

**B. Tech.**

**ARTIFICIAL INTELLIGENCE & DATA SCIENCE**

**(B.Tech Scheme upto 4th Year Syllabus)**



**Department of Artificial Intelligence & Data Science**

**VELAGAPUDI RAMAKRISHNA**

**SIDDHARTHA ENGINEERING COLLEGE**

**(An Autonomous, ISO 9001:2015 Certified Institution)**

**(Approved by AICTE, Accredited by NAAC with 'A+' Grade,**

**Affiliated to JNTUK, Kakinada)**

**(Sponsored by Siddhartha Academy of General & Technical  
Education)**

**Kanuru, Vijayawada**

**Andhra Pradesh - 520007, INDIA.**

**[www.vrsiddhartha.ac.in](http://www.vrsiddhartha.ac.in)**

### **INSTITUTE VISION**

To nurture excellence in various fields of engineering by imparting timeless core values to the learners and to mould the institution into a centre of academic excellence and advanced research.

### **INSTITUTE MISSION**

To impart high quality technical education in order to mould the learners into globally competitive technocrats who are professionally deft, intellectually adept and socially responsible. The institution strives to make the learners inculcate and imbibe pragmatic perception and pro-active nature so as to enable them to acquire a vision for exploration and an insight for advanced enquiry.

### **DEPARTMENT VISION**

The department vision is clearly defined and is in line with the college's vision. The vision of the department is:

"To evolve as a centre of academic excellence, advanced research and innovation in the field of Artificial Intelligence and Data Science discipline."

### **DEPARTMENT MISSION**

This mission of the Department is concise and supports the College's mission. The mission of Artificial Intelligence and Data Science Department is:

"To inculcate students with cognitive skills to perform intelligent data analysis, their application in solving data driven problems, with an inclination towards societal issues, research, professional career and higher studies ."

## **Program Educational Objectives(UG)**

We have program educational objectives for our Artificial Intelligence and Data Science Program. Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

### **Our program educational objectives are:**

I. The graduates of the Program will have knowledge and skills for data analysis, including mathematics, science and basic engineering.

II. The graduates of the Program will have in-depth learning skills to function as members of multi-disciplinary teams and to communicate effectively using modern tools.

III. The graduates of the Program will have extensive knowledge in state-of-the-art frameworks in Artificial Intelligence and be prepared for their careers in the software industry or pursue higher studies and continue to develop their professional knowledge.

IV. The graduates of the program will practice the profession with ethics, integrity, leadership and social responsibility

## PROGRAM OUTCOMES

**On successful completion of the B.Tech (AI&DS) programme the student will be able to :**

**PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering, data science fundamentals, and artificial intelligence to solve complex engineering problems.

**PO2: Problem analysis:** Identify, formulate, review research literature and analyze complex engineering problems to create solutions using the first principles of mathematics, engineering sciences, and data science.

**PO3: Design/development of solutions:** Design solutions Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4: Conduct investigations of complex problems:** Apply research methods including design of experiments, statistical analysis and business interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern tool usage:** Create, select, and apply appropriate Artificial intelligence principles, techniques, modern engineering and IT tools including prediction and modelling to model complex engineering activities with an understanding of the limitations.

**PO6: The engineer and society:** Apply reasoning using contextual knowledge to assess the needs of societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to data science engineering practice.

**PO7: Environment and sustainability:** Understand the impact of artificial

intelligence solutions in societal and environmental contexts, and demonstrate the knowledge for sustainable development.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and to execute responsibilities and adhere to norms of the engineering profession.

**PO9: Individual and team work:** Execute professional functions effectively as an individual, as well as a leader or member in diverse multidisciplinary teams.

**PO10: Communication:** Communicate effectively with the engineering community and with society in solving complex problems in terms of being able to comprehend and write effective reports, make effective presentations, as well as execute and receive clear instructions.

**PO11: Project management and finance:** Demonstrate an ability to use management principles and apply these to one's own work, as a member and lead projects and build cost models in an interdisciplinary professional setting.

**PO12: Lifelong learning:** Recognize the need for and develop learning mechanisms and inculcate the ability to prepare for lifelong learning in the context of technological change.

### **PROGRAM SPECIFIC OUTCOMES**

**PSO1:** Develop AI based software applications/solutions as per the needs of Industry and society

**PSO2:** Adopt new and fast emerging technologies in Artificial Intelligence and Data Science

**ARTIFICIAL INTELLIGENCE & DATA SCIENCE  
SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME [VR20]**

**SEMESTER I****CONTACT HOURS: 26**

<i>S.No</i>	<i>Course Code</i>	<i>Course Category</i>	<i>Course Name</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Credits</i>
1.	20BS1101A	Basic Science	Mathematics for Data Science	3	0	0	3
2.	20BS1102A	Basic Science	Applied Physics (CSE/IT/AI&DS)	3	0	0	3
3.	20ES1103	Engineering Science	Programming for Problem Solving	3	0	0	3
4.	20ES1104	Engineering Science	Basics of Electrical Engineering	3	0	0	3
5.	20HS1105	Humanities and Social Science	Technical English and Communication Skills	2	0	0	2
6.	20BS1151A	Basic Science	Engineering Physics Laboratory	0	0	3	1.5
7.	20ES1152	Engineering Science	Programming for Problem Solving Laboratory	0	0	3	1.5
8.	20HS1153	Humanities and Social Science	Technical English and Communication Skills Laboratory	0	0	3	1.5
9.	20ES1154	Engineering Science	Computing and Peripherals Laboratory	0	0	2	1
10.	20MC1106	Mandatory Course	Technology and Society	1	0	0	-
<b>Total</b>				<b>15</b>	<b>0</b>	<b>11</b>	<b>19.5</b>
11.	20MC1107	Mandatory Course	Induction Program				-

**SEMESTER II****CONTACT HOURS: 27**

<i>S.No</i>	<i>Course Code</i>	<i>Course Category</i>	<i>Course Name</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Credits</i>
1.	20BS2101A	Basic Science	Probability and Statistics for Data Science	3	0	0	3
2.	20BS2102	Basic Science	Engineering Chemistry	3	0	0	3
3.	20ES2103C	Engineering Science	Programming Essentials in Python	3	0	0	3
4.	20ES2104A	Engineering Science	Basic Electronics Engineering	3	0	0	3
5.	20ES2105	Engineering Science	Engineering Graphics	1	0	4	3
6.	20BS2151B	Basic Science	Engineering Chemistry Laboratory	0	0	3	1.5
7.	20ES2152C	Engineering Science	Programming Essentials in Python Laboratory	0	0	3	1.5
8.	20ES2153	Engineering Science	Engineering Workshop	0	0	3	1.5
9.	20MC2106	Mandatory Course	Professional Ethics and Practice	1	0	0	-
<b>Total</b>				<b>14</b>	<b>0</b>	<b>13</b>	<b>19.5</b>

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**SEMESTER III****CONTACT HOURS: 28**

<i>S.No</i>	<i>Course Code</i>	<i>Course Category</i>	<i>Course Name</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Credits</i>
1.	20BS3101A	Basic Science	Discrete Mathematics	3	0	0	3
2.	20ES3102	Engineering Science	Digital Logic and Computer Design	2	1	0	3
3.	20AI&DS3303	Program Core	Database Systems	2	1	0	3
4.	20AI&DS3304	Program Core	Java Programming	3	0	0	3
5.	20AI&DS3305	Program Core	Data Structures and Algorithms	3	0	0	3
6.	20AI&DS3351	Program Core Lab 1	Database Systems Lab	0	0	3	1.5
7.	20AI&DS3352	Program Core Lab 2	Java Programming Lab	0	0	3	1.5
8.	20AI&DS3353	Program Core Lab 3	Data Structures Lab	0	0	3	1.5
9.	20TP3106	<b>Soft Skills – 1</b>	Logic and Reasoning	0	0	2	1
10.	20MC3107A	Mandatory Course (AICTE suggested)	Environmental Studies	2	0	0	-
<b>Total</b>				<b>17</b>	<b>0</b>	<b>11</b>	<b>20.5</b>

**SEMESTER IV****CONTACT HOURS: 30**

<i>S.No</i>	<i>Course Code</i>	<i>Course Category</i>	<i>Course Name</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Credits</i>
1.	20BS4101G	Basic Science	Numerical Methods for Data Analysis	3	0	0	3
2.	20AI&DS4302	Program Core	Design and Analysis of Algorithms	2	1	0	3
3.	20AI&DS4303	Program Core	Advanced Java Programming	2	1	0	3
4.	20AI&DS4304	Program Core	Computer Networks	2	0	0	2
5.	20HS4105	Humanities and Social Sciences	Universal Human Values	3	0	0	3
6.	20AI&DS4309	Program Core	Operating Systems	2	0	0	2
7.	20AI&DS4351	Program Core Lab 1	Design and Analysis of Algorithms Lab	0	0	2	1
8.	20AI&DS4352	Program Core Lab 2	Advanced Java Programming Lab	0	0	3	1.5
9.	20AI&DS4353	Program Core Lab 3	Computer Networks Lab	0	0	2	1
10.	20TP4106	<b>Soft Skills – 2</b>	English for Professionals	0	0	2	1
11.	20AI&DS4607	<b>Skill Oriented Course -1</b>	Industry Standard coding practice-1	1	0	2	2
12.	20MC4108B	Mandatory Course (AICTE suggested)	Indian Constitution	2	0	0	-
<b>Total</b>				<b>19</b>	<b>0</b>	<b>11</b>	<b>22.5</b>
<b>Summer Internship 6 weeks (Mandatory) during summer vacation (EPICS)</b>							
<b>Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)</b>				<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**ARTIFICIAL INTELLIGENCE & DATA SCIENCE**  
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**SEMESTER V** **CONTACT HOURS: 33**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20AI&DS5301	Program Core	Artificial Intelligence	3	0	0	3
2	20AI&DS5302	Program Core	Machine Learning	3	0	0	3
3	20HS5103	Humanities and Social Sciences	Engineering Economics and Management	2	0	0	2
4	20AI&DS5404	Program Elective 1	Program Elective 1	3	0	0	3
5	20AI&DS5205	Open Elective 1	Open Elective 1	2	0	2	3
6	20AI&DS5351	Program Core Lab 1	Artificial Intelligence Lab	0	0	3	1.5
7	20AI&DS5352	Program Core Lab 2	Machine Learning Lab	0	0	3	1.5
8	20HS5153	Humanities and Social Sciences	English Communication Skills Laboratory	0	0	2	1
9	20TP5106	<b>Soft Skills – 3</b>	Personality Development	0	0	2	1
10	20AI&DS5354	Internship / Project (6 weeks)	EPICS	0	0	3	1.5
11	20AI&DS5607	<b>Skill Oriented course -2</b>	Industry Standard Coding Practice - II	1	0	2	2
12	20MC5108A	Humanities Elective (AICTE suggested)	Biology for Engineers	2	0	0	-
<b>Total</b>				<b>16</b>	<b>0</b>	<b>17</b>	<b>22.5</b>
<b>Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)</b>				<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**SEMESTER VI****CONTACT HOURS: 29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20AI&DS6301	Program Core	Big Data Analytics	3	0	0	3
2	20AI&DS6302	Program Core	Deep Learning	3	0	0	3
3	20AI&DS6303	Program Core	Software Engineering	1	1	0	2
4	20AI&DS6404	Program Elective 2	Program Elective 2	3	0	0	3
5	20AI&DS6205	Open Elective 2	Open Elective 2	2	0	2	3
6	20AI&DS6351	Program Core Lab 1	Big Data Analytics Lab	0	0	3	1.5
7	20AI&DS6352	Program Core Lab 2	Deep Learning Lab	0	0	3	1.5
8	20AI&DS6353	Program Core lab 3	Software Engineering Lab	0	0	3	1.5
9	20TP6106	<b>Soft Skills –4</b>	Quantitative Aptitude	0	0	2	1
10	20AI&DS6554	Internship / Project	Mini Project – I	0	0	2	1
11	20MC6107B	Mandatory Course (AICTE suggested)	Innovation, IPR & Entrepreneurship	2	0	0	0
<b>Total</b>				<b>15</b>	<b>0</b>	<b>15</b>	<b>20.5</b>
<b>Industrial/Research Internship six weeks (Mandatory) during summer vacation</b>							
<b>Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)</b>				<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>



**ARTIFICIAL INTELLIGENCE & DATA SCIENCE**  
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**SEMESTER VII****CONTACT HOURS: 29**

<i>S. No</i>	<i>Course Code</i>	<i>Course Category</i>	<i>Course Name</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Credits</i>
1	20AI&DS7301	Program Core	Automata & Compiler Design	3	0	0	3
2	20AI&DS7402	Program Elective 3	Program Elective 3	3	0	0	3
3	20AI&DS7403	Program Elective 4	Program Elective 4	3	0	0	3
4	20AI&DS7404	Program Elective 5	Program Elective 5	3	0	0	3
5	20AI&DS7205	Open Elective 3	Open Elective 3	0	0	0	3
6	20AI&DS7206	Open Elective 4	Open Elective 4	0	0	0	3
7	20AI&DS7607	<b>Advanced Skill Course</b>	Corporate Readiness Skills	1	0	2	2
8	20AI&DS7551	Internship / Project	Mini Project - II	0	0	3	1.5
9	20AI&DS7552	Internship / Project	Industrial / Research Internship	0	0	3	1.5
<b>Total</b>				<b>17</b>	<b>0</b>	<b>12</b>	<b>23</b>
<b>Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)</b>				<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

Note: Open Elective Courses 3 and 4 are self-learning. Students may opt from any MOOCs platform. They have to submit the certificate before the last instruction day of VII semester. Course selection for MOOCs is subject to approval by the Head of the Department.

**SEMESTER VIII****CONTACT HOURS: 24**

<i>S.No</i>	<i>Course Code</i>	<i>Course Category</i>	<i>Course Name</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Credits</i>
1	20AD8551	Internship / Project**	Major Project and Internship (6 Months)	0	0	24	12
<b>Total</b>				<b>0</b>	<b>0</b>	<b>24</b>	<b>12</b>

\*\* The student should undergo internship and simultaneously he/she should work on a project with well-defined objectives.

At the end of the semester the student should submit an internship completion certificate and a project report.

\*\* If any of our associated company comes forward to offer an emerging course that will be offered as an industry offered course in V, VI or VII semesters under program elective with the approval of BoS. This is incorporated to enhance student skills and Employability in cutting edge technologies.

**LIST OF PROGRAM ELECTIVES****Streams:**

1. Health Care Analytics
2. Business Analytics
3. Computer Networks & Cyber Security (CNCS)
4. Embedded AI
5. Computational Data Science
6. Data Processing
7. Full Stack Web Development (FS)
8. Industry Offered Course (IoC)

**SEMESTER V (Program Elective I)**

S.No	Course Code	Stream	Subject	L	T	P	Credits
1.	20AI&DS5404A	Health Care Analytics	AI in Health Care	3	0	0	3
2.	20AI&DS5404B	Business Analytics	Business Intelligence and Data Visualization	3	0	0	3
3.	20AI&DS5404C	CNCS	Cryptography and Network Security	3	0	0	3
4.	20AI&DS5404D	Embedded AI	MicroProcessor and Microcontrollers	3	0	0	3
5.	20AI&DS5404E	Computational Data Science	Distributed computing for data science	3	0	0	3
6.	20AI&DS5404F	Data Processing	Information Retrieval	3	0	0	3
7.	20AI&DS5404H	IoC	Industry Offered Course	3	0	0	3

**SEMESTER VI (Program Elective II)**

S.No	Course Code	Stream	Subject	L	T	P	Credits
1.	20AI&DS6404A	Health Care Analytics	Bioinformatics	3	0	0	3
2.	20AI&DS6404B	Business Analytics	Data and Internet Security Analytics	3	0	0	3
3.	20AI&DS6404C	CNCS	Cyber Security	3	0	0	3
4.	20AI&DS6404D	Embedded AI	Artificial Intelligence for Internet of Things (AIoT)	3	0	0	3
5.	20AI&DS6404E	Computational Data Science	High Performance Computing	3	0	0	3
6.	20AI&DS6404F	Data Processing	Natural Language Processing	3	0	0	3
7.	20AI&DS6404H	IoC	Industry Offered Course	3	0	0	3

**SEMESTER VII (Program Elective III)**

S.No	Course Code	Stream	Subject	L	T	P	Credits
1.	20AI&DS7402A	Health Care Analytics	Medical Image Analysis	3	0	0	3
2.	20AI&DS7402B	Business Analytics	Video Analytics	3	0	0	3
3.	20AI&DS7402C	CNCS	Block Chain Technology	3	0	0	3
4.	20AI&DS7402D	Embedded AI	Predictive Analysis and IoT	3	0	0	3
5.	20AI&DS7402E	Computational Data Science	UI&UX design	3	0	0	3
6.	20AI&DS7402F	Data Processing	Mining of Massive Datasets	3	0	0	3
7.	20AI&DS7402H	IoC	Industry Offered Course	3	0	0	3

**SEMESTER VII (Program Elective IV)**

S.No	Course Code	Stream	Subject	L	T	P	Credits
1.	20AI&DS7403A	Health Care Analytics	Industrial and Medical IoT	3	0	0	3
2.	20AI&DS7403B	Business Analytics	Remote Sensing Data Analytics	3	0	0	3
3.	20AI&DS7403C	CNCS	Cyber Security and Laws	3	0	0	3
4.	20AI&DS7403D	Embedded AI	Real time Data Analytics for Drones	3	0	0	3
5.	20AI&DS7403E	Computational Data Science	GPU Architecture and Programming	3	0	0	3
6.	20AI&DS7403F	Data Processing	Time Series Analysis and Text Mining	3	0	0	3
7.	20AI&DS7403H	Others	Agile Project Management	3	0	0	3
8.	20AI&DS7403I	IoC	Industry Offered Course	3	0	0	3

**SEMESTER VII (Program Elective V)**

S.No	Course Code	Stream	Subject	L	T	P	Credits
1.	20AI&DS7404A	Health Care Analytics	Computer Vision	3	0	0	3
2.	20AI&DS7404B	Business Analytics	Sentiment Analysis and Opinion Mining	3	0	0	3
3.	20AI&DS7404C	CNCS	Digital Forensics	3	0	0	3
4.	20AI&DS7404D	CNCS	Web and Database Security				
5.	20AI&DS7404E	Embedded AI	Cyber Physical Systems	3	0	0	3
6.	20AI&DS7404F	Computational Data Science	Mobile Commerce	3	0	0	3
7.	20AI&DS7404G	Data Processing	Reinforcement Learning	3	0	0	3
8.	20AI&DS7404H	IoC	Industry Offered Course	3	0	0	3

**LIST OF OPEN ELECTIVES****SEMESTER V (OE I)**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	20AI&DS5205A	Open Elective I	Introduction to toolkits for ML	2	0	2	3
2.	20AI&DS5205B	Open Elective I	Virtual Reality Technologies & AR Development	2	0	2	3
3.	20AI&DS5205C	Open Elective I	Designing human interfaces *For the students of Non CSE/IT branches only	2	0	2	3
4.	20AI&DS5205D	Open Elective I	Programming for Data Science	2	0	2	3

**SEMESTER VI (OE II)**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	20AI&DS6205A	Open Elective II	AI in Web Development	2	0	2	3
2.	20AI&DS6205B	Open Elective II	AI in Agriculture	2	0	2	3
3.	20AI&DS6205C	Open Elective II	Cloud Computing	2	0	2	3
4.	20AI&DS6205D	Open Elective II	Fundamentals of Robotics	2	0	2	3

**SEMESTER VII (OE III)**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	20AI&DS7205A	Open Elective III		0	0	0	3
2.	20AI&DS7205B	Open Elective III		0	0	0	3
3.	20AI&DS7205C	Open Elective III		0	0	0	3
4.	20AI&DS7205D	Open Elective III		0	0	0	3
5.	20AI&DS7205E	Open Elective III	Any other course offered by MOOCS	0	0	0	3

**SEMESTER VII (OE IV)**

S.No	Course Code	Course	Subject	L	T	P	Credits
1.	20AI&DS7206A	Open Elective IV		0	0	0	3
2.	20AI&DS7206B	Open Elective IV		0	0	0	3
3.	20AI&DS7206C	Open Elective IV		0	0	0	3
4.	20AI&DS7206D	Open Elective IV		0	0	0	3
5.	20AI&DS7206A	Open Elective IV	Any other course offered by MOOCS	0	0	0	3

# **SEMESTER – I**

**20BS1101A**  
**MATHEMATICS FOR DATA SCIENCE**

<b>Course</b>	Basic Science	<b>Credits:</b>	3
<b>Category:</b>			
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	Differentiation, Integration, Curve Tracing	<b>Continuous Evaluation: Semester end Evaluation: Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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Upon successful completion of the course, the student can be able to:

<b>CO1</b>	Solve linear system of equations and determine eigen values and eigen vectors	K3	1.2.1
<b>CO2</b>	Solve differential equations of different orders	K3	2.6.3, 2.8.1
<b>CO3</b>	Apply mean values theorems and Lagrange's method of undetermined multipliers where ever necessary	K3	5.4.1, 5.4.2
<b>CO4</b>	Minimize and maximize the linear programming problems	K4	5.4.1,5.4.2

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low,2-Medium,3- High)

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

## **COURSE CONTENT**

### **UNIT I**

Matrices:

Rank of a Matrix-Consistency of Linear System of Equations- Linear-Transformations-Vectors, Eigen values and Eigen vectors- Properties of Eigen values- Finding Inverse and Powers of a Matrix by Cayley-Hamilton Theorem-Reduction to Diagonal form-Reduction of Quadratic form to Canonical form-Nature of a Quadratic form- Complex matrices.

