by faculty mentor: 10

marks Self-assessment/Assessment

by peers: 10 M

Socially relevant project/Group Activities/Assignments: 20

marks Semester End Examination: 60 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.



### **Text Books**

1. R R Gaur, R Asthana, G P Bagaria, “A Foundation Course in Human Values and Professional Ethics”, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1  
The teacher’s manual
2. R R Gaur, R Asthana, G P Bagaria, “Teachers’ Manual for A Foundation Course in Human Values and Professional Ethics”, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

### **Reference Books**

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



**20EGMO4****GENDER SENSITIZATION**

Instruction	3 Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	--

**Course Objectives**

This course will introduce the students to:

1. Sensibility regarding issues of gender in contemporary India.
2. A critical perspective on the socialization of men and women.
3. Popular debates on the politics and economics of work while helping them reflect critically on gender violence.

**Course Outcomes**

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

1. Understand the difference between “Sex” and “Gender” and be able to explain socially constructed theories of identity.
2. Recognize shifting definitions of “Man” and “Women” in relation to evolving notions of “Masculinity” and “Femininity”.
3. Appreciate women’s contributions to society historically, culturally and politically.
4. Analyze the contemporary system of privilege and oppressions, with special attention to the ways gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
5. Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT – I****Understanding Gender:**

**Gender:** Why Should We Study It? (*Towards a World of Equals: Unit -1*)

**Socialization:** Making Women, Making Men (*Towards a World of Equals: Unit -2*)

Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

**UNIT – II****Gender And Biology:**

**Missing Women:** Sex Selection and Its Consequences (*Towards a World of Equals: Unit -4*)

Declining Sex Ratio. Demographic Consequences.

**Gender Spectrum:** Beyond the Binary (*Towards a World of Equals: Unit -10*)

Two or Many? Struggles with Discrimination.

**UNIT – III****Gender and Labour:**

**Housework:** the Invisible Labour (*Towards a World of Equals: Unit -3*)

“My Mother doesn’t Work.” “Share the Load.”

**Women’s Work:** Its Politics and Economics (*Towards a World of Equals: Unit -7*)

Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

#### UNIT-IV

##### Issues Of Violence

**Sexual Harassment:** Say No! (*Towards a World of Equals*: Unit -6)

Sexual Harassment, not Eve-teasing- **Coping with Everyday Harassment**- Further Reading: "Chupulu".

**Domestic Violence:** Speaking Out (*Towards a World of Equals*: Unit -8)

**Is Home a Safe Place?** -When Women Unite [Film]. Rebuilding Lives. Additional Reading:

New Forums for Justice. Thinking about Sexual Violence (*Towards a World of Equals*: Unit -11)

Blaming the Victim-"I Fought for my Life..." - Additional Reading: The Caste Face of Violence.

#### UNIT – V

##### Gender: Co - Existence

**Just Relationships:** Being Together as Equals (*Towards a World of Equals*: Unit -12)

Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers.

Additional Reading: Rosa Parks-The Brave Heart.

##### Textbook:

1. A. Suneetha, Uma Bhugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu "Towards a World of Equals: A Bilingual Textbook on Gender" published by Telugu Akademi, Hyderabad, Telangana State, 2015.

##### Suggested Reading:

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. Abdulali Sohaila. "I Fought For My Life...and Won." Available online at:  
<http://www.thealternative.in/lifestyle/i-fought-for-my-life-and-won-sohaila-abdulal/>

##### Web Resources:

1. <https://aifs.gov.au/publications/gender-equality-and-violence-against-women/introduction>
2. <https://theconversation.com/achieving-gender-equality-in-india>



20ADC15

**BIG DATA ANALYTICS LAB**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

**Course Objectives:**

This course is introduced to

1. To provide the knowledge to set up a Hadoop Cluster and implement applications using MapReduce.
2. To introduce Pig, PigLatin and HiveQL to process big data.
3. To get familiarized with the latest big data frameworks and writing applications using Spark and Scala.
4. To learn querying large datasets with SparkSQL.
5. To gain knowledge to work with NoSQL databases.

**Course Outcomes:**

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

1. Explain Hadoop working environment and develop applications using MapReduce framework.
2. Develop scripts using Pig to solve real world problems and query the datasets using Hive.
3. Develop applications in Spark environment using RDDs.
4. Query real time data using SparkSQL.
5. Query large datasets using NoSQL.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**List of Programs:**

1. Exploring and using basic HDFS commands.
2. Implement following applications using Mapreduce on single node cluster
  - (i) Word Count Application
  - (ii) Analysis of Weather Dataset
  - (iii) Uber Data Analysis
  - (iv) Web Log Analysis
3. Working with Pig Latin Script and HiveQL.
4. Understanding the processing of large dataset on Spark framework and working with Spark SQL.
5. Designing and modeling NOSQL databases with MongoDB.

**Text Books:**

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. Bill Chambers, Matei Zaharia, "Spark: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2018
3. Tanmay Deshpande, "Hadoop Real-World Solutions Cookbook", 2nd Edition, Packt Publishing, 2016.

**Suggested Reading:**

1. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.
2. VigneshPrajapati, "Big data Analytics with R and Hadoop", Packt Publishing, November 2013.

**Web Resources:**

1. <https://parthgoelblog.wordpress.com/tag/hadoop-installation>
2. <http://www.iitr.ac.in/media/facspace/patelfec/16Bit/index.html>
3. <https://class.coursera.org/datasci-001/lecture>
4. <http://bigdatauniversity.com>

20ADC16

**PROJECT PART-I**

Instruction	4 Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

**Prerequisite:** Knowledge of core engineering courses, Capable of searching for suitable literature, Problem Identification and Solving.

**Course Objectives:**

1. The student takes up investigative study in the broad field of Engineering / Technology, involving both theoretical and practical knowledge.
2. Motivate student(s) towards Research & Development with creative problem solving.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Identify problem from literature survey in his/her area of interest
2. Formulate possible solutions for the selected problem and compare with existing ones
3. Prepare synopsis of the selected problem
4. Gather the required information to set up the environment for the implementation of preliminary experimentation
5. Communicate the work effectively in both oral and written forms

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**The work shall include:**

1. Survey and study of published literature on the assigned topic
2. Preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary **Analysis/Modeling/Simulation/Experiment/Design/Feasibility**;
4. Preparing a **Written Report** on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral **Presentation** before a Departmental Research Committee.





20MEO03

**RESEARCH METHODOLOGIES**  
(Open Elective-1)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. To make the students to formulate the research problem.
2. To identify various sources for literature review and data collection.
3. To prepare the research design.
4. To equip the students with good methods to analyze the collected data.
5. To explain how to interpret the results and report writing.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Define research problem.
2. Review and assess the quality of literature from various sources.
3. Understand and develop various research designs.
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square.
5. Improve the style and format of writing a report for technical paper/Journal report.

**UNIT – I**

**Research methodology:** Objectives and motivation of research, types of research- descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical, research approaches, significance of research, research methods vs. methodology, research process, criteria of good research, problems encountered by researchers in India, technique involved in defining a problem.