### **UNIT II**

Differential Equations

Differential Equations of First Order and first degree-Exact Differential Equations- Equations Reducible to Exact Equations. Linear Differential Equations of Higher Order: Definitions- Operator D- Rules for finding the Complementary Function- Inverse Operator- Rules for finding Particular Integral- Working Procedure.

### **UNIT III**

Differential Calculus:

Fundamental Theorems-Rolle's Theorem- Lagrange's Mean Value Theorem- Cauchy's Mean Value Theorem and Taylor's Theorem- Expansions of functions- Maclaurin's Series and Taylor's Series. Curvature- Radius of Curvature-Maxima and minima of functions of Two variables-Lagrange's method of undetermined multipliers.

### **UNIT IV**

Linear Programming:

Introduction-Formulation of the problem-Graphical method-Some exceptional cases-General linear programming problem-Canonical and standard forms of LPP-Simplex method-Working Procedure of the simplex method-Artificial variable techniques-M-method-Two phase method-Exceptional cases-Degeneracy-Duality concept-Duality principle-Dual simplex method.

### **TEXT BOOK**

Higher Engineering Mathematics, by B S Grewal ,Khanna Publishers, 44<sup>th</sup> Edition 2019.

**REFERENCE BOOKS**

- [1].Erwin Kreyszig ,Advanced Engineering Mathematics,John Wiley & Sons, 10<sup>th</sup> Edition,2015.
- [2].B.V.Ramana, Higher Engineering Mathematics,Tata MC Graw Hill, 1<sup>st</sup> Edition,2007.[3].N.P.Bali, Dr.ManishGoyal,A Text Book of Engineering Mathematics, Laxmi Publications, 9<sup>th</sup>Edition,2014.
- [4].S.D.Sarma, Operations Research, KedarNath Ram Nath, Meerut.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1]. [www.nptel.videos.com/mathematics/](http://www.nptel.videos.com/mathematics/) (Math Lectures from MIT,Stanford,IIT'S)
- [2]. [nptel.ac.in/courses/122104017](http://nptel.ac.in/courses/122104017)
- [3]. [nptel.ac.in/courses/111105035](http://nptel.ac.in/courses/111105035)
- [4]. Engineering Mathematics Open Learning Project.  
[www.3.ul.ie/~mlc/support/Loughborough%20website/](http://www.3.ul.ie/~mlc/support/Loughborough%20website/)

**20BS1102A**  
**APPLIED PHYSICS**

<b>Course Category:</b>	Basic Science	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	10 + 2 level Physics	<b>Continuous Evaluation: Semester end Evaluation: Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the importance of quantum mechanics.	K2	
<b>CO2</b>	Analyse and understand various types of lasers and their applications.	K4	
<b>CO3</b>	Elaborate different types of optical fibers and understand the concept of Superconductivity	K2	
<b>CO4</b>	Understand the fabrication of nanomaterials and carbon Nanotubes.	K2	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3											1		
<b>CO2</b>	3		2									1		
<b>CO3</b>	3		1									1		
<b>CO4</b>	3				2							1		

### **COURSE CONTENT**

#### **Unit-I : Quantum Mechanics**

**Quantum Mechanics:** Dual nature of light, Matter waves and Debroglie's hypothesis, Davisson-Germer's experiment, G. P. Thomson experiment, Heisenberg's uncertainty principle and its applications (Non existence of electron in nucleus, Finite width of spectral lines), One dimensional time independent and time dependent Schrödinger's wave equations, physical significance of wave function, Particle in a box (One dimension).



**Unit-II :Lasers**

**Lasers:** Introduction, Characteristics of laser, Basic Principles of lasers (absorption, spontaneous emission, stimulated emission), Requirements of lasers (pumping, population inversion, cavity resonance), Einstein's coefficients, different types of lasers: solid-state lasers (Ruby, Neodymium), gas lasers (He-Ne, CO<sub>2</sub>), Semiconductor laser, applications of lasers in science, engineering and medicine.

**Unit- III : Fibre Optics and Superconductivity**

**Fibre Optics:** Introduction, Fundamentals of optic fibre, Propagation of light through optical fiber, Types of optical fibers, Numerical aperture, Fractional Refractive Index change, Fiber optics in communication and its advantages.

**Superconductivity:** Introduction, Critical parameters, Flux quantization, Meissner effect, Types of Superconductors, BCS theory, Cooper pairs, London's equation- penetration depth, high temperature super conductors, Applications of superconductors.

**TEXT BOOKS**

- [1]. M.N. Avadhanulu & P.G. Kshirsagar, Engineering Physics, S. Chand publications, Revised Edition, 2014
- [2]. P.K. Palanisamy, "Applied Physics", Scitech Publications(INDIA) Pvt. Ltd., Fifth Print, 2008.

**REFERENCE BOOKS**

- [1].B. K. Pandey and S. Chaturvedi, 'Engineering Physics' Cengage Learning', Delhi, 2012.
- [2].O. Svelto, Principles of Lasers, 5<sup>th</sup> Edition, Springer, London, 2010
- [3].M.R. Srinivasan, "Engineering Physics", New age international publishers, First Edition, 2011.
- [4].Gaur and Gupta, Engineering Physics, Dhanpatrai publishers, 8<sup>th</sup> edition 2008.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

1. <https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/lecture-videos/>
2. <https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/laser-fundamentals-i/>
3. <http://nptel.ac.in/courses/112106198/19>
4. <https://www.peterindia.net/NanoTechnologyResources.html>

**20ES1103****Programming for Problem Solving**

<b>Course</b>	Engineering Science	<b>Credits:</b>	3
<b>Category:</b>			
<b>Course Type:</b>	Theory	<b>Lecture-Tutorial-Practice:</b>	3-0-0
<b>Prerequisites:</b>	--	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand the different types of problem solving approaches	K2	
<b>CO2</b>	Apply the selections, loops, arrays, and string concepts in C to solve problems.	K3	
<b>CO3</b>	Apply functions and pointer concepts in C to solve problems.	K3	
<b>CO4</b>	Apply enum, structures, unions, and file handling functions to Solve problems	K3	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	1												
<b>CO2</b>		2	3										2	
<b>CO3</b>		2	3										3	
<b>CO4</b>		2	3										3	

**COURSE CONTENT****UNIT I**

**Introduction to computer-based problem solving:** Requirement of problem solving by computers, problem definition, Use of examples for problem solving, similarities between problems, Problem solving strategies, steps involved in problem solving.

**Program design and implementation issues:** programs and algorithms, top-down design and step-wise refinement, construction of loops-basic programming constructs, Implementation, programming environment.

**Algorithms for problem solving:** Exchanging values of two variables, Summation of a set of numbers, decimal to binary base conversion, reversing the digit of an integer, to find greatest common divisor (GCD) of two numbers, to verify whether an integer is prime or not, organize a given set of numbers in ascending order, find the square root of an integer, factorial of a given number, generate the Fibonacci sequence for n terms, evaluate  $\sin(x)$  as sum of series, to find the value of the power of a number raised by another integer, reverse order elements of an array, find largest number in an array, print elements of upper triangular matrix, multiplication of two matrices, to compute roots of a quadratic equation  $ax^2+bx+c=0$ .

### TEXT BOOKS

[1] Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly, 2017.[Unit1,II,III,IV]

[2] Buduma, Nikhil, and Nicholas Locascio. Fundamentals of deep learning: Designing next generation machine intelligence algorithms. " O'Reilly Media, Inc.", 2017 [Unit I]

### REFERENCE BOOKS

[1] Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press, 2017

[2] Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer, 2018.

[3] Gulli, Antonio, and Sujit Pal. Deep learning with Keras. Packt Publishing Ltd, 2017.

### E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Prof. Sudarshan Iyengar, Prof. Sanatan Sukhija, Introduction to Deep learning, <https://nptel.ac.in/courses/106/106/106106184/>

Last accessed on 19<sup>th</sup> November 2023.

[2] Ian Goodfellow , Adversarial Deep Learning, <https://www.youtube.com/watch?v=OcbPg1VtsSM> , Last accessed on 19<sup>th</sup> November 2023

**20ES1103****Programming for Problem Solving**

<b>Course</b>	Engineering Science	<b>Credits:</b>	3
<b>Category:</b>			
<b>Course Type:</b>	Theory	<b>Lecture-Tutorial-Practice:</b>	3-0-0
<b>Prerequisites:</b>	--	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES**

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

<b>CO1</b>	Understand the different types of problem solving approaches
<b>CO2</b>	Apply the selections, loops, arrays, and string concepts in C to solve problems.
<b>CO3</b>	Apply functions and pointer concepts in C to solve problems.
<b>CO4</b>	Apply enum, structures, unions, and file handling functions to Solve problems

**Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)**

	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	PSC 2
<b>CO1</b>	3	1												
<b>CO2</b>		2	3										2	
<b>CO3</b>		2	3										3	
<b>CO4</b>		2	3										3	

**COURSE CONTENT****UNIT I**

**Introduction to computer-based problem solving:** Requirement of problem

solving by computers, problem definition, Use of examples for problem solving similarities between problems, Problem solving strategies, steps involved in problem solving.

**Program design and implementation issues:** programs and algorithms, top-down design and step-wise refinement, construction of loops-basic programming constructs, Implementation, programming environment.

**Algorithms for problem solving:** Exchanging values of two variables, Summation of a set of numbers, decimal to binary base conversion, reversing the digit of an integer, to find greatest common divisor (GCD) of two numbers, to verify whether an integer is prime or not, organize a given set of numbers in ascending order, find the square root of an integer, factorial of a given number, generate the Fibonacci sequence for n terms, evaluate  $\sin(x)$  as sum of series, to find the value of the power of a number raised by another integer, reverse order elements of an array find largest number in an array, print elements of upper triangular matrix multiplication of two matrices, to compute roots of a quadratic equation  $ax^2+bx+c=0$ .

## UNIT II

**Introduction to the C Language:** Background of C program, Identifiers, Types Variables, Constants, Memory Layout, Input/Output, Programming Examples.

**Structure of a C Program:** Logical Data and Operators, Expressions, Precedence and Associativity, Evaluating Expressions, Type Conversion, Statements, Storage Class.

**Selection:** Two-way Selection, Multiway Selection, More Standard Functions.

**Repetition:** Concept of a Loop Loops In C, Loop Examples, Recursion, The Calculator Program.

**Arrays:** Array Concepts in C, Inter-Function Communication, Array Applications Two Dimensional Arrays, Multidimensional Arrays.

## UNIT III

**Strings:**String Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions, String- Data Conversion.

**Functions:** Functions in C, User Defined Functions, Call by Value, Call Value Reference, Inter-FunctionCommunication, Standard Functions, Scope.

**Pointers:** Introduction to Pointer, Pointers for Inter-Function Communications Pointers to Pointers, Compatibility, Lvalue and Rvalue.

**Pointer Applications:** Arrays and Pointers, Pointer Arithmetic and Arrays  
Passing an Array to a Function, Memory Allocations Functions, Array of Pointers.

## UNIT IV

**Enumerations:** The Type Definition(Typedef), Enumerated Types: Declaring an Enumerated Type , Operations on Enumerated Types, Enumeration Type Conversion, Initializing Enumerated Constants, Anonymous Enumeration Constants, Input/Output Operators.

**Structures:** Structure Type Declaration, Initialization, Accessing Structures Operations on Structures, Complex Structures, Structures and Functions, Sending the Whole Structure, Passing Structures through Pointers.

**Unions:**Referencing Unions, Initializers, Unions and Structures, Internet Address Programming Applications.

**File Handling:**Files, Streams, Standard Library Input/Output Functions Formatting Input/output Functions and Character Input/Output Functions Command-Line Arguments.

## TEXT BOOKS

- [1]. Programming and Problem Solving Through "C" Language By HarshaPriya R. Ranjeet · Firewall media 2006
- [2]. Behrouz A. Forouzan and Richard F. Gilberg, “Computer Science A Structured Programming Approach Using C”, CENGAGE Learning, Third Edition

## REFERENCE BOOKS

- [1]. Anil B. Chaudhuri, “Flowchart and Algorithm Basics: The Art of Programming”, Mercury Learning & Information, 2020.
- [2]. R.G. Dromey, “How to Solve it By Computer”, Prentice-Hall International Series in Computer Science,1982.
- [3]. YashwantKanetkar , “Let us C” , BPB Publications, 16th Edition 2017.
- [4]. Kernighan and Ritchie,“The C programming language”, The (Ansi C Version), PHI, second edition.
- [5]. Paul J. Dietel and Harvey M. Deitel, “C: How to Program”, Prentice Hall, 8th edition (Jan 19 ,2021).
- [6]. K.R.Venugopal, Sundeep R. Prasad, “Mastering C”, McGraw Hill, 2nd Edition, 2015.

## E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] Computer Science and Engineering - Noc:problem Solving Through Programming in C. [online] <https://nptel.ac.in/courses/106/105/106105171/>
- [2] Computer Science and Engineering - Noc:introduction To Programming in C [online] <https://-nptel.ac.in/courses/106/104/106104128/>
- [3] C For Everyone: Structured Programming [online]<https://www.coursera.org/learn/c-structured-programming>
- [4] Advanced C Programming CourseTim Academy-Jason Fedin. [online] [https://www.udemy.com/-\\_course/advanced-c-programming-course/](https://www.udemy.com/-_course/advanced-c-programming-course/)

**20ES1104**  
**BASICS OF ELECTRICAL ENGINEERING**

<b>Course</b>	Engineering Sciences	<b>Credits:</b>	3
<b>Category:</b>			
<b>Course Type:</b>	Theory	<b>Lecture-Tutorial- Practice:</b>	3-0-0
<b>Prerequisites:</b>	--	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Analyze Electric Circuit fundamentals.	K4	
<b>CO2</b>	Understand the basic concepts of Alternating Quantities and Magnetic Circuits.	K2	
<b>CO3</b>	Analyze the basic concepts of Electric Machines	K4	
<b>CO4</b>	Understand Measuring Instruments & Solar Photo Voltaic System concepts	K2	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3	3			2								1	
<b>CO2</b>	3	3											1	
<b>CO3</b>	2	1			2								1	
<b>CO4</b>	2	1											1	

**COURSE CONTENT**

**UNIT - I**

**Introduction to Electrical Engineering:** Electric Current, Electromotive force, Electric power and energy, Basic circuit components- Resistors-Inductors-Capacitors. Electromagnetic Phenomenon and Related Laws, Kirchhoff's laws.

**Network Analysis:** Network sources-Ideal independent voltage source, Ideal independent current source, Dependent sources, Practical voltage and



current sources, Source conversion, Voltage and Current division rule, series and parallel connection of R, L and C, Star-Delta or, Delta- Star transformation. Mesh and Nodal Analysis (with independent sources only).

## UNIT – II

**Alternating Quantities:** Introduction, Generation of a.c. voltages, Waveforms and Basic Definitions, Relationship between frequency, speed and number of poles, Root Mean Square and Average values of alternating current and voltages, Form Factor and Peak Factor, Phasor representation of alternating quantities.

**Magnetic Circuits:** Introduction, Magnetic Circuits, Magnetic Field Strength (H), Magneto motive Force, Permeability, Reluctance, Analogy between Electric and Magnetic Circuits, Magnetic potential drop, Magnetic circuit computations, Self and Mutual Inductance, Energy in Linear Magnetic Systems

(Derivation for pure inductor).

## UNIT - III

**DC Machines:** Introduction, Construction of dc machines, Armature Windings, Generation of dc voltage and torque production in a dc machine, Operation of a dc machine as a generator, Operation of dc machine as a motor.

**Induction Motors:** Introduction, Constructional features of three-phase induction motors, Principle of operation of three-phase induction motor- Slip and rotor frequency, Voltage and current equations and equivalent circuit of an induction motor.

## UNIT - IV

**Measuring Instruments:** Introduction, Classification of instruments, Operating Principles, Essential features of measuring instruments, Ammeters and Voltmeters, Measurement of power.

**Solar photovoltaic Systems:** Solar cell fundamentals, characteristics, classification, module, panel and array construction, Maximizing the solar PV output and load matching, Maximum Power Point Tracker Basic Algorithm and Flowchart, PV system components, solar PV systems and solar PV applications.

## TEXT BOOKS

[1] T.K. Nagasarkar and M.S. Sukhja, “Basic Electric Engineering”, 2nd ed., Oxford University press 2011.

**REFERENCE BOOKS**

- [1] B.H.Khan, "Non Conventional Energy Resources", 2nd ed., Mc.Graw Hill Education Pvt Ltd., New Delhi, 2013.
- [2] Ashfaq Hussain, Haroon Ashfaq, "Fundamentals of Electric Engineering" 4th ed., Dhanpat Rai & Co, 2014.
- [3] I.J.Nagarath and Kothari, "Theory and Problems of Basic Electric Engineering", 2<sup>nd</sup> ed., PHI Pvt. Ltd., 2016.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1]. <http://nptel.ac.in/courses/108108076/>

**20HS1105****TECHNICAL ENGLISH AND COMMUNICATION SKILLS**

<b>Course</b>	Humanities and Social Science	<b>Credits:</b>	2
<b>Category:</b>			
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2 - 0 - 0
<b>Prerequisites:</b>	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Develop administrative and professional compilations with felicity of expression	K4	1.2.1, 1.7.1, 2.8.1
<b>CO2</b>	Demonstrate Proficiency in advanced reading and context oriented writing	K3	1.2.1, 1.7.1, 2.8.1, 3.6.2, 4.6.1, 5.4.1
<b>CO3</b>	Apply the elements of functional English with sustained understanding for authentic use of language in any given academic and/or professional environment	K3	1.2.1, 1.7.1, 2.5.2, 5.5.2
<b>CO4</b>	Execute tasks in Technical communication with competence	K4	1.2.1, 1.7.1, 2.5.2, 5.5.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>						2				3				
<b>CO2</b>						2			2	3				
<b>CO3</b>						2			2	3				
<b>CO4</b>										3				

**COURSE CONTENT**

**UNIT I****Professional Writing Skills:-**➤ **Professional Letters:**

Business, Complaint and Transmittal – Purpose, Style and format with special reference to

Block Format and Modified Block Format

➤ **Paragraph and Essay Writing:**

Linkers, Descriptive and Analytical with illustrations

➤ **Effective writing Practice-**

Appropriateness, Brevity, clarity, cogency and coherence with guided and semi-controlled

compilations including the use of Idiomatic expressions

**UNIT II****Reading comprehension and Discourse development Skills**

➤ **Analytical and critical reading** - critical, creative and lateral thinking- language and thinking – thinking process and language development.

➤ **Effective reading Strategies** - Skimming, Scanning, Eye span, fixation, taming Regression, and Issues and Challenges of Vocalization and sub-vocalization.

➤ **Context-oriented Dialogue/ Argument writing** - Extending Invitation, Reciprocation, Acceptance, Concurrence, Disagreeing without being disagreeable- Discourse/dialogue Development and identification of inconsistencies in pre-prepared dialogues

**UNIT III****Vocabulary and Functional English**

➤ **Vocabulary for Competitive examinations** ( A list of 500 High frequency words) Synonyms, Antonyms, Matching Homonyms, Homophones and nearer words along with Root words

➤ **Verbal analogies**(Single Unit) – Synonym Relation, Antonym relation, Object- Operator relation, Object-Obstacle/obstruction relation, Sequence Relation, Place-Monument Relation, Science- area of activity relation, Profession- Tool relation, Gender relation, Diminutive relation, etc

➤ **Functional Grammar** with special reference to Tense, Concord, Articles pronoun-referent, Prepositions, use of Gerund, Parallelism, etc ( A Representative collection of 100 sentences)

**UNIT IV****Technical Communication skills:**

➤ **Technical Proposal writing-** Characteristics, Proposal Superstructure, Checklist, Formal Proposal

➤ **Technical Vocabulary-** Basic explanations and Description

**Technical Report writing-** Informational Reports and Feasibility Report-Types, Components, Style and Formats**TEXT BOOKS**

- [1] Martin Cutts, Oxford guide to Plain English, 7<sup>th</sup> Impression, Oxford University Press, 2011
- [2] M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.
- [3] John Langan, College Writing Skills, McGraw Hill, IX Edition, 2014.
- [4] Eclectic Learning materials offered by the Department

**REFERENCE BOOKS**

- [1] Randolph Quirk, Use of English, Longman, I Edition (1968) Reprinted 2004.
- [2] Thomson A.J & A.V, Martinet, Practical English Grammar, III Edition, Oxford University Press, 2001
- [3] V.Sethi and P.V. Dhamija, A Course in Phonetics and Spoken English, II Edition, PHI, 2006
- [4]

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] <https://www.britishcouncil.org/english>
- [2] [www.natcorp.ox.ac.uk/Wkshops/Materials/specialising.xml?ID=online](http://www.natcorp.ox.ac.uk/Wkshops/Materials/specialising.xml?ID=online)
- [3] [https://www.uni-marburg.de/sprachenzentrum/selbstlernzentrum/.../apps\\_for\\_esl.pdf](https://www.uni-marburg.de/sprachenzentrum/selbstlernzentrum/.../apps_for_esl.pdf)

**20MC1106**  
**TECHNOLOGY AND SOCIETY**

<b>Course Category:</b>	Mandatory Course	<b>Credits:</b>	--
<b>Course Type:</b>	Mandatory Learning	<b>Lecture -Tutorial-Practice:</b>	1 - 0 - 0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	100
		<b>Semester end Evaluation:</b>	--
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the origins of technology and its role in the history of human progress.	K2	
<b>CO2</b>	Know the Industrial Revolution and its impact on Society	K2	
<b>CO3</b>	Interpret the developments in various fields of technology till Twentieth Century.	K3	
<b>CO4</b>	Distinguish the impacts of Technology on the Environment and achievements of great scientists.	K2	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3							1						
<b>CO2</b>	3				2		1							
<b>CO3</b>	3							1						
<b>CO4</b>	3				2		1							

**COURSE CONTENT**

<b>UNIT</b> <b>(4 lectures)</b>	–	<b>I</b>
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**Introduction:** Origins of technology, The Agriculture revolution, Technological contributions of ancient civilizations- Mesopotamians, Egyptians, Greeks, Romans, Indians and Chinese.

**UNIT** – **II**  
(4 lectures)

**Industrial revolution:** The social and political background, The technical background, Steam: The power behind the Industrial Revolution, The revolution in Textile Industry, The Impact of Industrial Revolution on Society.

**UNIT** – **III**  
(4 lectures)

**The Flowering of modern technology:** Manufacturing Technologies, Prime Movers, Internal Combustion Engines, Production of Metals and Alloys, The Birth of Electrical Technology, Twentieth Century: The Flowering of modern technology like information technology and biotechnology, and its implications on society.

**UNIT** – **IV**  
(4 lectures)

**Technology, Science and Society:** Impact of technology on society, The Impacts of Technology on the environment, Sustainable development.

**Achievements of famous scientists:**

(**World**): Einestein, Newton, Faraday, Graham Bell, Edison, S.Hawking.

(**India**): CV Raman, S.Chandrasekhar, Aryabhatta, Homi J Bhabha, Vikram Sarabhai, APJ Abdulkalam, S.Ramanujan, M.Visweswarayya.

### **TEXT BOOKS**

Dr. R.V.G Menon, “Technology and Society”, Pearson Education, 2011

### **REFERENCE BOOKS**

Quan-Haase, A., “ Technology and Society: Inequality, Power, and Social Networks”, Oxford University Press, 2013

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

**20BS1151A****ENGINEERING PHYSICS LABORATORY**

<b>Course Category:</b>	Basic Science	<b>Credits:</b>	1.5
<b>Course Type:</b>	Lab	<b>Lecture -Tutorial- Practice:</b>	0 - 0 - 3
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Use function generator, spectrometer and travelling microscope in various experiments	K3	
<b>CO2</b>	Test optical components using principles of interference and diffraction of light	K4	
<b>CO3</b>	Determinethe V-I characteristicsof solar cell and photo celland appreciate the accuracy in measurements	K3	

**Contribution of Course Outcomes towards achievement of Program**

**Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>				3										
<b>CO2</b>				3										
<b>CO3</b>	2			3									2	
<b>CO4</b>														

**COURSE CONTENT**

1. Photo cell-Study of V-I Characteristics, determination of work function
2. Newton's Rings-Radius of curvature of plano convex lens.
3. Compound pendulum-Measurement of 'g'
4. LCR circuit- Study of Resonance
5. AC Sonometer –Verification of vibrating laws



6. Solar cell–Determination of Fill Factor
7. Diffraction grating-Wavelength of laser light
8. Optical fiber-Study of attenuation and propagation characteristics
9. Diffraction grating-Measurement of wavelength of mercury source
10. Hall effect –Hall coefficient measurement
11. Figure of merit of a galvanometer
12. Variation of magnetic field along the axis of current-carrying circular coil

**TEXT BOOKS**

- [1] Madhusudhan Rao, “Engineering Physics Lab Manual”, Isted., Scitech Publications, 2015
- [2] Ramarao Sri, ChoudaryNityanand and Prasad Daruka, ”Lab Manual of Engineering Physics”., Vth ed., Excell Books, 2010

**E-RESOURCES**

- [1] <http://plato.stanford.edu/entries/physics-experiment>
- [2] <http://www.physicsclassroom.com/The-Laboratory>
- [3] <http://facstaff.cbu.edu/~jvarrian/physlabs.html>

**VIRTUAL LAB REFERENCES**

- [1] <http://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1>
- [2] <http://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1>
- [3] <http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1>

## 20ES1152

### PROGRAMMING FOR PROBLEM SOLVING LABORATORY

<b>Course Category:</b>	Engineering Science	<b>Credits:</b>	1.5
<b>Course Type:</b>	Lab	<b>Lecture -Tutorial- Practice:</b>	0 - 0 - 3
<b>Prerequisites:</b>	---	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Implement the use of programming constructs in a structural programming language.	K4	
<b>CO2</b>	Apply the selections, loops, arrays, and string concepts in C to solve problems.	K3	
<b>CO3</b>	Apply functions, pointer, and Enum concepts in C to solve problems.	K3	
<b>CO4</b>	Solve problems using structures, Unions, and file handling functions.	K3	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1		3											1
<b>CO2</b>		1	3										1	
<b>CO3</b>		1	3										3	
<b>CO4</b>		1	3										3	

### COURSE CONTENT

#### WEEK – 1 : Introduction to C Programming

- a) The Structure of C Program with a sample program.
- b) Use identifiers, data types, format specifiers, constants, and variables declaration and initialization to write simple C programs.
- c) Write simple C programs using preprocessor commands and simple I/O

statements.

## **WEEK – 2 : Data Types and Variable Declarations**

- a) Use void, integral and floating point data types in different scenarios to write programs.
- b) Use various primitive data types for performing different mathematical operations.
- c) Programs to perform mathematical operations using various operators in C

## **WEEK – 3 : Selection – Making Decisions**

- a) Write programs using the if...else selection statements.
- b) Use nested if...else statement to solve problems that need multi-level selection making decisions.
- c) Write programs that use switch...case and else...if multi way statements to select one out of several options.

## **WEEK – 4 : Looping Constructs and Their Applications**

- a) To have a clear idea on loop initialization, validation and updation.
- b) Write programs using the while, for, or do...while loops.
- c) To understand the logic and adopt best looping construct for different kinds of problems.
- d) Design and develop programs based on Iterative loops using While, Do While, For, Nested For.

## **WEEK – 5 : Unconditional Control Transfer Statements**

- a) Write programs using of (break, and continue) unconditional control transfer statements.
- b) Use the goto statement to transfer the control from one part to another part of a program and the use of return statement to end the execution of a called function.

## **WEEK – 6 : Arrays and Their Applications**

- a) To utilize one dimensional and multi-dimensional arrays to solve problems that use set(s) of similar type input data.
- b) To write programs that perform multiple classical operations like searching, sorting, updation, or deletion on array elements.

## **WEEK – 7 : Strings, String I/O and Manipulation Functions**

- a) To write programs that work on read, write and manipulate fixed length and variable-length strings and/or arrays of strings
- b) To write programs that use predefined string I/O functions.
- c) To write programs that use string manipulation functions from the string library.

### **WEEK – 8 : Concepts of User Defined Functions**

- a) Design and develop programs depending on functions both user defined and standard library functions in C with different approaches.
- b) To write a program using more than one function with or without parameters and function return type.

### **WEEK – 9 : Pointers and Their Applications**

- a) Programs on declaration of pointers and their usage in C.
- b) Programs to relate between arrays and pointers and use them efficiently in a program.
- c) To pass pointers as an argument to a function, and use it efficiently in a program.
- d) To write programs using static and dynamic memory allocation.

### **WEEK – 10 : Structure, Union, and Enumeration**

- a) Programs to define, declare and access structure and union variables
- b) Design and develop programs to work with pointers to access data within a structure
- c) Programs to pass structure as an argument to a function
- d) To write C programs using enumeration data types, an easiest way of mapping symbolic names to integer values.

### **WEEK – 11 : File Handling Operations**

- a) Programs to open and close text and binary files using file I/O commands.
- b) Write programs to perform read and write operations using the formatting I/O and character I/O functions.
- c) Apply file positioning, status and system commands based on a problem requirements.

### **WEEK – 12 : Command Line Arguments**

- a) To use command line arguments to pass inputs in a single line while executing a program through the DOS command prompt or Linux terminal.

- b) To use atoi function to convert a default string value argument to an integer value inside the main function in a program.
- c) To use atof function to convert a default string value argument to a float value inside the main function in a program.

### Text Book(s)

- [1] Behrouz A. Forouzan and Richard F. Gilberg, “Computer Science A Structured Programming Approach Using C”, CENGAGE Learning, Third Edition.

### REFERENCE BOOKS

- [1] Anil B. Chaudhuri, “Flowchart and Algorithm Basics: The Art of Programming”, Mercury Learning & Information, 2020.
- [2] R.G. Dromey, “How to Solve it By Computer”, Prentice-Hall International Series in Computer Science, 1982.
- [3] Yashwant Kanetkar, “Let us C”, BPB Publications, 16<sup>th</sup> Edition 2017.
- [4] Kernighan and Ritchie, “The C programming language”, The (Ansi C Version), PHI, second edition.
- [5] Paul J. Dietel and Harvey M. Deitel, “C: How to Program”, Prentice Hall, 8<sup>th</sup> edition (Jan 19, 2021).
- [6] K.R. Venugopal, Sundeep R. Prasad, “Mastering C”, McGraw Hill, 2<sup>nd</sup> Edition, 2015.

### E-RESOURCES AND OTHER DIGITAL MATERIAL

- 1] Computer Science and Engineering - Noc:problem Solving Through Programming in C. [online] <https://nptel.ac.in/courses/106/105/106105171/>
- [2] Computer Science and Engineering - Noc:introduction To Programming in C. [online] <https://-nptel.ac.in/courses/106/104/106104128/>
- [3] C For Everyone: Structured Programming. [online] <https://www.coursera.org/learn/c-structured-programming>
- [4] Advanced C Programming Course Tim Academy-Jason Fedin. [online] <https://www.udemy.com/-course/advanced-c-programming-course/>

**20HS1153**  
**TECHNICAL ENGLISH AND COMMUNICATION SKILLS**  
**LABORATORY**

<b>Course Category:</b>	Humanities and Social Science	<b>Credits:</b>	1.5
<b>Course Type:</b>	Practical	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 3
<b>Prerequisites:</b>	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Develop active and authentic listening comprehension skills relevant for the professional world.	K4	
<b>CO2</b>	Execute web related(On-line) communication with felicity of expression	K4	
<b>CO3</b>	Apply relevant speech patterns including standard pronunciation	K3	
<b>CO4</b>	Demonstrate Proficiency in Interpersonal Communication with fluency and accuracy	K3	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>						3				3				
<b>CO2</b>									2	3				
<b>CO3</b>										3				
<b>CO4</b>									2	3				

**COURSE CONTENT**

**UNIT I****Listening Skills:**

- **Exposure to structured and open talks-** Active listening, Appreciative listening, Biased listening, Critical listening Empathetic listening, Judgmental listening
- **Content-oriented Listening Skills :**  
Short Conversations- 5-10 minute duration- components, statistics, nominal and other references
- **Concept oriented/ purposive Listening skills:**  
Long Conversations- 10-30minute duration -
- **Problems in comprehension & retention** – Note-taking practice – Listening tests-
- **Overcoming Barriers to listening:** Physical & psychological – Steps to overcome them with demonstration and practice

**Unit-II****Professional and On-line drafting skills:**

- **Professional drafting skills :** Circular, Notice, Executive summary
- **E-mail etiquette-** Awareness with Illustrations and practice
- **Elements of Chat-room interaction-** courtesy, techniques of argumentation
- **Written Response to web-content-** conciseness with accountability
- **Data interpretation-** compiling analytical, comparative and critical observations  
by interpreting graphs, charts, etc.

**UNIT III****Phonetics and Speech patterns:**

- **Speech Mechanism** – Organs of speech and patterns of articulation of speech sounds.
- **Vowels, Consonants and Diphthongs-** Transcription using International Phonetic Alphabet
- **Word Stress and Rhythm-** practice
- **Intonation pattern practice-** Tones , Tone group boundaries and Tonal variations
- **Strong forms and weak forms in Connected speech** - Illustrations and Practice

**UNIT IV****Internersonal Snoken communication skills:**

- **Fluency & accuracy in speech** –Improving self-expression
- **Listener oriented speaking** - Interpersonal Conversation- Manner and Temper
- **Developing persuasive speaking skills-** Role play
- **Overcoming Barriers to speaking** – Building self-confidence– through Conversation practice
- **Improving responding capacity** - Extempore speech practice

## TEXT BOOKS

1. Garner, Bryan A, HBR Guide to Better Business Writing, Harvard Business Review Press, Boston, Massachusetts, 2013.
2. Exercises in Spoken English, Prepared by Department of Phonetics and Spoken English, CIEFL,(Currently English and Foreign Languages University) OUP, 21<sup>st</sup> Impression, 2003

## REFERENCE BOOKS

- [1] Randolph Quirk, Use of English, Longman, I Edition (1968) Reprinted 2004.
- [2] Thomson A.J & A.V, Martinet, Practical English Grammar, III Edition, Oxford University Press,2001
- [3] V.Sethi and P.V. Dhamija, A Course in Phonetics and Spoken English, II Edition, PHI, 2006

## E-RESOURCES AND OTHER DIGITAL MATERIAL

1. ODII Language Learner's Software, Orell Techno Systems
2. Visionet Spears Digital Language Lab software Advance Pro
3. [www.natcorp.ox.ac.uk](http://www.natcorp.ox.ac.uk), *British National Corpus*



**20ES1154****COMPUTING AND PERIPHERALS LABORATORY**

<b>Course Category:</b>	Engineering Sciences	<b>Credits:</b>	1
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial- Practice:</b>	0 - 0 - 2
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Able to assemble a PC and install operating system and other software.	K3	
<b>CO2</b>	Able to trouble shoot hardware and software issues.	K3	
<b>CO3</b>	Able to configure network settings to connect to internet.	K3	
<b>CO4</b>	Able to createdocuments, presentations and spread sheets using office productivity tools.	K3	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3											3	3
<b>CO2</b>	3	2							3				3	2
<b>CO3</b>	3			1	2								3	
<b>CO4</b>	3									2			3	

**COURSE CONTENT****PC Hardware/Software**

**Week 1 – Task 1:** Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

**Week 1– Task 2:** Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also, students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course

content.