**UNIT-II**

**Literature survey:** Importance of literature survey, sources of information-primary, secondary, tertiary, assessment of quality of journals and articles, information through internet.

**UNIT – III**

**Research design:** Meaning of research design, need of research design, feature of a good design important concepts related to research design, different research designs, basic principles of experimental design, steps in sample design.

**UNIT – IV**

**Data collection:** Collection of primary data, Secondary data, measures of central tendency-mean, mode, median, measures of dispersion- range, mean deviation, standard deviation, measures of asymmetry (skewness), important parametric tests -z, t, F, Chi-Square, ANOVA significance.

**UNIT – V**

**Research report formulation and presentation:** Synopsis, dissertation, technical paper and journal paper, writing research grant proposal, making presentation with the use of visual aids, writing a proposal for research grant.

**Text Books:**

1. C.R Kothari, Research Methodology Methods & Technique, New Age International Publishers, 2004.
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011.
3. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009.

**Suggested Reading:**

1. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications, Hyderabad, 2012.
2. Naval Bajjai, Business Research Methods, Pearson Education, 2011.



20ECO14

**NEURAL NETWORKS AND FUZZY LOGIC**  
**(Open Elective-1)**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Prerequisite:** Probability knowledge is required

**Course Objectives:**

1. Learn various types of neural networks
2. Learn the concepts of Fuzzy systems
3. Study the applications of neural networks and Fuzzy controllers.

**Course Outcomes:**

Upon completion of this course, students will be able to:

1. Understand the principles of Neural Networks and Fuzzy Logic fundamentals.
2. Apply the basic concepts to model the Neural Networks and Fuzzy Logic systems.
3. Compare the Neural Network based systems and Fuzzy Logic based systems.
4. Analyze Fuzzy Logic controllers and its applications.
5. Explain the concepts of Fuzzy target tracing control systems.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
<b>CO1</b>	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1
<b>CO2</b>	3	3	2	2	1	-	-	-	-	-	-	2	3	1	1
<b>CO3</b>	2	2	2	1	1	-	-	-	-	-	-	1	2	1	1
<b>CO4</b>	2	2	3	2	1	-	-	-	-	-	-	2	3	1	1
<b>CO5</b>	1	1	2	1	2	-	-	-	-	-	-	1	2	1	1

**UNIT-I**

**Introduction:** Introduction to ANS (Artificial Neural systems) Technology, ANS simulation, Types of Neural Networks: Hopfield, perceptron and related models, Adaline and Madaline: Adaline and the Adaptive Linear Combiner, the Madaline and simulating the Adaline.

**UNIT-II**

Probabilistic Models, Fuzzy ARTMAP and Recurrent Networks: Probabilistic Neural Networks, General Regression Neural Networks, Fuzzy ARTMAP, Recurrent Back propagation Neural Networks.

**UNIT-III**

Application of Neural Networks: - Design and optimization of Systems: Non-Linear optimization, Inverse design problems, Pattern Recognition Applications: Control Chart pattern Recognition, Recognition of Machine-Cells in a group technology layout. Complex pattern Recognition tasks: Pattern mapping, pattern variability.

**UNIT-IV**

Introduction to Fuzzy systems, Fuzzy sets and operations on Fuzzy sets, Basics of Fuzzy relations, Fuzzy measures, Fuzzy integrals, Transform Image coding with Adaptive Fuzzy systems.

**UNIT-V**

Fuzzy Target Tracking control systems, Fuzzy and Math Model Controllers, Real Time Target Tracking, Fuzzy Controller, Fuzzified CMAC and RBF – Network based self-learning Controllers.

**Text Books:**

1. James A. Freeman and David M. Skapura, "Neural Networks: Algorithms Applications and Programing Techniques", Pearson Education, India, 2008.
2. James A. Anderson, "An introduction to Neural Networks", PHI, 2003.

**Suggested Readings:**

1. B. Yegnanarayana, "Artificial Neural Networks", PHI Publications, India, 2006.
2. M.AnandaRao and J.Srinivas, "Neural Networks: Algorithms and Applications", Narosa Publications, 2009



20EGO01

**TECHNICAL WRITING SKILLS**  
(Open Elective-1)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 marks
CIE	40 marks
Credits	3

**Course Objectives:**

1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Communicate effectively, without barriers and understand aspects of technical communication.
2. Differentiate between general writing and technical writing and write error free sentences using technology specific words
3. Apply techniques of writing in business correspondence and in writing articles.
4. Draft technical reports and technical proposals.
5. Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Communication** – Nature and process. **Channels of Communication** – Downward, upward and horizontal communication. Barriers to communication. **Technical Communication** – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

**UNIT-II**

**Technical Writing** – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

**UNIT-III**

**Business correspondence** – Sales letters, letters of Quotation, Claim and Adjustment letters. **Technical Articles** : Nature and significance, types. Journal articles and Conference papers, elements of technical articles.

**UNIT-IV**

**Technical Reports** : Types, significance, structure, style and writing of reports. Routine reports, Project reports

**Technical Proposals** : Definition, types, characteristics, structure and significance.

**UNIT-V**

**Mechanics of Meetings** : Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.

**Technical Presentations** : Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.



**Text Books :**

1. Meenakshi Raman & Sangeeta Sharma, “**Technical Communications-Principles and Practice**”, Oxford University Press, Second Edition, 2012.
2. I.M Ashraf Rizvi, “**Effective Technical Communication**”, Tata McGraw Hill Education Pvt Ltd, 2012.

**Suggested Reading :**

1. Kavita Tyagi & Padma Misra, “**Basic Technical Communication**”, PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, “**Business Correspondence and Report Writing**”, Tata McGraw Hill, 2003

**Web Resources:**

1. [https://onlinecourses.nptel.ac.in/noc18\\_mg13/preview](https://onlinecourses.nptel.ac.in/noc18_mg13/preview)
2. <https://www.technical-writing-training-and-certification.com/>
3. <https://academy.whatfix.com/technical-writing-skills>





# CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of VIII Semester of B.E. – Artificial Intelligence and Data Science  
as per AICTE Model Curriculum, with effective from 2022-23

## DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

### SEMESTER –VIII

S.No	Course code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>THEORY</b>								
1		Open Elective – 2	3	-	3	40	60	3
2		Open Elective – 3	3		3	40	60	3
<b>PRACTICALS</b>								
3	20ADC17	Technical Seminar	-	2	-	50	-	1
4	20ADC18	Project Part -2	08 Hours per week /180 Hours Industry		-	100	100	4
<b>TOTAL</b>			<b>6</b>	<b>2</b>	<b>6</b>	<b>230</b>	<b>220</b>	<b>11</b>

**L: Lecture    T: Tutorial    D: Drawing    P: Practical**  
**CIE – Continuous Internal Evaluation    SEE - Semester End Examination**

Open Elective- 2 (VIII Semester)			Open Elective- 3 (VIII Semester)		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	20MEO04	Principles of Entrepreneurship	1	20MTO03	Quantum Computing
2	20BTO04	Bioinformatics	2	20MEO07	Intellectual Property Rights
3	20MEO10	Introduction to Operations Research	3	20ECO01	Remote Sensing and GIS
4	20ECO06	Principle of VLSI	4	20CEO02	Disaster Risk Reduction and Management
5	20EEO04	Energy Conservation	5	20BTO05	Cognitive Neuro Science

  
 HEAD OF THE DEPARTMENT  
 Department of AI&DS  
 CHAITANYA BHARATHI  
 INSTITUTE OF TECHNOLOGY,  
 Hyderabad-500076, Telangana, India.

Instruction	4 Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

#### Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Collect Organize, Analyze and Consolidate information about emerging technologies from the literature.
2. Exhibit effective communication skills, stage courage, and confidence.
3. Demonstrate intrapersonal skills.
4. Explain new innovations/inventions in the relevant field.
5. Prepare Seminar Report in a prescribed format.

#### Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

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

#### The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Seminars are to be scheduled from 3<sup>rd</sup> week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall be preferably from any peer reviewed recent journal publications.

Guidelines for awarding marks		
S. No.	Description	Max Marks
1.	Contents and Relevance	10
2.	Presentation Skills	10
3.	Preparation of PPT slides	05
4.	Questions and Answers	05
5.	Report in a prescribed format	20

20MEO04

**PRINCIPLES OF ENTREPRENEURSHIP**  
(Open Elective-2)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Objectives:**

1. Concept and procedure of idea generation.
2. The nature of industry and related opportunities and challenges.
3. Elements of business plan and its procedure.
4. Project management and its techniques.
5. Behavioral issues and Time management.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Understand the concept and essence of entrepreneurship.
2. Identify business opportunities and nature of enterprise.
3. Analyze the feasibility of new business plan.
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects.
5. Use behavioral, leadership and time management aspects in entrepreneurial journey

**UNIT-I**

**Entrepreneurship:** Definition, functions of entrepreneurship, qualities of entrepreneurs, identification and characteristics of entrepreneurs, entrepreneur vs. intrapreneur, first generation entrepreneurs, women entrepreneurs, conception and evaluation of ideas and their sources.

**UNIT-II**

**Indian industrial environment:** Competence, opportunities and challenges, entrepreneurship and economic growth, small scale industry in India, objectives, linkage among small, medium and heavy industries, types of enterprises, corporate social responsibility.

**UNIT-III**

**Business plan:** Introduction, elements of business plan and its salient features, business model canvas, technical analysis, profitability and financial analysis, marketing analysis, feasibility studies, executive summary, selection of technology and collaborative interactions.

**UNIT-IV**

**Project management:** During construction phase, project organization, project planning and control using CPM, PERT techniques, human aspects of project management, assessment of tax burden.

**UNIT-V**

**Behavioral aspects of entrepreneurs:** Personality, determinants, attributes and models, leadership concepts and models, values and attitudes, motivation aspects, time management: approaches of time management, their strengths and weaknesses. time management matrix and the urgency addiction .

**Text Books:**

1. Vasant Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, 1997.
2. Prasanna Chandra, Project-Planning, Analysis, Selection, Implementation and Review, Tata Mcgraw- Hill Publishing Company Ltd, 1995.
3. S.S. Khanka, Entrepreneurial Development, S. Chand & Co. Pvt. Ltd., New Delhi, 2015.

**Suggested Reading:**

1. Robert D. Hisrich, Michael P. Peters, Entrepreneurship, 5<sup>th</sup> edition, Tata Mc Graw Hill Publishing Company Ltd., 2005.
2. Stephen R. Covey and A. Roger Merrill, First Things First, Simon and Schuster Publication, 1994.



20EE004

**ENERGY CONSERVATION**  
(Open Elective-2)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

**Prerequisites:** Students should have prior knowledge on Fundamentals of power systems, electrical machines, and power electronics.

**Course Objectives:**

1. To know the concept of Energy conservation
2. To understand the formulation of efficiency for various engineering systems
3. To explore the different ways to design various technologies for efficient engineering systems.

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

1. Know the current energy scenario and importance of energy conservation.
2. Understand the concepts of energy conservation.
3. Evaluate the performance of existing engineering systems.
4. Explore the methods of improving energy efficiency in different engineering systems.
5. Understanding different energy efficient devices.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

**Basics of Energy and its various forms:** Overview of engineering elements, Solar energy, electricity generation methods using solar energy, PV cell, elements of wind energy, electricity generation using wind energy, elements of bioenergy, biomass energy conservation, sources of chemical energy, fuel cells, Energy Scenario in India.

**UNIT-II**

**Energyconservation-1: Domestic Sector:** Energy conservation needs and objectives, energy conservation strategies in domestic sector, energy conservation tips in the kitchen, other energy saving tips in the domestic house, energy conservation measures in office, energy conservation processes/activities for a building. HVAC (heating, ventilation, air conditioning), components of HVAC, energy conservation opportunities in HVAC systems.

**UNIT-III**

**Energy conservation-2: Industrial Sector:** Energy conservation in Indian industrial sector, energy saving potential in industry: boiler, furnaces, air compressors, refrigeration systems, heat exchanger, heat pump, turbines, electric drives, pumps, cooling towers, fans and blowers.

Energy conservation in agriculture sector: Energy conservation opportunities in pumps used in agriculture sector, summary.

**UNIT-IV**

**Energy Efficient Technologies-I:** Importance of energy efficiency for engineers, Energy efficient technology in mechanical engineering: Heating, ventilation and air-conditioning, boiler and steam distribution systems. Energy efficient technology in civil engineering: future of roads, harnessing road and transport infrastructure; Energy efficient technology in agriculture: IoT and Drone Technology.





## UNIT-V

**Energy Efficient Technologies-II:** Energy efficient technology in electrical engineering: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors; Energy efficient technology in chemical engineering: green chemistry, low carbon cements, recycling paper. Green buildings concept.

### Text Books:

1. Umesh Rathore, "Energy management", Kataria publications, 2<sup>nd</sup> edition, 2014.
2. Guide books for National Certification Examination for Energy Manager/Energy Auditors Book-1, General Aspects
3. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) "An Overview of Energy Efficiency", opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland University of Technology.



20CE002

**DISASTER RISK REDUCTION AND MANAGEMENT**  
(Open Elective-3)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**Course Outcomes:**

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

1. Identify and understand the concepts of hazards, causes and impacts of disasters.
2. Develop a critical capacity to evaluate the principles and practices of disaster risk reduction and management.
3. Develop a deep awareness of disaster resilience, risk mitigation, and recovery policies as they arise from natural hazards around the globe.
4. Apply knowledge about existing global frameworks and existing agreements and role of community in successful Disaster Risk Reduction.
5. Evaluate DM study including data search, analysis and presentation as a case study.

**Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:**

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

**UNIT-I**

- Hazard and disaster-concepts, vulnerability and risk
- Hazard and disaster type – Natural, Water- related, Pandemic and Human induced hazards disasters
- Causes and Impacts of disasters – Impacts on natural eco systems: physical, psychological and social impact
- Disaster and financial resilience
- GIS and remote sensing
- Disaster vulnerability profile of India –Specific to geographical regions and states (as per regional significance)

**UNIT-II**

- Disaster Management Cycle –Rescue, Relief, Rehabilitation, Prevention, Mitigation and Preparedness
- Disaster risk reduction {DRR} –Community based DRR, institutions concerned with safety, disaster mitigation and construction techniques as per Indian standards
- Early warning systems

**UNIT-III**

- Trauma and stress management
- First aid and emergency procedures
- Awareness generation strategies for the community on safe practises in disaster (as per regional significance)

**UNIT-IV**

- Components of disaster management –preparedness of rescue and relief, mitigation, rehabilitation & reconstruction
- Institutional frame work of disaster management in India (NDMA-SDMA, NDRF, Civic volunteers, NIDM)
- Phases of disaster/risk management and post-disaster responses
- Compensation and insurance
- Applications of remote sensing &GIS in disaster management

**UNIT-V**

- Capacity building for disaster/damage mitigation (structural and non structural measures).
- Disaster risk reduction strategies and national disaster management guidelines
- Disaster management Act -2005
- Regional issues as per regional requirement/university can take minimum two topics as per high powered committee



**Text Books:**

1. Singh, R. (2017), "Disaster management Guidelines for Earth quakes, Landslides, Avalanches and Tsunami". Horizon Press publications.
2. Taimpo (2016), "Disaster management and preparedness". CRC Press Publications
3. Nidhi, G.D. (2014), "Disaster management preparedness". CBS Publications Pvt. Ltd.
4. Gupta, A.K., Nair, S.S., Shiraz, A. and Dey, S. (2013), "Flood Disaster Risk Management-CBS Publications Pvt Ltd.
5. Singh, R. (2016), "Disaster management Guidelines for Natural Disasters" Oxford University Press Pvt. Ltd.





**CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)**  
**AICTE Model Curriculum (with effect from 2023-24)**  
**M.Tech. (Artificial Intelligence and Data Science)**

**SEMESTER- I**

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>THEORY</b>								
1	23MTC101	Mathematical Foundations for Data Science	3	-	3	40	60	3
2	23ADC101	Artificial Intelligence	3	-	3	40	60	3
3		Program Elective-1	3	-	3	40	60	3
4		Program Elective-2	3	-	3	40	60	3
5	23MEM103	Research Methodology and IPR	2	-	3	40	60	2
6		Audit Course-1	2	-	2	-	50	Non-Credit
<b>PRACTICALS</b>								
7	23MTC102	Mathematical Foundations of Data Science Lab	-	2	-	50	-	1
8	23ADC105	Artificial Intelligence Lab	-	2	-	50	-	1
9		Laboratory-3 (Based on Elective-2)	-	2	-	50	-	1
<b>TOTAL</b>			<b>14</b>	<b>06</b>	<b>17</b>	<b>350</b>	<b>350</b>	<b>17</b>

**L: Lecture    T: Tutorial    D: Drawing**  
**CIE - Continuous Internal Evaluation**

**P: Practical**  
**SEE-Semester End Examination**





**CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)**  
**AICTE Model Curriculum (with effect from 2023-24)**  
**M.Tech. (Artificial Intelligence and Data Science)**

**SEMESTER-II**

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>THEORY</b>								
1	23ADC102	Introduction to Data Science	3	-	3	40	60	3
2	23ADC103	Machine Learning	3	-	3	40	60	3
3	23ADC104	Deep Learning	3	-	3	40	60	3
4		Program Elective-3	3	-	3	40	60	3
5		Program Elective-4	3	-	3	40	60	3
<b>PRACTICALS</b>								
6	23ADC106	Introduction to Data Science Lab	-	2	-	50	-	1
7	23ADC107	Machine Learning Lab	-	2	-	50	-	1
8		Laboratory-6 (Based on Elective-4)	-	2	-	50	-	1
9	23ADC109	Mini Project with Seminar	-	4	-	50	-	2
<b>TOTAL</b>			<b>15</b>	<b>10</b>	<b>15</b>	<b>400</b>	<b>300</b>	<b>19</b>

**L: Lecture    T: Tutorial    D: Drawing**  
**CIE-Continuous Internal Evaluation**

**P: Practical**  
**SEE-Semester End Examination**

  
 HEAD OF THE DEPARTMENT  
 Department of AI/DS  
 CHAITANYA BHARATHI  
 INSTITUTE OF TECHNOLOGY,  
 Hyderabad 500078, Telangana, India.



**CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)**  
**AICTE Model Curriculum (with effect from 2023-24)**  
**M.Tech. (Artificial Intelligence and Data Science)**

**SEMESTER-III**

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>THEORY</b>								
1		Program Elective-5	3	-	3	40	60	3
2		Open Elective	3	-	3	40	60	3
3		Audit Course-2	2	-	2	-	50	Non-Credit
<b>PRACTICALS</b>								
3	23ADC110	Dissertation/Phase-I	-	20	-	100	-	10
<b>TOTAL</b>			8	20	8	180	170	16

**SEMESTER-IV**

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
<b>PRACTICALS</b>								
1	23ADC111	Dissertation/Phase-II	-	32	Viva-Voce	100	100	16
<b>TOTAL</b>			-	32	-	100	100	16

**L: Lecture    T: Tutorial    D: Drawing**  
**CIE-Continuous Internal Evaluation**

**P: Practical**  
**SEE-Semester End Examination**

**Total No. of Credits: 68**



## LIST OF COURSES

S.No.	Code	Course	Credits
<b>Mandatory Courses</b>			
1.	23MEM103	Research Methodology and IPR	2
<b>Program Elective-1, Elective-3 and Elective-5 Courses (without Lab)</b>			
2.	23ADE101	Soft Computing	3
3.	23ADE102	Cloud Computing	3
4.	23ADE103	Information Retrieval Systems	3
5.	23ADE104	Time Series Analysis & Forecasting	3
6.	23ADE105	Social Network Analytics	3
7.	23ADE106	Block Chain Technology	3
8.	23ADE107	Intelligent Bio Informatics	3
9.	23ADE108	Recommender Systems	3
10.	23ADE109	Reinforcement Learning	3
11.	23ADE110	GPU Computing	3
12.	23ADE111	Scalable Algorithms and Systems for Data Analysis	3
13.	23ADE112	Cyber Physical Systems	3
14.	23ADE113	Explainable AI	3
15.	23ADE114	Advanced Data Structures	3
16.	23ADE115	High Performance Computing	3
17.	23ADE116	Ethics in AI	3
<b>Program Elective-2 and Elective-4 Courses (with Lab)</b>			
18.	23ADE117	Digital Image Processing and Analysis	3
19.	23ADE118	Cyber Security	3
20.	23ADE119	Big Data Analytics	3
21.	23ADE120	Augmented and Virtual Reality	3
22.	23ADE121	Predictive Analytics with R	3
23.	23ADE122	Natural Language Processing	3
24.	23ADE123	Robotic Process Automation	3