**Week 2 – Task 1:** Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

**Week 2 – Task 2:** Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot with both windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

**Week 3 – Task 1: Hardware Troubleshooting:** Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva

**Week 3 – Task 2: Software Troubleshooting:** Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva.

### **Networks, Internet & World Wide Web**

**Week 4:** Types of Network cables, connectors, crimping straight and crossover cables, identification of network devices (Hubs, Switches, Routers).

**Week 5:** Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally, students should demonstrate, to the instructor, how to access the websites and email.

**Week 6:** Wifi router configuration, connecting to internet, Static/Dynamic IP address configuration, DNS, Gateway, Security configuration.

### **Productivity tools**

#### **LaTeX and Word**

**Week 7– Word Orientation:** The mentor needs to give an overview of Microsoft (MS) office 2007/ equivalent (FOSS) tool word: Importance of MS office 2007/ equivalent (FOSS) tool Word as word Processors, Details of the three tasks and features that would be covered in word – Accessing, overview of components of toolbars, saving files, Using help and resources, rulers, format painter.

**Week 8- Latex:** Using LaTeX to create project certificate. Features to be covered: Formatting Fonts, Drop Cap, Applying Text effects, Using Character Spacing, Borders and Colours, Inserting Header and Footer, Using Date and Time option in both LaTeX.

**Week 9:** Creating project abstract Features to be covered: Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

### **Excel**

**Week 10 - Task 1 - Excel Orientation:** The mentor needs to tell the importance of MS office 2007/ equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the two tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

**Week 10 – Task2: Calculating GPA -Features to be covered:** Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP, Sorting, Conditional formatting

### **Power Point or equivalent (FOSS) tool**

Week 11– Task1: Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes: PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in both LaTeX and Power point. Students will be given model power point presentation which needs to be replicated (exactly how it's asked).

Week 12 - Task 3: Concentrating on the in and out of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topics covered during this week includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide master, notes etc), Inserting – Background, textures, Design Templates, Hidden slides.

### **TEXT BOOKS and REFERENCE BOOKS**

1. LaTeX Companion – Leslie Lamport, PHI/Pearson.
2. Introduction to Computers, Peter Norton, 6/e Mc Graw Hill Publishers.
3. Upgrading and Repairing, PC's 18th e, Scott Muller QUE, Pearson Education
4. Comdex Information Technology course tool kit Vikas Gupta, WILEY

**Dreamtech**

5. IT Essentials PC Hardware and Software Companion Guide Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education. PC Hardware and A+ Handbook – Kate J. Chase PHI (Microsoft)

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

1. <https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17-1.pdf>
2. <https://www.protosystech.com/rapid-prototyping.htm>
3. <https://www.arduino.cc/en/Tutorial/Foundations>
4. <https://www.tutorialspoint.com/arduino/>

# **SEMESTER – II**

**20BS2101A****Probability and Statistics for Data Science**

<b>Course Category:</b>	Basic Science	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	Vectors, Integration, Curve Tracing.	<b>Continuous Evaluation: Semester end Evaluation: Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand Probability, random variables and probability distributions.	K2	
<b>CO2</b>	Understand the probability density functions.	K2	
<b>CO3</b>	Analyze random phenomena of sample to test the hypothesis concerning one mean.	K4	
<b>CO4</b>	Analyze random phenomena of sample to test the hypothesis concerning two mean and regression.	K4	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3		2	1									1
<b>CO2</b>	3	3		2	1									1
<b>CO3</b>	3	3		2	1									1
<b>CO4</b>	3	3		2	1									1

**COURSE CONTENT****UNIT I**

**Probability Theory:**

Sample Spaces and events -Counting – Probability-The Axioms of Probability-Conditional

Probability -Bayes' Theorem.

**Probability Distributions**

Random variables –Binomial distribution - Mean and Variance of a Probability Distribution- The Poisson Approximation to the Binomial Distribution-Poisson Processes.

**Unit II Probability Densities**

Continuous random variables – The Normal Distribution – The Normal approximation to the Binomial Distribution

**Other Probability Densities**

The Uniform Distribution – The Log Normal Distribution – The Gamma Distribution-The Beta D **UNIT III**

**Sampling Distributions**

Populations and samples-sampling distribution of the mean-SD Known and Unknown-the sampling distribution of the variance.

**Inferences Concerning Mean**

Point Estimation- Interval Estimation-Maximum error of estimate-Tests of Hypothesis – Null Hypothesis and Tests of Hypothesis – Hypothesis concerning one mean.istribution – The Weibull distribution.

**UNIT IV****Comparing Two treatments**

Comparisons Two independent Large samples - Comparisons Two independent small samples – Matched pair of comparisons.

**Regression Analysis**

The method of least squares - Multiple Regression- Correlation

**TEXT BOOKS**

[1] Probability and Statistics for Engineers Eighth edition by Richard A. Johnson Prentice Hall of India. 8 thedition.

### **REFERENCE BOOKS**

[1] Applied Statistics and probability for engineers by Douglas C.Montgomery and George C.Runger, Wiley Student Edition

[2] Probability & Statistics for Engineers & Scientist by R.E. Walpole, R.H.Myers&S.L.Myers, Sixth Edition, Prentice Hall of India / Pearson Education.

[3] Probability and Statistics, Purna Chandra Biswal, Pearson Education Prentice Hall of India 2007.

[4] Probability and Statistics by T.K.V.Iyengar, B.Krishna Gandhi, S.Ranganatham, M.V.S.S.N.PrasadS.Chand.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

1. [probweb.berkeley.edu/teaching.html](http://probweb.berkeley.edu/teaching.html)
2. [statsci.org/teaching.html](http://statsci.org/teaching.html)
3. [video.lectures.nptel.iitm.ac.in](http://video.lectures.nptel.iitm.ac.in)



**20BS2102**  
**ENGINEERING CHEMISTRY**

<b>Course Category:</b>	Basic Science	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture-Tutorial-Practice:</b>	3-0-0
<b>Prerequisites:</b>	Chemistry knowledge at Intermediate level	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Analyze various water treatment methods and boiler troubles.	K4	
<b>CO2</b>	Apply the concept of phase equilibrium to different materials and the knowledge of working of electrodes and batteries in various technological fields.	K3	
<b>CO3</b>	Evaluate corrosion processes as well as protection methods.	K3	
<b>CO4</b>	Apply the knowledge of conventional fuels and mechanistic aspects of conducting polymers for their effective and efficient utilisation.	K3	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>		3												3
<b>CO2</b>	2												2	
<b>CO3</b>			3											
<b>CO4</b>					2									

**COURSE CONTENT****UNIT I (10 hours)**

**Water technology-I:** WHO standards - Water treatment for drinking purpose - sedimentation, coagulation, filtration, disinfection by chlorination, breakpoint chlorination and its significance - Desalination of brackish water - principle and process of electrodialysis and reverse osmosis, advantages and disadvantages.

**Water technology-II:** Boiler troubles - scales-formation, disadvantages and internal conditioning methods - phosphate conditioning, calgon conditioning and sodium aluminate, caustic embrittlement- reasons, mechanism and its control, and boiler corrosion – causes and control.

**UNIT II (10 hours)**

**Phase rule and applications:** Definition and explanation of the terms – phase, component and degree of freedom, phase rule equation, phase equilibria of single component system – water system, two component system – silver-lead system, applications of phase rule.

**Electrochemistry:** Construction and working of Calomel electrode, silver-silver chloride electrode, and principle, construction and working of glass electrode, determination of pH using glass electrode. Chemistry of modern batteries - Li/SOCl<sub>2</sub> battery and Li<sub>x</sub>C/LiCoO<sub>2</sub> battery – construction, working and advantages.

Fuel cells: General working principle of a fuel cell, examples, chemistry of H<sub>2</sub>-O<sub>2</sub> fuel cell.

**UNIT III (10 hours)**

**Corrosion principles:** Introduction, definition, reason for corrosion, examples – types of electrochemical corrosion - hydrogen evolution and oxygen absorption – corrosion due to dissimilar metals, galvanic series – differential aeration corrosion – pitting corrosion and concept of passivity.

**Corrosion control methods:** Cathodic protection- principle and types - impressed current method and sacrificial anode method, anodic protection-principle and method, corrosion inhibitors – types and mechanism of inhibition – principle, process and advantages of electroplating and electroless plating.

**UNIT IV****(10****hours)**

**Conducting polymers:** Definition, examples, classification-intrinsically conducting polymers and extrinsically conducting polymers- mechanism of conduction of undoped polyacetylene, doping of conducting polymers-mechanism of conduction of p-doped and n-doped polyacetylenes – applications of conducting polymers.

**Fuel technology:** Fuel-definition, calorific value- lower and higher calorific values and numericals on calculation of HCV and LCV relation, analysis of coal – proximate analysis and ultimate analysis, flue gas analysis by Orsat's apparatus, numericals based on calculation of air required for combustion.

**TEXT BOOKS**

- [1] Shikha Agarwal, "Engineering Chemistry – Fundamentals and Applications", Cambridge University Press, New Delhi, 1<sup>st</sup> edition (2015).

**REFERENCE BOOKS**

- [1] Sunita Rattan , "A Textbook of Engineering Chemistry", S.K. Kataria & Sons, New Delhi, First edition 2012.
- [2] P.C. Jain , "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Limited, New Delhi, 15<sup>th</sup> edition.
- [3] B.S. Bahl, G. D. Tuli and Arun Bahl, "Essentials of Physical Chemistry", S. Chand and Company Limited, New Delhi.
- [4] O. G. Palanna, " Engineering Chemistry", Tata McGraw Hill Education Pvt. Ltd., New Delhi.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] <http://www.cip.ukcentre.com/steam.htm>
- [2] <http://corrosion-doctors.org/Modi;es/mod-basics.htm>
- [3] <http://nopr.niscair.res.in/bitstream/123456789/5475/1/JSIR%2063%289%29%20715-728.pdf>
- [4] [https://chem.libretexts.org/Core/Analytical\\_Chemistry/Electrochemistry/Basics\\_of\\_Electrochemistry](https://chem.libretexts.org/Core/Analytical_Chemistry/Electrochemistry/Basics_of_Electrochemistry)
- [5] <http://www.filtronics.com/blog/tertiary-treatment/stages-in-typical-municipal-water-treatment/>
- [6] NPTEL online course, "Corrosion Part-I" offered by MHRD and instructed by Prof. Kallol Mondal of IIT Kanpur

**20ES2103C****PROGRAMMING ESSENTIALS IN PYTHON**

<b>Course Category:</b>	Engineering Science	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3- 0 - 0
<b>Prerequisites:</b>	20ES1103Programming for Problem Solving	<b>Continuous Evaluation: Semester end Evaluation: Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand the python syntax and semantics of control flow statements	K3	
<b>CO2</b>	Apply functions, modules and string handling in Python to solve problems	K3	
<b>CO3</b>	Analyze the methods to create and manipulate programs with Python data structures	K3	
<b>CO4</b>	Analyse the concepts of object oriented approach to solve problems	K4	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2	2	1		2						1		3	
<b>CO2</b>			1		2						1		1	
<b>CO3</b>		1	1		1						1		2	
<b>CO4</b>		3	2		2						2		3	

**COURSE CONTENT****UNIT I**

**Basics of Python Programming:** Features, History, future of python, , writing and executing first python program, Literal constants, variables and identifiers,

data types, input operation, comments, reserved words, indentation, operators and expressions, expressions, Type conversion

**Decision control statements:** Introduction, Selection/conditional branching statements, Basic loop structures/iterative statements, Nested loops, break, continue and pass statements

**Strings:** Concatenating, appending and multiplying strings, immutability, String formatting operator, built-in string methods and function, slice operation.

## UNIT II

**Lists:** access and update values in lists, nested and cloning lists, basic list operations, List methods, Using lists as Stack and Queues, list comprehensions, looping in lists, functional programming:filter(), map(), reduce() functions.

**Tuple:** Creating tuple, utility of tuples, accessing values in a tuple, updating tuple, deleting elements in tuple, basic tuple operations

**Sets and Dictionaries:** Creating a Set and set operations, Creating a dictionary, accessing values, add, modify, delete, sort items in a dictionary, looping over a dictionary.

**Functions and Modules:** Introduction, function declaration and definition, function definition, function call, variable scope and lifetime, the return statement, recursive functions, modules, packages in python.

## UNIT III

**File Handling:** Introduction, Types of files, Opening and Closing of files, Reading and Writing files, file position, renaming and deleting files, Directory Methods

**Error and Exception Handling:** Introduction to errors and exceptions, handling exceptions, multiple except blocks, multiple exceptions in a single block, except block without exception, the else clause, raising exceptions, built-in and user-defined exceptions, the finally block.

**Regular Expression:** match(), search(), sub(), findall(), finditer() Functions, Flag Option, Meta-Characters in Regular Expression

**Classes and Objects:** Introduction, classes and objects, class method and self argument, init() method, class and object variables, del() method, other special

methods, public and private data members, private methods, calling a class method from another class method, built-in class attributes, garbage collection, class and static methods

## UNIT IV

**Polymorphism:** Introduction, implementing operator overloading, reverse adding, overriding `__getitem__()` and `__setitem__()` methods, overriding the `in` operator, overriding miscellaneous functions, overriding the `_call__()` method.

**Inheritance:** Introduction, inheriting classes in python, types of inheritance, composition/containership/complex objects, abstract classes and interfaces, Meta class.

**Python Packages for Data Exploration:** Introduction to numpy for handling arrays, matplotlib: Controlling the line properties of a chart, creating multiple plots, styling your plots, Box plots, Heatmaps, Scatter plots with histograms, Area plots, Bubble charts

### Self-Study:

String functions: `ord()`, `chr()` functions, `in` and `not in` operators

Standard Library modules, `Globals()`, `Locals()`, `Reload()`, `date`, `time`, `sys`

Comparing, iterating string, the `String` module, Re-raising exception, Assertions in python

### TEXT BOOKS:

[1] Reema Thareja, "Python Programming Using Problem Solving Approach", Oxford University Press, 2019.

[2] Mastering Python for Data Science by Samir Madhavan Released August 2015 Publisher(s): Packt Publishing ISBN: 9781784390150

### REFERENCE BOOKS

[1]. Zed Shah, "Learn Python The Hard Way", Third edition, Addison-Wesley, 2013.

[2]. Charles Severance, "Python for Informatics- Exploring Information", 1st edition Shroff Publishers, 2017.

[3]. John V. Guttag, "Introduction to Computation and Programming Using Python", The MIT Press, 2013

[4]. W.Chun , "Core Python Programming", 2nd Edition, Prentice Hall, 2006.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1]. Charles Severance: University of Michigan, Python for Everybody [COURSERA]. (05-01-2021), Available: <https://www.coursera.org/>
- [2]. Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIT Dharwad, The Joy Of Computing Using Python [NPTEL], (05-01-2021), Available: <https://nptel.ac.in/courses/106/106/106106182/#>
- [3]. Prof KannanMoudgalya, Professor, IIT Bombay, Python 3.4.3, [SWAYAM], (05-01-2021), Available: [https://onlinecourses.swayam2.ac.in/aic20\\_sp33/preview](https://onlinecourses.swayam2.ac.in/aic20_sp33/preview)
- [4]. Corey Schafer, Python OOP Tutorials - Working with Classes, (05-01-2021), Available: [Python OOP Tutorials - Working with Classes - YouTube](#)

**20ES2104A****BASIC ELECTRONICS ENGINEERING**

<b>Course Category:</b>	Engineering Science	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3-0-0
<b>Prerequisites:</b>		<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Comprehend the fundamentals of electronic components, devices, transducers	K2	
<b>CO2</b>	Understand and apply the principles of digital electronics	K2	
<b>CO3</b>	Learn the principles of various communication systems.	K2	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3	3			2									
<b>CO2</b>	3	3												
<b>CO3</b>	2				2									

**COURSE CONTENT****UNIT I**

**Electronic Components:** Passive components - resistors, capacitors & inductors (properties, common types, I-V relationship and uses).  
**Semiconductor Devices:** Semiconductor Devices - Overview of Semiconductors - basic principle, operation and characteristics of PN diode, Zener diode, BJT, JFET, optoelectronic devices (LDR, photodiode, phototransistor, solar cell, photo couplers).

**UNIT II**

**Transducers:** Transducers - Instrumentation - general aspects, classification of transducers, basic requirements of transducers, passive transducers - strain gauge, thermistor, Hall-Effect transducer, LVDT, and active transducers - piezoelectric and thermocouple -DHT, ULTRASONIC , PIR..sensors



**UNIT III**

**Digital Electronics:** Number systems - binary codes - logic gates Boolean algebra, laws & theorems - simplification of Boolean expression - Implementation of Boolean expressions using logic gates – standard forms of Boolean expression.

**UNIT IV**

**Digital Communication:** Block diagram of a basic communication system - frequency spectrum - need for modulation, Types of communication-Analog and Digital communication-Advantages and Disadvantages of Digital Communication, Time and frequency domain representation of signals, Sampling theorem, Nyquist rate and Nyquist interval, Pulse code modulation, Line coding-Variou formats, Generation of digital modulation techniques-ASK,FSK,PSK

**TEXT BOOKS**

- [1] Thyagarajan.T, SendurChelvi.K.P, Rangaswamy, “Engineering Basics: Electrical, Electronics and computer Engineering”, T.R, New Age International, Third Edition, 2007. (UNIT- I&II)
- [2] Thomas L. Floyd, “Electronic Devices”, Pearson Education, 9thEdition, 2011. (UNIT- III)
- [3] Dr. Sanjay Sharma, “Communication Systems(Analog & Digital)”, S.K.Kataria& Sons (KATSON Books), 6<sup>th</sup> edition, 2014 (UNIT- IV)

**REFERENCE BOOKS**

- [1] M. Morris Mano, Michael D. Ciletti, —Digital Design||, 4th edition, Prentice Hall, 2007.
- [2] S. Salivahanan, N.Suresh Kumar & A. Vallavaraj, “Electronic Devices & Circuits”, 2nd Edition, Tata McGraw Hill,2008.
- [3] Simon Haykin. —Communication Systems, 4<sup>th</sup> edition, 2000, John Wiley and Sons

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] <https://nptel.ac.in/courses/117/103/117103063/>
- [2] <https://nptel.ac.in/courses/108/105/108105132/>
- [3] <https://nptel.ac.in/courses/108/102/108102096/>

**20ES2105****ENGINEERING GRAPHICS**

<b>Course Category:</b>	Engineering Science	<b>Credits:</b>	3
<b>Course Type:</b>	Theory & Practice	<b>Lecture -Tutorial- Practice:</b>	1 - 0 - 4
<b>Prerequisites:</b>	Nil	<b>Continuous Evaluation: Semester end Evaluation: Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the Scales and conics.	K2	
<b>CO2</b>	Draw Orthographic projections of points, Lines and Planes.	K2	
<b>CO3</b>	Draw Orthographic projections of Solids and to understand basics of Auto CAD.	K2	
<b>CO4</b>	Understand the sections, Development of solids and draw isometric views using Auto CAD.	K2	

**Contribution of Course Outcomes towards achievement of Program**

**Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3		3				3						3	
<b>CO2</b>	2		3				3						2	
<b>CO3</b>	2		3				3						2	
<b>CO4</b>	1		3				3						1	

**COURSE CONTENT****UNIT – I**

**Introduction to Engineering Drawing:** Principles of Engineering Graphics and their Significance

**Scales:** Construction of plain and diagonal Scales

**Conic Sections:** Construction of ellipse, parabola and hyperbola (Treatment is limited to Eccentricity or General method only)

**UNIT – II**

**Orthographic Projections:** Principles of Orthographic Projections –Projections of Points, Lines (Treatment is limited to First Angle Projection) and Projections of Plane regular geometric figures (Up to Plane Inclined to both of the Reference planes)

### UNIT – III

**Projections of Solids:** Projections of simple solids such as Cubes, Prisms, Pyramids, Cylinders and Cones with varying positions (Limited to Solid Inclined to one of the Reference planes)

**INTRODUCTION TO AUTO CAD:**Basic introduction and operational instructions of various commands in AutoCAD.(Internal Evaluation only)

### UNIT – IV

**Sections and Development of Surfaces of Right Angular Solids:**

Sections and sectional views of right angular solids of Prism, Pyramid and Cone, Development of surfaces of Right Regular Solids of Prism, Pyramid and Cone.

**Isometric Projections:** Conversion of isometric views into Orthographic Projections of simple castings using Auto CAD. (Treatment is limited to simple objects only, Internal Evaluation only).

### TEXT BOOKS

- [1] BasanthAgrawal & C M Agrawal, "Engineering Drawing", McGraw Hill Education Private Limited, New Delhi.
- [2] N.D. Bhatt "Engineering Drawing", Charotar Publishing House, Anand. 53<sup>rd</sup> Edition – 2019.

### REFERENCE BOOKS

- [1] K. L. Narayana & P. Kanniah, "Text Book on Engineering Drawing", Scitech publications (India) Pvt. Ltd., Chennai, 2nd Edition - fifth reprint 2006
- [2] K. Venugopal, "Engineering Drawing and Graphics + Auto CAD", New Age International, New Delhi
- [3] D M Kulkarni, AP Rastogi, AK Sarkar, "Engineering Graphics with Auto CAD", PHI Learning Private Limited, Delhi Edition – 2013

### E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] <http://www.youtube.com/watch?v=XCWJXrkWco>.
- [2] <http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html#isodrawing>.
- [3] [https://onlinecourses.nptel.ac.in/noc20\\_me79/preview](https://onlinecourses.nptel.ac.in/noc20_me79/preview)
- [4] <http://nptel.ac.in/courses/112/103/112103019/>

**20BS2151B****ENGINEERING CHEMISTRY LABORATORY**

<b>Course Category:</b>	Basic Science	<b>Credits:</b>	1.5
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial- Practice:</b>	0 - 0 - 3
<b>Prerequisites:</b>	Knowledge of chemistry practicals at Intermediate level	<b>Continuous Evaluation: Semester end Evaluation: Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Analyze ores, commercial samples, quality parameters of water samples from different sources	K4	1.2.1, 1.7.1, 2.8.1
<b>CO2</b>	Perform quantitative analysis using instrumental methods.	K3	1.2.1, 1.7.1, 2.8.1, 3.6.2, 4.6.1, 5.4.1
<b>CO3</b>	Apply the knowledge of preparation of polymers, separation of ions, mechanism of corrosion and photochemical reactions.	K3	1.2.1, 1.7.1, 2.5.2, 5.5.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>		3												3
<b>CO2</b>				2										
<b>CO3</b>	2												2	

**COURSE CONTENT****List of Experiments:**

1. Determination of MnO<sub>2</sub> in Pyrolusite / Iron in Haematite ore
2. Determination of total alkalinity of a water sample
3. Determination of purity of a boric acid sample
4. Conductometric analysis of a strong base using a strong acid
5. Determination of total hardness of a water sample
6. Determination of copper in a given sample
7. Chemistry of blueprinting
8. Determination of Mohr's salt - Permanganometry

9. Determination of Mohr's salt - Dichrometry
10. Comparison of corrosion rates of different metals
11. Determination of available chlorine in a bleaching powder sample
12. Determination of chlorides in a water sample
13. pH metric analysis of a strong base using a strong acid
14. Preparation of urea-formaldehyde resin
15. Separation of ions by paper chromatography

### **REFERENCE BOOKS**

- [1] *S.K. Bhasin and Sudha Rani*, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 2<sup>nd</sup> edition.
- [2] *Sunitha Rattan*, "Experiments in Applied Chemistry", S.K. Kataria & Sons, New Delhi, 2<sup>nd</sup> edition.

**20ES2152C****PROGRAMMING ESSENTIALS IN PYTHON LABORATORY**

<b>Course Category:</b>	Engineering Science	<b>Credits:</b>	1.5
<b>Course Type:</b>	Lab	<b>Lecture -Tutorial- Practice:</b>	0 - 0 - 3
<b>Prerequisites:</b>	20ES1152 Programming for Problem Solving Laboratory	<b>Continuous Evaluation: Semester end Evaluation: Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Demonstrate the usage of Python syntax and semantics in solving the problems	K3	
<b>CO2</b>	Develop python programs using functions and built in modules	K4	
<b>CO3</b>	Implement Python data structures to solve the complex problems	K4	
<b>CO4</b>	Apply object oriented concepts to design solution to real world scenarios	K3	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2	2	1		2								3	
<b>CO2</b>			1		2								1	2
<b>CO3</b>		1	1		1								2	2
<b>CO4</b>		2	2		2								3	

**COURSE CONTENT**

Implement the following programmes using IDE's (pycharm, jupyter notebook, spyder etc.,)

**Week 1: Declaration of Variables, identifiers and type conversions**

Write a program

- i) to define variables and assigning values of different basic data types
- ii) to know data type of a variable using Type statement

2. Write programs to do multiple assignments at a time

3. Write programs for writing multiple statements in a single line
4. Use Input statement, type conversion
5. Use different operators in programs

### **Week 2: Python programs on Decision Control Statements, Looping Control Structures**

- a. Write programs using selection statements
- b. Implement programs on and conditional branching statements
- c. Design and develop programs using Iterative statements- while, for , nested loops
- d. Use Break, continue, pass statements in programs
- e. Understand the usage of else statement in loops with a case study

### **Week 3 : Solve the problems using Strings**

- a. Apply string formatting operator
- b. Use built in string methods and functions

### **Week 4:Programs on the implementation of methods and operations on List and Tuple data structures**

- a. Define a list and write programs to access and modify elements of a list
- b. Practice basic list operations, methods
- c. Write programs to use list as a stack and queue

### **Week 5: Implement programs to solve the problems using Python other data structures: Set and Dictionaries**

- a. Write programs to define a dictionary and write programs to modify values, adding new keys
- b. Apply looping over a dictionary
- c. Use built in dictionary methods, functions
- d. Create a tuple and assign values
- e. Use basic tuple operations and comparisons

### **Week 6: Identify the need and importance in the creation of Python Functions and Modules**

- a. Write programs for defining and calling functions
- b. Understand Scope of a variable and Use global statement
- c. Differentiate fruitful and void functions through a case study
- d. Apply recursive and Lambda functions
- e. Understand different kinds of arguments through a case study
- f. Installing and usage of standard library modules
- g. Use python packages

**Week 7: File and Exception Handling**

- a. Write a simple exception handling program with try- except
- b. Write a program for catching multiple exceptions
- c. Demonstrate raising and re raising exceptions
- d.

**Week 8: Regular Expressions****Week 09: Implement the Python Classes and Objects to address the real world scenarios**

- a. Define classes and objects using python for the real world scenario
- b. Defining constructors and using Self
- c. Understand public and private members
- d. Practice calling class methods from another class
- e. Write built in functions to check, get, set and delete attributes

**Week 10: Develop the programs to implement Inheritance and Polymorphism**

- a. Demonstrate different inheritance types
- b. Apply polymorphism and method overriding
- c. Create abstract classes
- d. Demonstrate the usage of polymorphism in overloading of operators

**Week 11: Programs on Data Representation and Visualisation****TEXT BOOKS**

- [1]. ReemaThareja,“Python ProgrammingUsing Problem Solving Approach”, Oxford University Press, 2019.
- [2]. Mastering Python for Data Science by Samir Madhavan Released August 2015 Publisher(s):Packt Publishing ISBN: 9781784390150

**REFERENCE BOOKS**

- [1]. Zed Shah, “Learn PythonThe Hard Way”, Third edition, Addison-Wesley, 2013.
- [2]. Charles Severance, " Python for Informatics- Exploring Information", 1st edition Shroff Publishers, 2017.
- [3]. John V. Guttag, “Introduction to Computation and Programming Using Python”, The MIT Press, 2013
- [4]. W.Chun , "Core Python Programming", 2nd Edition, Prentice Hall, 2006.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1]. Charles Severance: University of Michigan,Python for Everybody



- [COURSERA]. (05-01-2021), Available: <https://www.coursera.org/>
- [2]. Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIT Dharwad, The Joy Of Computing Using Python [NPTEL], (05-01-2021), Available:<https://nptel.ac.in/courses/106/106/106106182/#>
- [3]. Prof KannanMoudgalya, Professor, IIT Bombay, Python 3.4.3, [SWAYAM], (05-01-2021), Available: [https://onlinecourses.swayam2.ac.in/aic20\\_sp33/preview](https://onlinecourses.swayam2.ac.in/aic20_sp33/preview)
- [4]. Corey Schafer,Python OOP Tutorials - Working with Classes, (05-01-2021), Available: [Python OOP Tutorials - Working with Classes - YouTube](#)

**20ES2153**  
**ENGINEERING WORKSHOP**

<b>Course Category:</b>	Engineering Sciences	<b>Credits:</b>	1.5
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial- Practice:</b>	0 - 0 - 3
<b>Prerequisites:</b>	-	<b>Continuous Evaluation: Semester end Evaluation: Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the basic joints using wood and familiarize with various fundamental aspects of house wiring.	K2	
<b>CO2</b>	Prepare basic models using sheet metal and practice joining of metals using arc welding technique.	K2	
<b>CO3</b>	Familiarize with various manufacturing processes such as injection moulding and 3D printing	K2	
<b>CO4</b>	Understand the preparation of PCB	K2	
<b>CO5</b>	Understand simple IOT Applications using Arduino	K2	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>			2					1			3	2		2
<b>CO2</b>			2					1			3	2	2	2
<b>CO3</b>			2					1			3	2		
<b>CO4</b>						1							1	1
<b>CO5</b>							2						1	1

**COURSE CONTENT**

**PART-A****Carpentry:**

- a. Demonstration of Cross half lap and T joints.  
(1 class)
- b. Demonstration of power tools.

**Electrical Wiring:**

- a. Fundamentals of Electric wiring and practice of Series wiring.  
(1 class)
- b. Practice of stair case wiring and connecting a fluorescent Tube.

**Sheet metal & soldering:**

- a. Preparation of complete funnel using sheet metal and practice of soldering.  
(2 classes)
- b. Preparation of a square box using sheet metal and practice of soldering.

**Welding:**

- a. Preparation of Corner Joint using arc welding process.  
(1 class)
- b. Preparation of “T” joint using arc welding process.

**Manufacturing processes:**

- a. Preparation of a small plastic part using injection moulding process.  
(1 class)
- b. Demonstration of manufacturing a simple model using 3D printing process.

**Electronic Circuits:**

- 1. To prepare PCB for the given electronic circuit**
  - a. To prepare the layout and printing it on copper clad board
  - b. To etch and drill the holes on PCB  
(2 classes)
- 2. To solder the components on the PCB prepared and test the circuit**
  - a. To identify and solder the components on the PCB prepared
  - b. To test the operation of the circuit.

**Basic IOT:**

- 1. Demonstration of Arduino board**
  - a. Demonstrate different components & pin configuration of Arduino
  - b. To set up Arduino IDE for programming.
- 2. To measure Temperature & Humidity**
  - a. Interfacing of temperature & humidity sensor with Arduino.

(2 classes)

b. Execute the program on Arduino IDE & display the measured values.

### 3. To measure Distance

a. Interfacing of Ultrasonic Sensor with Arduino

b. Execute the program on Arduino IDE & display the measured value.

## **PART-B**

### **GROUP ACTIVITY**

(4 classes)

**Students must prepare a Working model / Assembly using the knowledge gained from the above trades.**

### **TEXT BOOKS**

- [1] Kannaiah P. & Narayana K. C., “Manual on Workshop Practice”, Scitech Publications, Chennai, 1999.
- [2] Venkatachalapathy, V. S., “First year Engineering Workshop Practice”, Ramalinga Publications, Madurai, 1999.

### **REFERENCE BOOKS**

- [1] Gopal, T.V., Kumar, T., and Murali, G., “A first course on workshop practice – Theory, Practice and Work Book”, Suma Publications, Chennai, 2005

### **E-RESOURCES AND OTHER DIGITAL MATERIALL**

1. <https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17-1.pdf>
2. <https://www.protosystech.com/rapid-prototyping.htm>
3. <https://www.arduino.cc/en/Tutorial/Foundations>
4. <https://www.tutorialspoint.com/arduino/>

**20MC2106****PROFESSIONAL ETHICS & PRACTICE**

<b>Course Category:</b>	Mandatory Course	<b>Credits:</b>	--
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	1 - 0 - 0
<b>Prerequisites:</b>		<b>Continuous Evaluation: Semester end Evaluation: Total Marks:</b>	100 -- 100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Know the moral autonomy and uses of ethical theories.	K2	
<b>CO2</b>	Understand Engineering as Experimentation	K2	
<b>CO3</b>	Understand about safety, risk and professional rights.	K2	
<b>CO4</b>	Know the ethics regarding Global issues related to Environment, Computers and weapon's development. Understand general principles of contracting.	K2	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2												2	
<b>CO2</b>					3									
<b>CO3</b>					3									
<b>CO4</b>											2			

**COURSE CONTENT****UNIT****(4 lectures)****I**

**Engineering Ethics:** Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory -

Gilligan's theory - consensus and controversy - Models of Professional Roles - theories about right action - Self-interest - customs and religion- uses of ethical theories.

## UNIT II

(4 lectures)

**Engineering as Social Experimentation:** Engineering as experimentation – engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

## UNIT III

(4 lectures)

**Safety, Responsibilities and Rights:** Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – the three mile island and chernobyl case studies. Collegiality and loyalty – respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

## UNIT IV

(4 lectures)

**Global Issues:** Multinational corporations- Environmental ethics- computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics (Specific to a particular Engineering Discipline).

**General principles of contracts management :** Indian contract act,1972 and amendments covering general principles of contracting.

## TEXT BOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in engineering”, McGraw Hill, New York (1996).
2. Govindarajan M, Natarajan S, Senthil Kumar V. S., “Engineering Ethics”, Prentice Hall of India, New Delhi(2004).

## REFERENCE BOOKS

- [1] Baum, R.J. and Flores, A., “Ethical Problems in Engineering, Center for the studyof the Human Dimensions of Science and Technology”, Rensellae Polytechnic Institute,Troy, New York, 335 pp. eds. (1978)
- [2] Beabout, G.R., Wennemann, D.J. , “Applied Professional Ethics: A Developmental Approach for Use with Case Studies”, University Press of

America Lanham, MD, 175 pp (1994).

[3] Dutt (1994) Indian Contract Act, Eastern Law House.

# **SEMESTER III**



**20BS3101A**  
**DISCRETE MATHEMATICS**

<b>Course Category:</b>	Institutional Core	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	Set theory, Relations	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Analyze of propositional calculus and first order logic	K4	1.2.1,1.7.1, 2.5.1,4.6.3
<b>CO2</b>	Apply the basic and advanced counting techniques	K3	1.2.1,2.5.1, 2.5.3
<b>CO3</b>	Analyze of relations and digraphs and their applications.	K4	1.2.1,2.8.1, 4.4.1
<b>CO4</b>	Analyze of graphs and their applications	K4	1.2.1,2.5.3, 4.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3	3		1										
<b>CO2</b>	3	3		1										
<b>CO3</b>	3	3		1										
<b>CO4</b>	3	3		1										

**COURSE CONTENT****UNIT I: Propositional Calculus**

**Fundamentals of Logic:** Propositions, Connectives, Propositional functions, Truth tables, Tautology, Contradiction, Logical equivalences, Normal forms, Logical inferences, Methods of proof of an implication.

**First Order Predicate Logic:** Predicate, Quantifiers, and Rules of inference for Quantified propositions.

## **UNIT II: Counting Techniques**

**Basics of Counting:** Sum and product rules, Indirect counting, One to one correspondence, Combinations and permutations, Enumerating combinations and permutations with and without repetitions.

**Advanced Counting Techniques:** Generating function of sequences, Recurrence relations, Solving recurrence relations – substitution- Generating functions-The method of characteristic roots, Solution of inhomogeneous recurrences relations.

## **UNIT III: Relations and Digraphs**

Relations and basic graphs, Special properties of binary relations, Equivalence relation, Partially ordered sets, Hasse diagrams, Lattices, Operations on relations, Paths and closures, Directed graphs and Adjacency matrices, Transitive closure, Warshall's algorithm.

## **UNIT IV: Graph Theory**

Introduction(graphs, sub graphs, circuits, trees) Sum of degrees theorem, Isomorphism and sub graphs, planar graphs, Euler's formula, Multi graphs and Euler's circuits, Hamiltonian graphs, Grin-berg's theorem, Graph coloring, Chromatic numbers.

### **TEXT BOOKS**

[1] J. L. Mott, A. Kandel, and T. P. Baker: Discrete Mathematics for Computer Scientists & Mathematicians, PHI, 2<sup>nd</sup> Edition.

### **REFERENCE BOOKS**

[1] J. P. Trembly and R. Manohar: Discrete Mathematical structures with applications to computer science, TMH.

[2] K. H. Rosen: Discrete Mathematics and its Applications, Mc Graw Hill Companies, 7<sup>th</sup> Edition.