25.	23ADE124	Federated Machine Learning	3
26.	23ADE125	Internet of Things	3
27.	23ADE126	Advanced Algorithms	3
<b>Audit Course – 1 and 2</b>			
28.	23EGA101	English for Research Paper Writing	0
29.	23CEA101	Disaster Mitigation and Management	0
30.	23EEA101	Sanskrit for Technical Knowledge	0
31.	23ECA101	Value Education	0
32.	23EGA102	Constitution of India	0
33.	23ADA101	Pedagogy Studies	0
34.	23EGA103	Stress Management by Yoga	0
35.	23EGA104	Personality Development Through Life's Enlightenment Skills	0
<b>Open Elective Courses</b>			
36.	23CS0101	Business Analytics	3
37.	23MEO102	Introduction to Optimization Techniques	3
38.	23CEO101	Cost Management of Engineering Projects	3
39.	23MEO101	Industrial Safety	3
40.	23MEO103	Composite Materials	3
41.	23EEO101	Waste to Energy	3
<b>Labs, Seminars &amp; Projects</b>			
<b>Laboratory-2 and Laboratory-4</b>			
<b>(Based on Elective-2 and Elective-4 Courses) *</b>			
42.	23ADE127	Digital Image Processing and Analysis Lab	1
43.	23ADE128	Cyber Security Lab	1
44.	23ADE129	Big Data Analytics Lab	1
45.	23ADE130	Augmented and Virtual Reality Lab	1
46.	23ADE131	Predictive Analytics in R Lab	1
47.	23ADE132	Natural Language Processing Lab	1
48.	23ADE133	Robotic Process Automation Lab	1



49.	23ADE134	Federated Machine Learning Lab	1
50.	23ADE135	Internet of Things Lab	1
51.	23ADE136	Advanced Algorithms Lab	1
<b>Seminar and Projects</b>			
52.	23ADC109	Mini Project with Seminar	2
53.	23ADC110	Dissertation Phase-I	10
54.	23ADC111	Dissertation Phase-II	16

**\* Lab courses for Laboratory-2 and Laboratory-4 must be in one-to-one correspondence with the Elective courses opted in Program Elective-2 and Program Elective-4, respectively.**



23MTC101

## MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to

1. Discuss vector space and subspace.
2. Understand the linear transformation.
3. Explore the stochastic processes.
4. Explain different estimates.
5. Fit the curve to the data using the least squares approximation.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

Upon successful completion of this course, students will be able to:

1. Identify the Basis and Dimension of vector space.
2. Calculate the Rank and Nullity of linear transformation.
3. Determine the stochastic measures for the process.
4. Infer the estimation of the statistical Parameters.
5. Apply the appropriate model for Regression diagnostic of the raw data.

### CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	1	2	1
CO2	2	-	1	2	1
CO3	3	-	1	3	2
CO4	3	-	2	3	2
CO5	3	-	1	3	2

### UNIT I

**General Vector Spaces:** Introduction to **General Vector Spaces**, Subspace of a Vector Space, Linear Independence and Basis, Dimension, Properties of a Matrix, solutions to a non-homogeneous system of linear equations.

### UNIT II

**Linear Transformations:** Introduction to **Linear Transformations**, Kernel and Range of a Linear Transformation, Rank and Nullity, **Inverse Linear Transformations**, The Matrix of a Linear Transformation, Composition and Inverse Linear Transformations.

### UNIT III

**Expectation:** Introduction, **Moments, Expectation** Based on Multiple Random Variables, Transform Methods, Moments and Transforms of Some Distributions (Weibul and Exponential), Computation of Mean Time to Failure. Stochastic Process: Classification of Stochastic Processes, the Bernoulli Process, the Poisson Process and the normal process.

### UNIT – IV

**Concepts of Inference:** Point Estimation, Maximum Likelihood Estimation, Confidence Interval Estimation, Hypothesis Testing, Likelihood Ratio Tests; Inferences for Single Samples: Inferences on Mean (Large Samples), Inferences on Mean (Small Samples), Inferences on Variance.

## UNIT – V

**The least squares Approximation:** The least squares method, The model for simple linear regression, Fitting a line, goodness of fit, Statistical inference with the simple linear regression model, prediction and confidence intervals, Regression diagnostics. Multiple linear regression, the model for multiple linear regression, Goodness of fit, multiple correlation coefficient, Statistical inference for multiple regression, ANOVA tables

### TEXT BOOKS:

1. Kishor S. Trivedi, “Probability and Statistics with Reliability”, “Queuing, and Computer Science Applications”, John Wiley & Sons, 2016.
2. Randall Pruim, “Foundations and Applications of Statistics” (An Introduction Using R), American Mathematical Society, 2010.
3. Kuldeep Singh, Linear Algebra Step by Step, Oxford University Press, 2014.

### Reference Books:

1. William M. Mendenhall Terry L. Sincich, STATISTICS for Engineering and the Sciences, SIXTH EDITION, CRC Press Taylor & Francis Group, 2016.
2. David Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/ Cole, 2005.



23ADC101

## ARTIFICIAL INTELLIGENCE

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to

1. Understand the basics of AI and concept of Intelligent Agent.
2. Familiarize the various Searching techniques
3. Introduce first-order and second-order predicate Logic to infer knowledge
4. Explore classical and real-world planning approaches
5. Understand uncertainty and probabilistic reasoning models

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Understand the basics of AI and concept of Intelligent Agent.
2. Compare the advanced Searching techniques.
3. Understand and apply the first-order and second-order predicate Logic to infer the knowledge
4. Analyse classical and real-world planning approaches
5. Understand the uncertainty and apply the probabilistic reasoning models

### CO-PO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	3	3	3
CO2	3	1	3	3	3
CO3	3	1	2	2	2
CO4	2	1	3	2	3
CO5	2	1	3	2	2

### UNIT-I

**Introduction:** AI Definition, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art ; **Intelligent Agents** : Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents; **Solving Problems by Searching:** Problem Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

### UNIT-II

**Beyond Classical Search:** Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments, Adversarial Search: Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games, State-of-the-Art Game Programs; Alternative Approaches; Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs , Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

### UNIT-III

**Logical Agents** : Knowledge-Based Agents, the Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic; **First-Order Logic:** Representation Revisited, Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic; **Inference in First-Order Logic:** Propositional Vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution



#### UNIT-IV

**Classical Planning:** Definition of Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches; **Planning and Acting in the Real World:** Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning; **Knowledge Representations:** Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World

#### UNIT-V

**Quantifying Uncertainty:** Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, The Wumpus World Revisited; **Probabilistic Reasoning:** Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks, Probabilistic Reasoning over Time: Time and Uncertainty, Inference in Temporal Models, Hidden Markov Models

#### TEXT BOOKS:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Edition, 4th Edition

#### SUGGESTED READING:

1. Rich, Knight, Nair: —Artificial intelligencel, Tata McGraw Hill, Third Edition, 2009.
2. Nilsson, N., —Artificial Intelligence: A New Synthesisl, San Francisco, Morgan Kaufmann, 1998.
3. Kulkarni, Parag, Joshi, Prachi , —Artificial Intelligence : Building Intelligent Systemsl, PHI, 2015
4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.

#### Web Resources:

1. [https://onlinecourses.nptel.ac.in/noc19\\_cs19/](https://onlinecourses.nptel.ac.in/noc19_cs19/)
2. <https://www.coursera.org/learn/ai-for-everyone>



## RESEARCH METHODOLOGY AND IPR

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

### COURSE OBJECTIVES: This course aims to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

### COURSE OUTCOMES: After completion of this course, students will be able to

1. Define research problem, review and assess the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights\

### CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3
CO1	3	2	1
CO2	3	3	3
CO3	3	2	2
CO4	3	1	2
CO5	3	3	3

### UNIT-I

**Research Methodology:** Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods versus Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

### UNIT-II

**Literature Survey Report Writing:** Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

### UNIT-III

**Research Design:** Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

### UNIT-IV

**Data Collection and Analysis:** Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

## UNIT-V

**Patents and Copy Right:** Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

### TEXT BOOKS:

1. C. R. Kothari, "Research Methodology, Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011.

### SUGGESTED READING:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications", Macmillan India Ltd, 2006
2. B. L. Wadehra, "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications", Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan, "Law of Copyright and Industrial Designs", Eastern law House, Delhi 2010.



23ADE102

**CLOUD COMPUTING**  
(Program Elective-1, Elective-3 and Elective-5 Courses)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to

1. Familiarize basic concepts of cloud computing and enabling technologies.
2. Introduce Auto-Scaling, capacity planning and load balancing in cloud.
3. Impart knowledge on issues related to security, privacy and compliance.
4. Introduce cloud management standards and programming models.
5. Deal with the concepts of Service-oriented architecture and cloud database technology.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Understand different types of cloud computing concepts and the techniques.
2. Determine the issues related to scaling, capacity planning and load balancing.
3. Assess the cloud infrastructure, information security and compliance issues.
4. Analyse the Portability and Interoperability issues of cloud virtualization.
5. Evaluate the importance of SOA and cloud database technology.

**CO-PO Articulation Matrix**

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	2	2
CO2	2	2	2	2	2
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3

**UNIT-I**

**Introduction-** Limitations of the Traditional Computing Approaches, Three Layers of Computing, Three Layers in Traditional Computing, The End of Traditional Computing, Influences behind Cloud Service Adoption. Benefits and challenges: Origin of the Term 'Cloud Computing', Early Initiatives, Utility Computing, Metering and Billing in Cloud, Separation of Data Center Operation, Benefits of Cloud Computing, Challenges of Cloud Computing, How Cloud Computing Addresses Business Challenges, Ethical Issues in Cloud Computing, Cloud Computing: Network as Computer, Role of Web Service, Role of API, Ubiquitous Cloud, Confusion Between Cloud and Internet. Cloud computing services, Resource Virtualization, Resource pooling, sharing and provisioning.

**UNIT-II**

**Scaling in cloud-** Introduction to Scaling, Scaling in Traditional Computing, Scaling in Cloud Computing, Foundation of Cloud Scaling, Scalable Application, Scaling Strategies in Cloud, Auto-Scaling in Cloud, Types of Scaling, Performance and Scalability, the Resource Contention Problem, Cloud Bursting: A Scenario of Flexible Scaling, Scalability is a Business Concern

**Capacity Planning-** Capacity Planning, Capacity Planning in Computing, Capacity Planning in Cloud Computing, Approaches for Maintaining Sufficient Capacity, Steps for Capacity Planning

**Load Balancing-** Load Balancing, Importance of Load Balancing in Cloud Computing, Load Balancing in Cloud, Goals of Load Balancing, Categories of Load Balancing, Load Balancing Algorithms, Case study on Google cloud and Amazon Elastic Compute Cloud (EC2), File System and Storage.





### UNIT-III

**Content Delivery Network:** CDN Service Operations, Evolution of CDN, Advantages of CDN, Disadvantages of CDN, CDN Service Provider, Security Reference Model

**Security Issues-** Cloud security, threats to Cloud Security, Infrastructure Security, Information Security, Identity Management and Access Control, Cloud Security Design Principles, Cloud Security Management Frameworks, Security-as-a-Service, Privacy and Compliance Issues.

### UNIT-IV

**Portability and Interoperability Issues-** Challenges in the Cloud, The Issues in Traditional Computing, Addressing Portability and Interoperability in Cloud, Portability and Interoperability Scenarios, Machine Imaging or Virtual Machine Image, Virtual Appliance, Difference between Virtual Machine Image and Virtual Appliance, Open Virtualization Format (OVF), Cloud Management and a Programming Model Case Study, Popular Cloud Services.

### UNIT-V

**Service-Oriented Architecture:** The Pre-SOA Era, Role of SOA in Cloud Computing, Service-Oriented Architecture, Goal of System Designing, Service Represents Business Functionality, Open Standard Implementation, Benefits of SOA, SOA and Cloud Computing.

**Database Technology:** Database in Cloud, Data Models, Database-as-a-Service, Relational DBMS in Cloud, Non-relational DBMS in Cloud.

### TEXT BOOK:

1. Sandeep Bhowmik, "Cloud Computing", Cambridge University Press, 2017.

### SUGGESTED READING:

1. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Elsevier, 2012.
2. Barrie Sosinsky" Cloud Computing Bible", Wiley-India, 2010
3. Ronald L. Krutz, Russell Dean Vines "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley- India,2010
4. John W. Rittenhouse, James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2009.
5. Enterprise Cloud Computing - Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press, 2016. 3 Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra,

### WEB RESOURCES:

1. <https://nptel.ac.in/courses/106105167/1>
2. <https://www.manning.com/books/exploring-cloud-computing> (e-book)
3. <https://www.coursera.org/specializations/cloud-computing>



23ADE119

**BIG DATA ANALYTICS**  
**(Program Elective-2 and Elective-4 Courses)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

**COURSE OBJECTIVES:** This course aims to

1. Introduce to some of the most common frameworks such as Apache Spark, Hadoop, MapReduce, Pig and Hive
2. Provide Large scale data storage technologies such as NoSQL distributed databases with MongoDB
3. Facilitate learning of Spark and GraphX with machine learning applications

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Design of Hadoop Distributed Files system and build applications using MapReduce
2. Perform analysis on large datasets using Pig and Hive
3. Model the data using NoSQL and MongoDB
4. Develop applications of Parallel programming with Spark and Spark SQL
5. Develop machine learning solutions using Spark and Spark GraphX.