[3] D. S. Malik and M. K. Sen: Discrete Mathematical Structures: Theory and applications

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Prof. Arindama Singh Department of Maths IIT Madras, Last accessed on 15-02-2022, <https://nptel.ac.in/courses/111/106/111106052/>

[2] Prof SoumenMaity, Department of Maths, IISER Pune, Last accessed on 15-

02-2022, <https://nptel.ac.in/courses/111/106/111106102/>

- [3] Dr.L.SunilChandran, Department of Computer Science and Automation, IISC Bangalore, Last accessed on 15-02-2022, <https://nptel.ac.in/courses/106/108/106108051/>

**20ES3102****DIGITAL LOGIC AND COMPUTER DESIGN**

<b>Course Category:</b>	Engineering Science	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2-1-0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Apply simplification techniques to minimize the Boolean functions.	K3	1.2.1, 1.7.1
<b>CO2</b>	Apply concepts of combinational logic to design MSI and LSI circuits.	K3	1.7.1,2.7.1, 2.7.2,3.7.1 ,3.8.1
<b>CO3</b>	Apply sequential logic techniques to design Counters and Registers.	K3	1.7.1,2.7.1,2.7.2, 3.7.1 ,3.8.1
<b>CO4</b>	Understand the organization and design of a basic computer.	K2	2.7.1,2.7.2

**Contribution of Course Outcomes towards achievement of Program Outcomes  
(1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2												1	
<b>CO2</b>	1	2	2										1	
<b>CO3</b>	1	2	2										1	
<b>CO4</b>		2											1	

**COURSE CONTENT****UNIT I**

**Boolean Functions:** Introduction to Boolean Functions, Boolean Functions Simplification- The Map Method, Two and three variable Maps, Four-variable Map, Five variable Map, Product of Sums Simplification, Don't care conditions,

The Tabulation Method, Determination of Prime Implicants, Selection of Prime-Implicants.

**Combinational Logic:** Introduction, Design Procedure, Adders, Subtractors, Code Conversions, Exclusive-or Gates, Parity Generators and Checkers.

## UNIT II

**Combinational Logic with MSI and LSI:** Binary Parallel Adder, Decimal Adder, Magnitude Comparator, Decoders, Demultiplexers, Encoders, Multiplexers.

**Programmable Logic:** Read only memory (ROM), Programmable read only memory (PROM), Programmable Logic Array (PLA), Programmable Array Logic (PAL), Introduction to FPGA.

## UNIT III

**Sequential Logic:** Sequential circuits, Classification, Latches, Flip Flops, Triggering of Flip-Flops, Master slave flip-flop, Flip-Flop Excitation tables, flip-flop direct inputs. Analysis of Clocked Sequential Circuits, State table, State diagram, state equations, State Reduction and Assignment, Design Procedure, design with unused states.

**Registers, Counters:** Registers, Shift Registers, Asynchronous Counters, Synchronous Counters, Ring Counter, Johnson Counter, Timing Sequences.

## UNIT IV

**Register Transfer and Micro-Operations:** Register Transfer Language, Register Transfer, Bus and memory Transfers, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit.

**Basic Computer Organization and Design:** Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input-Output and Interrupt, Design of Basic Computer, Design of Accumulator Logic.

## TEXT BOOKS

[1] M.Morris Mano, Digital Logic & Computer Design 1 e/d reprint, Pearson education, 2016.

[2] Morris M. Mano, Computer System Architecture, 3/e, Pearson/PHI, 2007

## REFERENCE BOOKS

[1] A. Anand Kumar, Switching Theory and Logic Design, 2nd Edition, PHI, 2013

[2] M.Morris Mano, Michael D Ciletti Digital Design with an Introduction to Verilog HDL 5<sup>th</sup> e/d, Pearson education, 2013

[3] Charles H. Roth, Fundamentals of Logic Design, 6/e, Cengage learning, 2010

[4] Computer Architecture and Organization Designing for Performance, William Stallings, Ninth edition, Pearson Education series, 2014.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Prof. Neeraj Goel IIT Ropar, 18<sup>th</sup> May 2022, **Digital Systems**, NPTEL VIDEO, Available: <https://nptel.ac.in/courses/108/106/108106177/>

[2] Prof. N.J. Rao, IISc Bangalore, 18th May 2022, Digital systems, NPTELWEB Notes , Available at: <https://nptel.ac.in/courses/106/108/106108099/>

**20AI&DS3303**  
**DATABASE SYSTEMS**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2 - 1 - 0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the concepts of database systems	K2	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3
<b>CO2</b>	Analyse the Entity-Relationship models, in turn develop the Relational models that leads to database design	K4	2.5.2, 2.5.3, 2.6.3,2.7.2, 3.5.6,3.6.2
<b>CO3</b>	Apply various normalization techniques to relational models in order to improve database design quality	K3	2.5.2, 2.5.3, 2.6.3,2.7.2, 3.5.6,3.6.2
<b>CO4</b>	Understand database transactions processing, protocols for Concurrency control, Recovery, query processing and optimization techniques in database	K2	1.7.1, 2.5.2, 2.6.3,2.7.2
<b>CO5</b>	Implement database management techniques using relational SQL database to real world applications	K5	2.5.2, 2.5.3, 2.6.3, 2.6.4, 2.8.4, 5.4.2,5.5.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	2											1	1
<b>CO2</b>		2	3										1	1
<b>CO3</b>		2	3										1	1

<b>CO4</b>	<b>1</b>	<b>2</b>											<b>1</b>	<b>1</b>
<b>CO5</b>		<b>2</b>	<b>3</b>		<b>3</b>								<b>2</b>	<b>2</b>

## COURSE CONTENT

### UNIT I

**Introduction to Database Systems** - Introduction, An example, Characteristics of Database Approach, Advantages of Using the DBMS Approach, A Brief History of Database Applications.

**Database System—Concepts and Architecture:** Data Models, Schemas and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment.

SQL Schema Definition, SQL Data Definition and Data Types , Specifying constraints in SQL, Basic retrieval queries in SQL, Additional features of SQL, More complex SQL Queries, Insert, Delete and Update statements in SQL, Joined Tables in SQL and Outer Joins, Aggregate functions, The GROUP BY and HAVING Clauses, Specifying Constraints as Assertions and Triggers, Views (Virtual Tables) in SQL, Schema Change Statement in SQL.

### Unit II

Data Modeling Using the Entity-Relationship Model- Using High-Level Conceptual Data Models for Database Design; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types. Refining the ER Design, ER Diagrams, Naming Conventions, Relational Database Design using ER to-Relational Mapping.

Relational Data Model and Relational Database Constraints: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations.

Relational Algebra: Unary Relational Operations, SELECT and PROJECT, Relational Algebra Operations from Set Theory Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra.

### Unit III

Relational Database Design: Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-



Codd Normal Form; Properties of Relational Decomposition; Multivalued Dependencies, Fourth Normal Form and Fifth Normal Form.

Transaction Processing: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions.

#### **Unit IV**

Concurrency Control and Recovery : Two-Phase Locking Techniques for Concurrency Control, Recovery Concepts, NO-UNDO/REDO Recovery Techniques based on Deferred Up-date, Recovery Techniques Based on Immediate Update, Shadow Paging, The ARIES Recovery Algorithm.

Query Processing – Overview, Measures of Query Cost.

#### **TEXT BOOKS**

- [1] Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, 7<sup>th</sup> edition, Pearson Education Ltd, 2016. [UNIT I,II,III,IV]
- [2] Abraham Silberschatz, Henry F.Korth, S.Sudarshan, “*Database System Concepts*”, 7<sup>th</sup> edition, McGraw-Hill Education, 2019 [UNIT IV – Query Processing]

#### **REFERENCE BOOKS**

- [1] Raghu Rama Krishnan, Johannes Gehrke, “*Database Management Systems*”, 3<sup>rd</sup> Edition, McGraw Hill Education, 2014

#### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

1. Dr S.Srinath IIT-Madras “Conceptual design process “  
<https://nptel.ac.in/courses/106/106/106106093/> Last accessed on 10/02/2022
2. Prof P.Srinivasa Kumar IIT-Madras “ Normalization process”  
[https://nptel.ac.in/courses/106/106/106106095/Lecture 7](https://nptel.ac.in/courses/106/106/106106095/Lecture%207), Last accessed on 10/02/2022
3. Prof D.Janakiram IIT-Madras “Concurrency Control techniques”  
<https://nptel.ac.in/courses/106/106/106106093/> Lecture 20,21,22,23 Last accessed on 10/02/2022
4. Andy Pavlo, Carnegie Mellon University, Relational model concepts,  
<https://15445.courses.cs.cmu.edu/fall2017/slides/01-introduction.pdf>  
Last accessed on 10/02/2022
- 5.e-book:<https://archive.org/details/database-system-concepts-7th-edition/page/n20/mode/1up>  
Last accessed on 10/02/2022

**20AI&DS3304**  
**JAVA PROGRAMMING**

<b>Course Category:</b>	Program Core	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3-0-0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

COURSE OUTCOMES		BTL	POI
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand the basic concepts of object oriented programming.	K2	1.7.1,2.5.1,2.5.2,2.7.1
<b>CO2</b>	Apply multiple inheritance through interfaces for a given application.	K3	1.7.1,2.5.1,2.5.2,2.6.3,2.7.1,3.5.1,3.8.2
<b>CO3</b>	Apply exceptions, thread capabilities and handling files on a given application.	K3	1.7.1,2.5.1,2.5.2,2.6.3,2.6.4,3.5.1,3.8.2
<b>CO4</b>	Apply functional programming and Collections framework for a given application.	K3	2.5.1,2.5.2,2.6.3,2.6.4,3.5.1,3.6.2,3.8.2,5.4.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	3												
<b>CO2</b>	2	2	3										2	2
<b>CO3</b>	2	2	3										2	2
<b>CO4</b>		2	3		2								2	2

## COURSE CONTENT

### UNIT I

**Introduction, The History and Evolution of Java:** Java history and evolution, Java features, Java's Magic: Byte Code, How Java differs from C and C++.

**An Overview of Java: Object Oriented Programming:** Two paradigms, Principles of OOP, A First simple Program and Control statements.

**Data Types, Variables and Arrays:** Java keywords, Primitive types, Integers, Floating-Point Types, Characters, Booleans, Variables, Operators, Type Conversion, Casting and Arrays.

**Introducing Classes and Objects:** Class fundamentals, declaring objects, assigning object reference variables, introducing methods, constructors, this keyword, Garbage collection, overloading methods, using objects as parameters, returning objects, static and final keywords, nested and inner classes.

### UNIT II

**String Handling:** The String Constructors, String Buffer Class, String Tokenizer class.

**Inheritance:** Inheritance basics, using super, multilevel hierarchy, method overriding, dynamic method dispatch, using abstract classes, final with inheritance.

**Packages & Interfaces:** Defining a package, finding package and CLASSPATH. Access protection, importing packages, Defining an interface, implementing interfaces, nested interfaces, applying interfaces, variables in interfaces.

### UNIT III

**Exception handling:** Exception handling fundamentals, exception types, uncaught exceptions, using try and catch, multiple catch clauses, throw, throws, finally, creating your own exception subclasses.

**I/O streams:** Byte Streams- InputStream, OutputStream, FileInputStream, FileOutputStream, Character Streams- Reader, Writer, FileReader, FileWriter.

**Multithread Programming:** The Java Thread Model, Creating a thread: Implementing Runnable, Extending Thread, creating multiple threads, Thread Priorities, Synchronization: Using Synchronized methods, The synchronized Statement.

**UNIT IV**

**Pragmatic Functional Programming using Lambdas:** Introduction to Functional programming, Functional Programming concepts and terminology, Functional Interfaces, Working with Lambda Expressions and Method References.

**Collections Framework:** Collections overview, Collection interfaces: Collection, List, and Set. Collection Classes: ArrayList, LinkedList, HashSet. Map Classes: HashMap, TreeMap

**The Stream API:** Stream basics, Reduction operations, Using parallel streams, Mapping, Collecting, Iterators and Streams.

**TEXT BOOKS**

[1] Herbert Schildt, “Java The Complete Reference”, Eleventh Edition, Oracle Press, . 2019.

**REFERENCE BOOKS**

[1] Herbert Schildt, Dale Skrien, “Java Fundamentals A Comprehension Introduction”, Special Indian Edition, McGraw-Hill Education India Pvt. Ltd, 2017.

[2] E Balaguruswamy, "Programming with Java", 4th Edition, Mc Graw Hill , 2020.

[3] Paul J. Dietel and Dr. Harvey M. Deitel, “Java How to Program”, Eleventh Edition, Deitel & Associates, Inc.1 , 2018.

[4] Timothy Budd, “Understanding Object Oriented Programming with Java “, Updated edition, Pearson Education, 2013.

[5] Kathy Sierra & Bert Bates, "Head First Java", 2nd Edition, Oreilly.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

1] Prof. Debasis Samanta. (14th, July, 2021), Department of Computer Science & Engineering, I.I.T., Kharagpur, Swayam, NPTEL.

[https://onlinecourses.nptel.ac.in/noc21\\_cs03/preview](https://onlinecourses.nptel.ac.in/noc21_cs03/preview).

[2] Evan Jones, Adam Marcus, Eugene Wu "Introduction to Programming in Java", MIT OpenCourseWare, Massachusetts Institute of Technology, May 28, 2021. <https://ocw.mit.edu/courses>

[3] Prof. Owen Astrachan, "Object Oriented Programming in Java", Duke University, 21st May 2021. coursera.org

<https://www.coursera.org/specializations/object-oriented-programming>

[4] Dheeru Mundluru, "Java In-Depth: Become a Complete Java Engineer", Udemy, 14th May 2021.

<https://www.udemy.com/course/java-in-depth-become-a-complete-java-engineer/>

[5] Prof. Olufisayo Omojokun, "Introduction to Object-Oriented Programming with Java I: Foundations and Syntax Basics", Georgia Institute of Technology, edX, May 2021.

<https://www.edx.org/course/introduction-to-java-programming-i-foundations-and-syntax-basics>

**20AI&DS3305****DATA STRUCTURES AND ALGORITHMS**

<b>Course Category:</b>	Program Core	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3-0-0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI****Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Apply different approaches to evaluate performance of algorithms, and stack data structure to solve problems.	K3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.6.4, 2.8.4
<b>CO2</b>	Understand the operations on Queues and linked lists data structures.	K2	1.7.1, 2.5.1, 2.5.2
<b>CO3</b>	Apply tree and heap algorithms to solve problems.	K3	1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4
<b>CO4</b>	Apply graph algorithms and hashing techniques to solve problems	K3	1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2											1	
<b>CO2</b>	1	1	1										1	
<b>CO3</b>	1	2	1										1	
<b>CO4</b>	1	2											1	

**COURSE CONTENT**

## UNIT I

**Introduction:** Algorithm specification, data abstraction, performance analysis-time complexity, space complexity, asymptotic notations, linear and binary searches complexity analysis. Insertion, Merge sort, Quick sort and their complexity analysis.

**Stacks:** Definition, representing stacks and its operations: algorithms and their complexity analysis, Applications of stacks: expression conversion and evaluation – corresponding algorithms.

## UNIT II

**Queues:** Queue and its sequential representation, queue as an abstract data type, types of queues: simple queue, circular queue, operations on each type of queues: algorithms.

**Linked lists:** Representation in memory, singly linked lists: operations and algorithms; linked list representation of stack and queue, doubly linked list: operations and algorithms; circular linked lists: operations and algorithms.

## UNIT III

**Trees:** Tree terminology, representation of trees, binary Tree, complete binary tree, expression trees construction and evaluation; binary tree traversals: inorder, preorder and postorder, binary search trees, operations on binary search trees.

**Heap:** Min heap and max heap, operations on min Heap and max Heap, Heap sort.

## UNIT IV

**Graphs:** Introduction, graph terminology, representation of graphs, graph traversal algorithms: breadth-first search, depth first search.

**Hashing and Collision:** Introduction, hash tables, hash functions, different hash functions, collisions: collision resolution by open addressing, collision resolution by chaining, pros and cons of hashing.

## TEXT BOOKS

[1] Horowitz Sahni and Anderson-Freed “Fundamentals of Data Structures in C”. 2<sup>nd</sup> Edition, Universities Press, 2008.

[2] Reema Thareja, “Data Structures using C”, Second Edition, Oxford University Press, 2011.

## REFERENCE BOOKS

- [1] Richard F. Gilberg & B. A. Forouzan “Data Structures A Pseudocode Approach with C”, Second Edition, CENGAGE Learning.
- [2] Mark Allen Weiss, “Data structure and Algorithm Analysis in C”. Addison Wesley Publication. 2006.
- [3] Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with Applications”, McGraw Hill, 1984.
- [4] Thomas Cormen, C. Leiserson, R. L. Rivest & C. Stein, “Introduction to Algorithms”. 3rd Edition, The MIT Press, 2009.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Dr. P. P. Chakraborty, IIT Kharagpur, May 19, 2010, Data Structures, NPTEL, Available: [www.youtube.com/watch?v=S47aSEqm\\_0I](http://www.youtube.com/watch?v=S47aSEqm_0I)
- [2] Dr. Naveen Garg, IIT Delhi, Sep 24, 2008, Data Structures, NPTEL, Available: <http://nptel.iitm.ac.in>, <http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms>
- [3] Shai Simonson, Jun 16, 2014, Data Structures, NPTEL, Available: <http://nptel.ac.in/video.php?-subjectId=106102064>



**20AI&DS3351**  
**DATABASE SYSTEMS LABORATORY**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	1.5
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial-Practice:</b>	0 -0- 3
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

COURSE OUTCOMES		BTL	POI
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Demonstrate DDL, DML and DCL statements with integrity constraints	K3	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2
<b>CO2</b>	Design relational database and manipulate the same using simple and complex queries in SQL	K6	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2, 5.5.2
<b>CO3</b>	Develop Entity Relationship and the corresponding Relational models for the given real-world application	K6	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2, 5.5.2
<b>CO4</b>	Illustrate database objects like Procedure, Functions, Triggers and Package using PL/SQL	K4	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2
<b>CO5</b>	Apply transactions processing, Concurrency control and Recovery techniques on relational database	K3	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2

**Contribution of Course Outcomes towards achievement of Program Outcomes  
(1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	2	2		2								1	1
<b>CO2</b>	1	3	3		3								1	1
<b>CO3</b>	1	3	3		3								1	1
<b>CO4</b>	1	2	2		2								1	1
<b>CO5</b>	1	2	2		2								2	2

## COURSE CONTENT/TASKS

**Task 1:** Execute DDL, DML and DCL Commands on the suitable database.

**Task 2:** Implement the following Integrity Constraints on relevant Database

a. Primary Key    b. Foreign Key    c. Unique    d. Not NULL    e. Check

**Task 3:** Execute the aggregate functions like count, sum, avg etc on the suitable database. Make use of built-in functions according to the need of database chosen. Retrieve data from the database based on date function.

**Task 4:** Apply Set operations (UNION, UNION ALL, INTERSECT and MINUS), Sub-queries, Group by, Order by clause and Pattern Matching operators (LIKE, %, \_) on fine-tuned Database

**Task 5:** Implementation of different types of Joins, Views and Ranks.

**Task 6:** Draw ER diagram for an application with at least 3 entities and establish relationships between them using a tool. Perform ER to Relational mapping to derive Relational database.

**Task 7:** Write PL/SQL procedure for an application using exception handling for the following

- a. Predefined exceptions.
- b. User defined exceptions.

**Task 8:** Write a PL/SQL block for transaction operations of a typical application using triggers.

**Task 9: a.** Create concurrent transactions and obtain concurrency control using SSMS

b. Utilizing recovery management, restore the database in case a catastrophic disk loss occurred.

### Task 10:

For a sample schema join illustrate Choice of join algorithms that will perform query optimization. Also provide a graphical representation of execution plan of how the query optimizer chose to execute a query

### (DBMS LAB PROJECT)

Design and Implement the given Database Application using the following requirements

- **Database Analysis and Design**
  - ✓ Build Conceptual schema using tools
  - ✓ Apply Normalization process for relational database design
  - ✓ Relational Model Database
- **Implementation:**
  - ✓ Front End: Java/Perl/PHP/Python/Ruby/.net

- ✓ Backend: SQL/MySQL/SQLite
- ✓ Database Connectivity: ODBC/JDBC/Servlets

Testing: Data Validation

## **TEXT BOOKS**

[1] Ramez Elmasri, Shamkant B. Navathe, —Fundamentals of Database Systems, 7th edition, Pearson Education Ltd, 2016.

## **REFERENCE BOOKS**

[1] Gordon S Linnoff Data Analysis Using SQL and Excel, 2nd Edition Wiley 2016

[2] Joan Casteel, Oracle 12c:SQL, Cengage Learning ,2017

[3] J D Ullman, —Principles of database systems, Computer Science Press, 2001.

## **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Prof Arnab Bhattacharya IIT Kanpur, SQL Introduction

<https://nptel.ac.in/courses/106104135/10>

[2] Prof Arnab Bhattacharya IIT Kanpur SQL: Updates, Joins, Views and Triggers <https://nptel.ac.in/courses/106104135/11>

[3] Geoff Allix and Graeme Malcolm: Microsoft , Querying with Transact-SQL (edX) <https://www.mooc-list.com/course/querying-transact-sql-edx>

**20AI&DS3352**  
**JAVA PROGRAMMING LABORATORY**

<b>Course Category:</b>	Program Core	<b>Credits:</b>	1.5
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial-Practice:</b>	0-0-3
<b>Prerequisites:</b>	20ES1152 Programming for Problem Solving Laboratory	<b>Continuous Evaluation:</b> <b>Semester end Evaluation:</b> <b>Total Marks:</b>	30 70 100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Design solutions to applications using object oriented approach using Java	<b>K3</b>	1.7.1, 2.5.1, 2.5.2, 2.7.1, 5.4.1, 5.4.2, 11.4.1
<b>CO2</b>	Implement java technology to solve runtime errors and test the correctness of programs using exception handling and assertions	<b>K3</b>	2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1, 3.8.2, 5.4.1, 5.4.2, 11.4.1
<b>CO3</b>	Develop java applications to make use of I/O Streams and multithreading to solve real world problems.	<b>K5</b>	2.5.1, 2.5.2, 3.5.1, 3.8.2, 5.4.1, 5.4.2, 9.6.1, 11.4.1
<b>CO4</b>	Solve real world problems using Collections framework.	<b>K3</b>	2.5.1, 2.5.2, 3.5.1, 3.8.2, 5.4.1, 5.4.2, 9.6.1, 11.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2				1						3		2	1
<b>CO2</b>		2	3		2						2		3	1
<b>CO3</b>		2	2		2				3		2	2	2	2
<b>CO4</b>		2	2		3				3		2	2	2	2

**COURSE CONTENT/TASK**

**Task 1**

Apply fundamentals of Java Data types, Variables, Operators, and Control Statements.

**Task 2**

Apply the concepts of Classes and Objects.

**Task 3**

Apply the concepts of Arrays.

**Task 4**

Apply the concepts of String and String Tokenizer classes.

**Task 5**

Apply the concepts of Inheritance and types of Inheritance.

**Task 6**

Apply the concepts of Method Overloading and Method Overriding.

**Task 7**

Apply the concepts of Packages.

**Task 8**

Apply the concepts of Interfaces.

**Task 9**

Apply the concepts of Exception Handling.

**Task 10**

Develop a Java application to copy content from one file to another file using I/O Streams.

**Task 11**

Apply the concepts of Threads and Multithread.

**Task 12**

Apply the concepts of Lambda Expressions, Collections Framework and Stream API.

**Projects**

1. A group project with unique topics.

**TEXT BOOKS**

- [1] Herbert Schildt, “Java The Complete Reference”, Eleventh Edition, Oracle Press, . 2019.

**REFERENCE BOOKS**

- [1] Herbert Schildt, Dale Skrien, “Java Fundamentals A Comprehension

Introduction”, Special Indian Edition, McGraw-Hill Education India Pvt. Ltd, 2017.

[2] E Balaguruswamy, "Programming with Java", 4th Edition, Mc Graw Hill , 2020.

[3] Paul J. Dietel and Dr.Harvey M. Deitel, “Java How to Program”, Eleventh Edition, Deitel& Associates, Inc.1 , 2018.

[4] Timothy Budd, “Understanding Object Oriented Programming with Java “, Updated edition,Pearson Education, 2013.

[5] Kathy Sierra & Bert Bates, "Head First Java", 2nd Edition, Oreilly.

## **E- RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Prof. DebasisSamanta. (14th,July, 2021), Department of Computer Science & Engineering, I.I.T.,Kharagpur, Swayam, NPTEL.

[https://onlinecourses.nptel.ac.in/noc21\\_cs03/preview](https://onlinecourses.nptel.ac.in/noc21_cs03/preview).

[2] Evan Jones, AdamMarcus,Eugene Wu "Introduction to Programming in Java", MIT OpenCourseWare, Massachusetts Institute of Technology, May 28, 2021.

<https://ocw.mit.edu › courses>

[3] Prof. Owen Astrachan, "Object Oriented Programming in Java", Duke University, 21st May 2021. coursera.org

<https://www.coursera.org/specializations/object-oriented-programming>

[4] DheeruMundluru, "Java In-Depth: Become a Complete Java Engineer", Udemy, 14th May 2021.

<https://www.udemy.com/course/java-in-depth-become-a-complete-java-engineer/>

[5] Prof. OlufisayoOmojokun,"Introduction to Object-Oriented Programming with Java I: Foundations and Syntax Basics", Georgia Institute of Technology, edX, May 2021.

<https://www.edx.org/course/introduction-to-java-programming-i-foundations-and-syntax-basics>

**20AI&DS3353**  
**DATA STRUCTURES LABORATORY**

<b>Course Category:</b>	Program Core	<b>Credits:</b>	1.5
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial-Practice:</b>	0- 0-3
<b>Prerequisites:</b>	20ES1152 Programming for Problem Solving Laboratory	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Demonstrate various operations of stack and queue data structures for problem solving	K4	1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4
<b>CO2</b>	Implement different types of operations on queues and linked lists.	K3	1.7.1, 2.5.1, 2.5.2, 2.8.4
<b>CO3</b>	Perform operations on binary search tree and heap.	K4	1.7.1, 2.5.1, 2.5.2, 2.8.4
<b>CO4</b>	Implement different graph traversal algorithms and hashing techniques to solve problems.	K3	1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4, 12.1.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	2	2										1	2
<b>CO2</b>	1	2	2										1	1
<b>CO3</b>	1	2	2										1	2
<b>CO4</b>	1	2	2									2	1	1

**COURSE CONTENT/TASK**

**Task 1:** Searching and sorting techniques: Linear and binary searches,

**Task 2:** Sorting techniques: Insertion, Merge and Quick sorts.

**Task 3:** Operations on a stack data structure.

**Task 4 and 5:** Stack applications (expression conversion and evaluation)

**Task 6:** Operations on queues and circular queues.

**Task 7:** Operations on singly linked list and doubly linked list.

**Task 8:** Operation on circular linked list.

**Task 9:** Binary search tree operations and tree traversal techniques.

**Task 10:** Operations on heap and heap sort.

**Task 11:** Graph Traversal algorithms: Depth First Search and Breadth First Search.

**Task 12:** Hashing: Open and close hashing techniques.

## **TEXTBOOKS**

- [1] Horowitz Sahni and Anderson-Freed “Fundamentals of Data Structures in C”. 2nd Edition, Universities Press, 2008.
- [2] Reema Thareja, “Data Structures using C”, Second Edition, Oxford University Press, 2011.

## **REFERENCE BOOKS**

- [1] Richard F. Gilberg & B. A. Forouzan “Data Structures A Pseudocode Approach with C”, Second Edition, CENGAGE Learning.
- [2] Mark Allen Weiss, “Data structure and Algorithm Analysis in C”. Addison Wesley Publication. 2006.
- [3] Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with Applications”, McGraw Hill, 1984.
- [4] Thomas Cormen, C.Leiserson, R. L.Rivest & C.Stein, “Introduction to Algorithms”. 3rd Edition, The MIT Press, 2009.

## **E- RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Dr. P. P. Chakraborty, IIT Kharagpur, May 19, 2010, Data Structures, NPTEL, Available: [www.youtube.com/watch?v=S47aSEqm\\_0I](http://www.youtube.com/watch?v=S47aSEqm_0I). Last accessed on 19 May 2022.
- [2] Dr. Naveen Garg, IIT Delhi, Sep 24, 2008, Data Structures, NPTEL, Available: <https://nptel.ac.in/courses/106102064>. Last accessed on 19 May



2022.

[3] Shai Simonson, Jun 16, 2014, Data Structures, NPTEL,

Available: <http://nptel.ac.in/video.php?-subjectId=106102064>. Last accessed on 19 May 2022.

**20TP3106**  
**LOGIC AND REASONING**

<b>Course Category:</b>	Soft Skills - 1	<b>Credits:</b>	1
<b>Course Type:</b>	Learning by Doing	<b>Lecture -Tutorial- Practice:</b>	0-0-2
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	100
		<b>Semester end Evaluation:</b>	0
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Think reason logically in any critical situation	K2	6.2.1
<b>CO2</b>	Analyze given information to find correct solution	K4	2.2.3
<b>CO3</b>	To reduce the mistakes in day to day activities in practical life	K2	8.2.2
<b>CO4</b>	Develop time-management skills by approaching different shortcut methods	K3	9.2.1
<b>CO5</b>	Use mathematical based reasoning to make decisions	K3	1.4.1
<b>CO6</b>	Apply logical thinking to solve problems and puzzles in qualifying exams in any competitive exam.	K3	1.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>						2								
<b>CO2</b>		2												
<b>CO3</b>							2							
<b>CO4</b>								2						
<b>CO5</b>	2													
<b>CO6</b>	1													

**COURSE CONTENT****UNIT I :**

1. Series Completion,
2. Coding-Decoding,
3. Blood Relations,
4. Puzzles test

**UNIT II:**

1. Direction sense test,
2. Logical Venn diagrams,
3. Number test, ranking test,
4. Mathematical operations

**UNIT III:**

1. Arithmetical Reasoning,
2. Inserting missing character,
3. Syllogism.

**UNIT IV: Non – Verbal:**

1. Water images,
2. Mirror images,
3. Paper folding,
4. Paper cutting,
5. Embedded Figures,
6. Dot situation,
7. Cubes & Dice

**TEXT BOOKS**

- [1] R. S. Aggarwal, “ Verbal and non-verbal reasoning”, Revised Edition, S Chand publication, 2017 ISBN:81-219-0551-6

**20MC3107A**  
**ENVIRONMENTAL STUDIES**

<b>Course Category:</b>	Mandatory Course	<b>Credits:</b>	-
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2 - 0 - 0
<b>Prerequisites:</b>	Consciousness of Environment	<b>Continuous Evaluation:</b>	100
		<b>Semester end Evaluation:</b>	0
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Identify various factors causing degradation of natural resource and control measures	K2	1.3.1
<b>CO2</b>	Identify various ecosystem and need for biodiversity	K2	2.8.1, 3.6.2
<b>CO3</b>	Realize and explore the problems related to environmental pollution and its management	K2	3.5.2, 5.5.2
<b>CO4</b>	Apply the information and technology to analyze social issues, use acts associated with environment	K3	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1							1					1	
<b>CO2</b>		1	1							1			1	
<b>CO3</b>				1	1							1	1	
<b>CO4</b>						1	1	1					1	

**COURSE CONTENT**

**UNIT I**

The Multidisciplinary Nature of Environmental Studies  
Definition, scope and importance  
Need for public awareness.

**Natural Resources :**

**Renewable and Non-renewable Resources:** Natural resources and associated problems.

**(a)Forest resources:** Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forests and tribal people.

**(b)Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

**(c)Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources.

**(d)Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

**(e)Energy resources:** Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.

**(f)Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

## UNIT II

### Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem:

(a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem

(d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

### Biodiversity and Its Conservation

Introduction, definition: genetic, species and ecosystem diversity. Biogeographically classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

## UNIT III

### Environmental Pollution

Definition ,Causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards

**Solid waste management:** Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

**Disaster management:** Floods, earthquake, cyclone and landslides.

## UNIT IV

### **Social Issues and the Environment:**

From unsustainable to sustainable development. Urban problems related to energy.

Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns.

**Environmental ethics** Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation.Consumerism and waste products.

### **Environment Protection Act**

Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation.

### **Public awareness**

Human Population and the Environment,Population growth, variation among nations, Population explosion—Family Welfare Programme.

### **Environment and human health**

Human rights, Value education,HIV/AIDS,Women and Child Welfare,Role of Information Technology in environment and human health.

### **Field Work/ Case Studies**

Visit to a local area to document environmental assets—river/forest/grassland/hill/ mountain. Visit to a local polluted site—Urban/Rural/Industrial/Agricultural.Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

### **Self Study:**

Water resources, Threats to biodiversity, Solid waste management, Role of

Information Technology in environment and human health.

### **TEXT BOOKS**

[1] Erach Bharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research

### **REFERENCE BOOKS**

[1] Anjaneyulu Y. Introduction to Environmental sciences, B S Publications PVT Ltd, Hyderabad

[2] Anjireddy.M Environmental science & Technology, BS Publications PVT Ltd,  
Hyderabad

[3] Benny Joseph, 2005, Environmental Studies, The Tata McGraw- Hill publishing company limited, New Delhi.

[4] Principles of Environmental Science. & Engg. P.Venu Gopala Rao, 2006, Prentice-Hall of India Pvt. Ltd., New Delhi.

[5] Ecological and Environmental Studies – Santosh Kumar Garg, Rajeswari Garg

(or) Rajani Garg, 2006, Khanna Publishers, New Delhi.

[6] Essentials of Environmental Studies, Kurian Joseph & R Nagendran, Pearson Education publishers, 2005

[7] A.K Dee – Environmental Chemistry, New Age India Publications

[8] Bharucha Erach- Biodiversity of India, Mapin Publishing Pvt.Ltd.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Erach Bharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and

Research.<https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf>

[2] NPTEL Courses - Environmental Studies By Dr.Tushar Banerjee | Devi Ahilya Viswavidyalaya, Indore.

# **SEMESTER - IV**



**20BS4101G****NUMERICAL METHODS FOR DATA ANALYSIS**

<b>Course Category:</b>	Basic Science	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	<b>Solve</b> algebraic and transcendental equations, system of linear equations and estimate function values near end points for equally spaced arguments.	3	
<b>CO2</b>	<b>Estimate</b> function values near middle points and derivative using polynomial interpolation.	3	
<b>CO3</b>	<b>Evaluate</b> integrals numerically and solve initial value problems.	4	
<b>CO4</b>	<b>Apply</b> Python modules for symbolic computation, to solve IVP and system of equations.	3	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	2			1								1	1
<b>CO2</b>	3	2			1								1	1
<b>CO3</b>	3	2			1								1	1
<b>CO4</b>	3	2			2								1	1

**COURSE CONTENT****UNIT-I****[Text Book-1]**

Numerical Methods: Solution of Algebraic and Transcendental equations, Bisection

method, Newton-Raphson method, Useful deductions from Newton-Raphson formula.

Solution of Linear Simultaneous Equations: Iterative methods of solution, Jacobi's Iterative method, Gauss-Seidel method.

Interpolation: Finite differences, Differences of polynomial, Other difference operators, Relations between the operators, Newton's Interpolation formulae.

## **UNIT-II**

**[Text Book-1]**

Interpolation: Central difference Interpolation formulae, Gauss Forward Interpolation formula, Gauss Backward Interpolation formula, Stirling's formula, Interpolation with unequal intervals, Lagrange's formula for unequal Intervals, Divided differences, Newton's divided difference formula.

Numerical Differentiation: Derivatives using Newton's forward difference formula, Newton's forward difference formula.

## **UNIT-III**

**[Text Book-1]**

Numerical Integration: Newton-Cote's quadrature formula, Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule.

Numerical Solutions of Differential Equations: Introduction, Euler's method, Modified Euler's method, Runge-Kutta method of 4th order.

Simultaneous First Order Differential Equations: Runge-Kutta method of 4th order.

## **UNIT-IV**

**[Text Book-2]**

Numerical methods using Python: Symbolic computation, SymPy, Symbols, Numeric types, Differentiation and Integration, Ordinary differential equations, Linear equations and matrix inversion, Nonlinear equations, Visualizing data, Matplotlib, PyLab, Pyplot, SciPy, Numerical integration, Solving ordinary differential equations, Systems of coupled ODEs, Root finding using bisection method, Root finding using fsolve function, Interpolation.

**TEXT BOOKS**

- 1] B.S.Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 43rd edition, 2014. [UNIT I,II,III]
- [2] Hans Fangohr, “Introduction to Python for Computational Science and Engineering”, online edition link, <https://fangohr.github.io/introduction-to-python-for-computational-science-and-engineering/book.pdf> , Jan21, 2022. [UNIT IV]

**REFERENCE BOOKS**

- 1] Krezig, “Advanced Engineering Mathematics”, John Wiley & sons, 8th edition, 2007.
- [2] R.K.Jain &S.R.K.Iyengar, “Advanced Engineering Mathematics”, 3rd edition, Narosa Publishers.
- S.S.Sastry, “Introductory Methods of Numerical Analysis”, Prentice Hall of India, 2005.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1].Prof.Ameeya Kumar Nayak,Sanjeev Kumar, IIT Roorkee, Numerical methods, Available:[https://onlinecourses.nptel.ac.in/noc21\\_ma45/preview](https://onlinecourses.nptel.ac.in/noc21_ma45/preview)
- [2] Henrik Schmidt, Massachusetts Institute of Technology: MIT Open Courseware, Introduction to Numerical Analysis for Engineering.  
Available:<https://ocw.mit.edu>
- [3] Prof. Adrijit Goswami,IIT Kharagpur,Transform Calculus and its applications in Differential Equations.  
Available:<https://nptel.ac.in/courses/111/105/111105123/>

**20AI&DS4302****DESIGN AND ANALYSIS OF ALGORITHMS**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2 - 1 - 0
<b>Prerequisites:</b>	20AI&DS3305 Data Structures and Algorithms	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand different types of algorithms, asymptotic notations, and performance analysis techniques.	K2	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3
<b>CO2</b>	<i>Apply</i> the algorithm design technique – string matching, divide and conquer, and greedy methods for solving different problems.	K3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4
<b>CO3</b>	<i>Apply</i> dynamic programming, backtracking and branch and bound techniques to solve different problems.	K3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4
<b>CO4</b>	<i>Understand</i> P, NP, NP-Hard, and NP-Complete problems.	K2	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2											2	
<b>CO2</b>	2	2											2	
<b>CO3</b>	2	2											2	
<b>CO4</b>	2	1											1	

**COURSE CONTENT****UNIT – I**

Introduction: Algorithms, algorithms as a technology, recursive and randomized algorithms, growth of functions (Asymptotic notations), recurrences, Solution of Recurrences by substitution, recursion tree method, Master Theorem. Time complexity analysis of Merge and Quick sort.