**CO-PO Articulation Matrix**

PO/PSO/CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	2	3	3
CO2	3	2	2	3	2
CO3	3	1	1	2	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2

**UNIT-I**

**Introduction to Big Data:** Introduction, Big Data Enabling Technologies, Hadoop Stack for Big Data

**The Hadoop Distributed Files system:** Overview, The Design of HDFS, HDFS Concepts, The Command-Line Interface, Hadoop File systems.

**MapReduce:** Overview, Developing a MapReduce Application, How MapReduce works, MapReduce Types and Formats, MapReduce Features, MapReduce Examples.

**UNIT-II**

**Pig:** Generating Examples, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators, Pig in Practice.

**Hive:** Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions, Writing a User Defined Functions, Writing a User Defined Aggregate Function.

**UNIT-III**

**No SQL Databases:** Review of traditional Databases, Need for NoSQL Databases, Columnar Databases, Failover and reliability principles, CAP Theorem, Differences between SQL and NoSQL databases.

**Working Mechanisms of Mongo DB:** Overview, Advantages, Environment, Data Modelling, Create Database, Drop Database, Create collection, Drop collection, Data types, Insert, Query, Update and Delete operations, Limiting and Sorting records, Indexing, Aggregation



#### UNIT-IV

**Parallel programming with Spark:** Overview of Spark, Fundamentals of Scala and functional programming, Spark concepts - Resilient Distributed Datasets (RDD), creating RDDs, Basic Transformations, Basic Actions, Word Count example; Spark operations, Job execution, Spark Applications – Cluster computing with working sets.

**Spark SQL:** What is SQL, Big Data and SQL – Spark SQL, How to Run Spark SQL Queries, Tables, Views, Databases, Select Statements.

#### UNIT-V

**Machine Learning with Spark:** Designing a Machine Learning System, Obtaining, Processing and Preparing Data with Spark, Building a Recommendation Engine with Spark, Building a Classification Model with Spark, Building a Regression Model with Spark and Building a Clustering Model with Spark.

**Spark GraphX & Graph Analytics:** *GraphX* – Introduction, Graphs in Machine Learning Landscape, Graph-structured data, PageRank, *Graph Analytics* – Property Graphs, Graph Operators, Distributed Graphs, GraphX – Unified Analytics; *Case Study:* Flight Data Analysis using Spark GraphX

#### TEXT BOOKS:

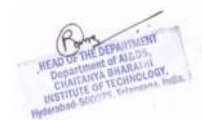
1. Tom White, "Hadoop: The Definitive Guide", Fourth Edition, O'Reilly Media Inc, 2015.
2. Bill Chambers & Matei Zaharia, "Spark: The Definitive Guide", O'Reilly Media Inc, 2018.
3. Nick Pentreath, "Machine Learning with Spark", First Edition, Packt Publishing, 2015.

#### SUGGESTED READING:

1. Thilina Gunarathne, "Hadoop MapReduce v2 Cookbook", Second Edition, Packt Publishing, 2015.
2. Chuck Lam, Mark Davis, Ajit Gaddam, "Hadoop in Action", Manning Publications Company, 2016.
3. Alex Holmes, "Hadoop in Practice", Manning Publications Company, 2012.
4. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.
5. Edward Capriolo, Dean Wampler, Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, 2012.

#### Web Resources:

1. <https://nptel.ac.in/courses/106104189>
2. <http://www.planetcassandra.org/what-is-nosql>
3. <https://stanford.edu/~rezab/sparkworkshop/slides/xiangrui.pdf>
4. <https://class.coursera.org/datasci-001/lecture>



23EGA101

**ENGLISH FOR RESEARCH PAPER WRITING  
(Audit Course – 1 and 2)**

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

**Prerequisite:** Writing to express on science and technological concepts with good taste for research and development.

**COURSE OBJECTIVES:** This course aims to

1. Motivate learners for academic writing and thus encourage them for continuous professional updating and up-gradation.
2. Facilitate a practical understanding of the multiple purposes of Writing Research Papers and help them infer the benefits and limitations of research in science and technology.
3. Brainstorm and develop the content, formulating a structure and illustrating the format of writing a research paper.
4. Survey and select a theme/topic for a thorough reading and to writing a research paper.
5. Understand to implement the intricacies of writing and publishing a research paper.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Improve work performance and efficiency, illustrate the nuances of research paper writing and draw conclusions on professional usefulness.
2. Classify different types of research papers and organize the format and citation of sources.
3. Explore various formats of APA, MLA and IEEE and set up for writing a research paper.
4. Draft paragraphs and write theme based thesis statements in a scientific manner.
5. Develop an original research paper while acquiring the knowledge of how and where to publish their papers.

**CO-PO-PSO Articulation Matrix**

PO/PSO/CO	PO1	PO2	PO3	PSO1	PSO2
CO 1	1	2	1	1	1
CO 2	1	1	1	1	1
CO 3	1	2	2	1	1
CO 4	1	2	1	1	1
CO 5	2	3	1	1	1

**UNIT - I**

**Academic Writing:** Meaning & Definition of a research paper; Purpose of a research paper - Scope, Benefits, Limitations and outcomes for professional development, An introduction to methods and Approaches of Research.

**UNIT - II**

**Research Paper Format:** Title - Abstract - Introduction - Discussion - Findings - Conclusion - Style of Indentation - Font size/Font types - Indexing - Citation of sources.

**UNIT - III**

**Process of Writing a research paper,** Writing to Draft a Format, Develop content, Adapting, Reviewing, Paraphrasing& Plagiarism Checks.

**UNIT - IV**

**Choosing a topic - Thesis Statement - Outline - Organizing notes - Language of Research - Word order, Paragraphs - Writing first draft-Revising/Editing - The final draft and proof reading. Understanding APA, MLA, IEEE formats.**

**UNIT - V**



**Research Paper Publication Reputed Journals** –Paid, Free and peer reviewed journals, National/International - ISSN No, No. of volumes, Scopus Index/UGC Journals. Getting Papers Published.

#### **TEXT BOOKS:**

1. Kothari, C. R. and Gaurav, Garg, Research Methodology Methods and Techniques”, 4thEdition, New Age International Publishers, New Delhi, 2019.
2. Ellison, Carroll. “Writing Research Papers”, McGraw Hill’s Concise Guide, 2010.
3. Lipson, Charles. “Cite Right: A Quick Guide to Citation Styles-- MLA, APA, Chicago, the Sciences, Professions, and More”, 2nd Edition., University of Chicago Press. Chicago, 2018.

#### **SUGGESTED READING:**

1. Day, Robert A. “How to Write and Publish a Scientific Paper”, Cambridge University Press, 2006
2. Girden, E. R. “MLA Hand book for writers of Research Papers”, 7<sup>th</sup> Edition, East West Press Pvt. Ltd, New Delhi, 2009
3. Bailey, Stephen. “Academic Writing: A Handbook for International Students”, Routledge, 2018

#### **Online Resources:**

1. [https://onlin://onlinecourses.nptel.ac.in/noc\\_18\\_mg13/preview](https://onlin://onlinecourses.nptel.ac.in/noc_18_mg13/preview)
2. <https://nptel.ac.in/courses/121/106/121106007/>
3. <https://www.classcentral.com/course/swayam-introduction-to-research-5221>

#### **Writing Tools:**

1. [https://owl.purdue.edu/owl\\_exercises/index.html](https://owl.purdue.edu/owl_exercises/index.html) - The Owl writing lab
2. [https://www.turnitin.com/login\\_page.asp?lang=en\\_us](https://www.turnitin.com/login_page.asp?lang=en_us) – Turn tin software



23MTC102

## MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE LAB

Instruction  
CIE  
Credits

2 P Hours per week  
50 Marks  
1

**COURSE OBJECTIVES:** This course aims to

1. To learn techniques for finding Eigen values and Eigen vectors.
2. To learn about reliability for probability function.
3. To learn about Estimating the parameter using LR test.
4. To learn about Hypothesis Testing for generalized linear model.
5. To learn about Prediction and Analysis of Variance.

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Construct Eigen vectors for the nth order transformation.
2. Test the reliability for the probability function.
3. Estimate the parameter using the LR test.
4. Identify the significance level for the generalized linear model.
5. Predict the values of generalized linear models using Analysis of Variance.

### CO-PO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3		2	2	1
CO2	3		2	2	1
CO3	3		2	2	1
CO4	3		2	2	1
CO5	3		2	2	1

### LIST OF PROGRAMS:

1. Compute Eigen values and Eigen vectors for nth order transformation.
2. Solution of non-homogenous system of linear equations.
3. Estimate Inverse matrix of linear transformation.
4. Verification of MTTF for the continuous Distributions.
5. Likely Hood Ratio Test by Hypothesis Testing.
6. Hypothesis Testing by F-Test.
7. Compute the significance level (P value) for generalized linear model.
8. Linear Predicted Model.
9. Multiple Regression Model.
10. ANOVA for Multiple Regressions.

### REFERENCE BOOKS:

1. R For Statistics by Cornillon Pierre Andre Et Al , T and F India, January 2015.
2. An Introduction to Statistical Learning: with Applications in R, Springer; 2017. R Statistics Cookbook, Francisco Jureting, Packt publishing ltd, 2019.



23ADC105

## ARTIFICIAL INTELLIGENCE LAB

Instruction  
CIE  
Credits

2 P Hours per week  
50 Marks  
1

**COURSE OBJECTIVES:** This course aims to

1. Familiarize with search and game playing strategies.
2. Introduce logic programming concepts through Prolog
3. Learn probabilistic reasoning on uncertain data.
4. Learn knowledge representation and inference
5. Learn building AI Systems

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Solve AI problems through Python Programming
2. Demonstrate an intelligent agent
3. Evaluate Search algorithms
4. Build knowledge representation system and infer knowledge from it
5. Apply probabilistic reasoning on data.

### CO-PO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	3	3	3
CO2	3	1	3	3	2
CO3	2	1	3	2	2
CO4	2	-	3	3	3
CO5	2	1	3	2	1

### LIST OF PROGRAMS:

1. Implementation of uninformed search techniques.
2. Implementation of informed search techniques.
3. Implementation of game search.
4. Implementation of a program to represent knowledge
5. Implementation of a program to construct a Bayesian network from given data.
6. Implementation of a program to infer from the Bayesian network.
7. Installation of Prolog and demonstration of basic operations.
8. Mini Project work

### TEXT BOOK:

1. Russell, Norvig, —Artificial Intelligence: A Modern Approach, Pearson Education, Third Edition, 2015
2. Allen B. Downey, —Think Python How to Think Like a Computer Scientist, Second Edition, O'Reilly, 2016.

### SUGGESTED READING:

1. Saroj Kaushik, —Artificial Intelligence, Cengage Learning India, 2011.
2. Rich, Knight, Nair: —Artificial intelligence, Tata McGraw Hill, Third Edition, 2009.
3. Nicole Bauerle, Ulrich Rieder, —Markov Decision Process with Applications to Finance, Springer, 2011.
4. Nilsson. N., —Artificial Intelligence: A New Synthesis, First Edition, Morgan Kaufmann, 1998.
5. Trivedi, M.C., —A Classical Approach to Artificial Intelligence, Khanna Publishing House, Delhi

### WEB RESOURCE:

1. [https://ai.berkeley.edu/project\\_overview.html](https://ai.berkeley.edu/project_overview.html)
2. <http://aima.cs.berkeley.edu/>



23ADE129

**BIG DATA ANALYTICS LAB**  
**(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)\*)**

Instruction  
CIE  
Credits

2 P Hours per week  
50 Marks  
1

**COURSE OBJECTIVES:** This course aims to

1. To provide the knowledge to setup a Hadoop Cluster and to develop programs using MapReduce
2. To introduce Pig, PigLatin and HiveQL and NoSQL to process big data
3. To introduce the latest big data frameworks and writing applications using Spark and Scala

**COURSE OUTCOMES:** After the completion of this course, the student will be able to

1. Understand Hadoop working environment
2. Work with big data applications in multi node clusters using MapReduce
3. Write scripts using Pig to solve real world problems.
4. Write queries using Hive to analyse the datasets
5. Use Spark working environment to solve real world problems.

**CO-PO Articulation Matrix**

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	2	3	2
CO2	3	2	2	3	2
CO3	3	1	2	3	2
CO4	3	1	2	3	2
CO5	3	1	2	3	3

**LIST OF PROGRAMS:**

1. Demonstrate the following using HDFS
  - a. Basic HDFS commands
  - b. Working with Hadoop file system: Reading, Writing and Copying
2. Develop the following applications using MapReduce
  - . Word count application using Map Reduce on single node cluster
  - a. Analysis of Weather Dataset on Multi node Cluster using Hadoop
  - b. Real world case studies on Map Reduce applications
3. Writing User Defined Functions/Eval functions for filtering unwanted data in Pig
4. Working with Hive on the following
  - . HiveQL
  - a. Writing User Defined Functions in Hive
5. Demonstrate the working of NoSQL database MongoDB
6. Implement the following on Spark
  - . Processing large datasets on Spark framework
  - a. Word count application
7. Build a Clustering Model with Spark
8. Implement the case study “Flight Data Analysis” using Spark GraphX

**TEXT BOOKS:**

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. TanmayDeshpande, “HadoopReal-World Solutions Cookbook”, Second Edition, Packt Publishing 2016.





**SUGGESTED READING:**

1. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.
2. VigneshPrajapati, "Big data Analytics with R and Hadoop", Packt Publishing, November 2013.
3. Nick Pentreath, "Machine Learning with Spark", First Edition, Packt Publishing, 2015.

**Web Resources:**

1. <https://parthgoelblog.wordpress.com/tag/hadoop-installation>
2. <http://www.iitr.ac.in/media/facspace/patelfec/16Bit/index.html>
3. <https://class.coursera.org/datasci-001/lecture>
4. <http://bigdatauniversity.com>.