String Matching: Naive string-matching algorithm, Rabin-Karp algorithm

## UNIT – II

Divide and conquer: General method, Finding the maximum and minimum, Strassen's matrix multiplication.

Greedy method: General method, Job sequencing with deadlines, knapsack problem, Huffman codes, Minimum cost spanning tree: Prims and Kruskal's algorithm, shortest path algorithms: Dijkstra

## UNIT - III

Dynamic Programming: General method, Matrix chain multiplication, longest common subsequence, optimal binary search trees, 0/1 knapsack problem, Traveling salesperson problem.

Backtracking: General method, n-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles, 0/1 knapsack problem.

## UNIT - IV

Branch and Bound: General method, applications - Traveling salesperson problem, 0/1 knapsack problem: LC branch and bound solution, FIFO branch and bound solution.

NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, P, NP, NP Hard and NP Complete problems with examples, Cook's theorem

## TEXT BOOKS

[1] Ellis Horowitz, SatrajSahni and Rajasekharan, "Fundamentals of Computer Algorithms", Galgotia Publications Pvt. Ltd, 2008.

[1] T.H.Cormen, C.E.Leiserson, R.L.Rivest and C.Stein, "Introduction to Algorithms", 2/e, PHI Pvt. Ltd., Pearson Education, 2009.

## REFERENCE BOOKS

[1] Allen Weiss, "Data structures and Algorithm Analysis in C++", Third Edition, Pearson Education, 2007.

[2] M.T.Goodrich and R.Tomassia, "Algorithm Design: Foundations, Analysis and Internet examples", John Wiley and sons, 2006.

## E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] N. Garg, IIT Delhi, Dec 31, 2009, Data Structures and Algorithms, NPTEL, Available:

<http://nptel.ac.in/courses/106102064/25>.

[2] A. G. Ranade, S. Viswanathan, and A. A. Diwan, IIT Bombay, Dec 31, 2009, Design and Analysis of Algorithms, NPTEL, Available:

<https://nptel.ac.in/courses/106/101/106101060/>(last accessed on 12-12-2022)

[3] E. Demaine, S. Devadas, and N. Lynch, MIT, Design and Analysis of Algorithms, MIT OpenCourseWare, Available: (last accessed on 12-12-2022)

<https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/>(last accessed on 12-12-2022)

[4] Timroughgarden.org. Tim Roughgarden's Online Courses. Available :

<http://timroughgarden.-org/videos.html>.(last accessed on 12-12-2022)

**20AI&DS4303**  
**ADVANCED JAVA PROGRAMMING**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2 - 1 - 0
<b>Prerequisites:</b>	Java Programming: 20AI&DS3304	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the basics of HTML and XML	K2	1.7.1, 2.7.1 3.8.2, 3.8.3
<b>CO2</b>	Apply the concepts of Java Servlets for developing Dynamic Web Pages	K3	1.7.1, 3.5.6, 3.8.2, 5.4.2
<b>CO3</b>	Apply the concepts of Java Server Pages to build a Web Application	K3	1.7.1, 3.5.6, 3.8.2, 5.4.2
<b>CO4</b>	Apply Object-relational Mapping Technology and basic Spring Concepts	K3	1.7.1, 3.5.6, 3.8.2, 5.4.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	2	3										1	1
<b>CO2</b>	1		2		3								2	1
<b>CO3</b>	1		2		3								2	1
<b>CO4</b>	1		2		3								2	2

## COURSE CONTENT

### UNIT I:HTML and XML

HTML – Basic concepts of HTML, The Skeleton of a Web Page, Creating a Form, Tables.

XML – Use of XML, The XML Flow, XML Parsers, Browsers and XML, The Design of an XML Document, Nesting Elements, Processing Instructions, Attributes, Create a DTD, Create an XML Schema, Referencing an XML Schema, Create an XSLT.

### UNIT II: JAVA SERVLETS

Java Servlets, Web Applications, Servlets and HTTP Servlets, Filters, Security, Internationalization, Servlet Life Cycle, Servlets for the World Wide Web – Requests, Responses, and Headers, GET and POST, HTTP Response Codes, Coding a HttpServlet – Deploying a Servlet, Web Application Deployment Descriptor Structure, Servlet Configuration – Limitations of Configuration:web.xml Additions, Client/Server Servlet Programming, HttpServletRequest and HttpServletResponse, HttpServletRequest, Servlet Context – Initial Web Application Parameters, Servlet Event Listners.

### UNIT III:JAVA SERVER PAGES

JSP 2.0 Specification– JSP, Java Beans, Custom Tags and JSP Fragments, Expression Language. JSP Lifecycle, Difference between Servlets and JSP, JSP Syntax and Semantics– Elements and Template Data, Two types of Syntax, Scripting Elements, Directives, JSP Configuration, Standard JSP Actions, White Space Preservation, Attributes, Comments, Quoting and Escape Characters, Implicit Objects – pageContext, out, config, page, JSP in XML Syntax – XML Rules, JSP Documents. JavaBeans and JSP Expression Language, JSTL Expression Language, Core Tags– General Purpose Tags, Iteration, Conditionals, URL Manipulation.

### UNIT IV:HIBERNATE AND SPRING

Hibernate: An overview of Object-Relational Mapping (ORM) – Relationships and Cardinality, Object Identity, Cascade, Mapping, In-Memory versus Persisted Objects, Design of Database – Denormalization, Naming Convention, Database Design Disclaimers, DDL Script, HSQLDB, Working with Hibernate.

Spring Framework:Overview of Spring – Spring Packing for Development and Deployment, Overview of the Spring Modules, Benefits of using Spring,



Fundamental Spring Concepts. Spring Web MVC Framework – Benefits, Spring Web MVC Concepts, Spring Setup, Developing User Interfaces with Spring.

### **TEXT BOOKS**

- [1] Jim Keogh, “J2EE: The Complete Reference”, McGraw Hill, 2002. (Unit I)
- [2] Jayson, Falkner, and Jones Kevin. "Servlets and Java Server Pages: The J2EE Technology Web Tier.", Addison-Wesley, 2004. (Unit II, III)
- [3] Hemrajani, Anil. Agile Java Development with Spring, Hibernate and Eclipse. Sams publishing, 2006. (Unit IV)

### **REFERENCE BOOKS**

- [1] Hans Bergsten, “JavaServer Pages”, 3rd Edition, O'Reilly Media, Inc., 2003.
- [2] Christian Bauer, Gavin King, “Hibernate in Action”, Manning Publications, 2005.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Java EE: Servlets and JavaServer Pages (JSP)  
<https://www.linkedin.com/learning/java-ee-servlets-and-javascript-server-pages-jsp>  
Last accessed on 01-12-2022
- [2] Building Cloud Services with the Java Spring Framework  
<https://in.coursera.org/learn/cloud-services-java-spring-framework> Last  
accessed on 01-12-2022

**20AI&DS4304**  
**Computer Networks**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	2
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2 - 0 - 2
<b>Prerequisites:</b>	20AI&DS3305	<b>Continuous Evaluation:</b>	30
	Data Structures	<b>Semester end Evaluation:</b>	70
	and Algorithms	<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the fundamental concepts of computer networks and reference models	K2	1.7.1, 2.6.4
<b>CO2</b>	Analyze error and flow control mechanisms in data link layer	K4	1.7.1, 2.5.2, 2.6.2
<b>CO3</b>	Analyse subnetting and various routing protocols of network layer	K4	1.7.1, 2.5.2, 2.6.4
<b>CO4</b>	Analyze transport layer and application layer protocols for specific applications.	K4	1.7.1, 2.6.3

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3	2											2	
<b>CO2</b>	3	2	1		1								2	1
<b>CO3</b>	3	2											2	
<b>CO4</b>	3	2	3										2	

**COURSE CONTENT**

**UNIT I**

**Introduction:** Uses of Computer Networks, Network Topology, Network Hardware: LANs, MANs, WANs, Connection oriented vs Connection less.

**Reference Models:** The OSI Reference Model, TCP/IP Reference Model, the

comparison of the OSI and TCP/IP reference models.

**Physical Layer:** Guided transmission media: Magnetic Media, Twisted Pair, Coaxial Cable, and Fiber Optics, Wireless Transmission: Radio transmission, Infrared and Light Transmission

## UNIT II

**Data Link Layer:** Design issues - Framing, Error Detection and Correction- Hamming Code , CRC, Checksum, Sliding Window Protocols – One bit sliding window, GoBack – N, Selective Repeat.

**Medium Access Control Sub layer:** Multiple access protocols- Aloha - Slotted Aloha -CSMA, CSMA/CD, Collision Free Protocols, Ethernet: Architecture, Frame Formats – DIX, IEEE 802.3, Wireless LAN: Architecture and Protocol stack, IEEE 802.11 format

## UNIT III

**Network Layer:** Design Issues: Store and forward, Services to transport layer, Implementation of connection less and connection oriented, VC and Datagram Networks, **Routing Algorithms:** Shortest Path, Flooding, DVR, and Link State routing algorithm, Congestion Control Algorithms. IPv4 Protocol, IP address- Classful Addressing – Classless Addressing – Network Address Translation, IPv6- Header, Extension Header

## UNIT IV

**Transport Layer:** UDP Header, TCP Header, Connection establishment, Connection Release, Connection Management, Congestion Control. **Application Layer:** The Domain Name System (DNS), and E-Mail- Architecture, Message Format – RFC 5322, MIME, SMTP.

## TEXT BOOKS

- [1] Andrew S Tanenbaum, David J Wetherall “Computer Networks”, 5th edition, Pearson Education.

## REFERENCE BOOKS

- [1] Behrouz A.Fourozan, “Data Communications and Networking”. 4 ed, TATA McGraw Hill.
- [2] Computer Networking: A Top-Down Approach Featuring the Internet, J.F. Kurose and K.W.Ross, 6th Ed., Pearson Education, 2012

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Prof Sowmya Kanti Ghosh, IIT Kharagpur, NPTEL Lectures, 18th April 2018, Video Lectures, Available: <https://nptel.ac.in/courses/106/105/106105183/>
- [2] MIT Open Courseware, MIT, , 14th May 2015, Video Lectures, Available: <http://ocw.mit.edu/courses/electricalengineering-and-computer-science/6-033-computer-systemengineering-spring-2009/video-lectures/>
- [3] Dheeraj, IIT Kharagpur, 14th May 2015, Lecture Notes, Available: <http://www.cse.iitk.ac.in/users/dheeraj/cs425>

**20HS4105****UNIVERSAL HUMAN VALUES – II : UNDERSTANDING HARMONY**

<b>Course Category:</b>	Humanities and Social Sciences	<b>Credits:</b>	3
<b>Course Type:</b>	Mandatory Course (Suggested by AICTE)	<b>Lecture -Tutorial-Practice:</b>	3 – 0 – 0
<b>Prerequisites:</b>	Universal Human Values - I desirable.	<b>Continuous Evaluation:</b> <b>Semester end Evaluation:</b> <b>Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand and aware of themselves and their surroundings (family, society and nature).	K2	
<b>CO2</b>	Handle problems with sustainable solutions, while keeping human relationships and human nature in mind.	K2	
<b>CO3</b>	Exhibit critical ability and become sensitive to their commitment towards their understanding of human values, human relationship and human society.	K3	
<b>CO4</b>	Apply what they have learnt to their own self in different day-to-day settings in real life.	K3	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>						1			2					
<b>CO2</b>			3											
<b>CO3</b>						2								
<b>CO4</b>								3				2		

**COURSE CONTENT**

## **UNIT – I: Course introduction, need, basic guidelines, content and process for value education:**

**Part-1:** Purpose and motivation for the course, recapitulation from UHV-I, Self-exploration: what is it?, its content and process, ‘Natural acceptance’ and experiential validation- as the process for self-exploration. Continuous Happiness and Prosperity – A look at basic Human Aspirations.

**Part-2:** Right understanding, Relationship and Physical Facility – the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly – A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

(Practice sessions are to be included to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking).

## **UNIT – II: Understanding Harmony in the Human Being – Harmony in Myself:**

**Part-1:** 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).

**Part-2:** 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.

(Practice sessions are to be included to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease).

## **UNIT – III: Understanding Harmony in the Family and Society – Harmony in Human-Human Relationship:**

**Part-1:** Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment 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.

**Part-2:** 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.

(Practice sessions are to be included to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives).

#### **UNIT – IV:**

**Part-1: Understanding Harmony in Nature & Existence – Whole existence as Coexistence:** Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of Nature – recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

**Part-2: 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.

(Part-1: Practice sessions are to be included to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology, etc. Part-2: Practice exercises and case studies are to be taken up in practice (tutorial) sessions eg. to discuss the conduct as an engineer or scientist, etc.)

### **TEXT BOOKS**

[1] Human values and professional ethics, R. R. Gaur, R. Sangal and G. P. Bagaria, Excel Books Private Limited, New Delhi (2010).

### **REFERENCE BOOKS**

[1] Jeevan Vidya: Ek Parichaya, A. Nagaraj, Jeevan Vidya Prakashan, Amarkantak (1999).

[2] Human Values, A. N. Tripathi, New Age International Publishers, New Delhi (2004).

[3] The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better, Annie Leonard, Free Press, New York (2010).

[4] The story of my experiments with truth: Mahatma Gandhi Autobiography, Mohandas Karamchand Gandhi, B. N. Publishing (2008).

[5] Small is beautiful: A study of economics as if people mattered, E. F. Schumacher, Vintage Books, London (1993).

[6] Slow is beautiful: New Visions of Community, Cecile Andrews, New Society Publishers, Canada (2006).

[7] Economy of Permanence, J. C. Kumarappa, Sarva-Seva-Sangh Prakashan, Varanasi (2017).

[8] Bharat Mein Angreji Raj, Pandit Sunderlal, Prabhath Prakashan, Delhi (2018).

[9] Rediscovering India, Dharampal, Society for Integrated Development of Himilayas (2003).

[10] Hind Swaraj or Indian Home Rule, M. K. Gandhi, Navajivan Publishing House, Ahmedabad (1909).

[11] India Wins Freedom: The Complete Version, Maulana Abul Kalam Azad, Orient Blackswan (1988).

[12] The Life of Vivekananda and the Universal gospel, Romain Rolland, Advaita Ashrama, India (2010).



[13] Mahatma Gandhi: The Man who become one with the Universal Being, Romain Rolland, Srishti Publishers & Distributors, New Delhi (2002).

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] AICTE – SIP Youtube Channel:

[https://www.youtube.com/channel/UCo8MpJB\\_aaVwB4LWLAX6AhQ](https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAX6AhQ)

[2] AICTE – UHV Teaching Learning Material:

<https://fdp-si.aicte-india.org/download.php#1>

## 20AI&DS4309 OPERATING SYSTEMS

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	2
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2-0-0
<b>Prerequisites:</b>	20AI&DS3305	<b>Continuous Evaluation:</b>	30
	Data Structures	<b>Semester end Evaluation:</b>	70
	and Algorithms	<b>Total Marks:</b>	100

### COURSE OUTCOMES

BTL

POI

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

<b>CO1</b>	Understand the basic components of an Operating System	K2	1.7.1
<b>CO2</b>	Apply CPU Scheduling and disk scheduling algorithms to achieve specific criteria	K3	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4
<b>CO3</b>	Analyze the mechanisms used for process synchronization and handling deadlocks	K4	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1
<b>CO4</b>	Analyze virtual memory techniques & Secondary storage management techniques	K4	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1

### Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	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
<b>CO1</b>	3												2	
<b>CO2</b>	3	3	1										2	
<b>CO3</b>	3	2	1										2	
<b>CO4</b>	3	3	1										2	

### COURSE CONTENT

## UNIT I

**Operating-System Structures:** Operating-System Services, User and Operating-System Interface, System Calls: Example, Application Programming Interface, Types of System Calls, System Services

**Processes:** Process Concept: The Process, Process State, Process Control Block, Threads, Process Scheduling: Scheduling Queues, CPU Scheduling, Context Switch, Operations on Processes: Process Creation, Process Termination, Interprocess Communication, IPC in Shared-Memory Systems, IPC in Message-Passing Systems: Naming, Synchronization, Buffering.

## UNIT II

**CPU Scheduling:** Basic Concepts: CPU-I/O Burst Cycle, CPU Scheduler, Preemptive & Nonpreemptive Scheduling, Dispatcher, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, RR, Priority, Multilevel Queue, Multilevel Feedback Queue Scheduling, Multiple-Processor Scheduling: Approaches, Multicore Processors, Load Balancing, Processor Affinity, Heterogeneous Multiprocessing, Real-Time CPU Scheduling: Minimizing Latency, Priority-Based, Rate-Monotonic, Earliest-Deadline-First, Proportional Share Scheduling.

**Process Synchronization:** Background, The Critical-Section Problem, Peterson's Solution, Hardware Support for Synchronization, Mutex Locks, Semaphores: Semaphore usage, Semaphore Implementation, Monitors: Usage, Implementing using Semaphores, Resuming a Process, Liveness: Deadlock, Priority Inversion, Classic Problems of Synchronization: The Bounded-Buffer Problem, The Readers-Writers Problem, The Dining-Philosophers Problem

## UNIT III

**Deadlocks:** System Model, Deadlock in Multithreaded Applications: Livelock, Deadlock Characterization: Necessary conditions, Resource-Allocation Graph, Methods for Handling Deadlocks, Deadlock Prevention: Mutual Exclusion, Hold and Wait, No Preemption, Circular Wait, Deadlock Avoidance: Safe State, Resource-Allocation-Graph Algorithm, Bankers Algorithm, Deadlock Detection: Single Instance of Each Resource type, Several Instances, Detection Algorithm Usage, Recovery from Deadlock: Process and Thread Termination, Resource Preemption.

**Main Memory:** Background: Basic Hardware, Address Binding, Logical Vs Physical Address Space, Dynamic Loading, Dynamic Linking & Shared Libraries, Contiguous Memory Allocation: Memory Protection, Memory Allocation, Fragmentation, Paging: Basic Method, Hardware Support, Protection, Shared Pages, Structure of the Page Table: Hierarchical, Hashed Page Tables, Inverted

Page Tables, Swapping: Standard Swapping, Swapping with Paging, Swapping on Mobile Systems.

#### UNIT IV

**Virtual Memory:** Background, Demand Paging: Basic Concepts, Free-Frame List, Performance, Copy-on-Write, Page Replacement: Basic Page Replacement, FIFO, Optimal, LRU, LRU Approximation, Counting Based, Page Buffering, Allocation of Frames: Minimum Number of Frames, Allocation Algorithms, Global vs Local Allocation, Non Uniform Memory Access, Thrashing: Cause of Thrashing, Working-Set Model, Page-Faulty Frequency, Memory Compression

**Mass-Storage Structure:** HDD Scheduling: FCFS, SCAN, C-SCAN Scheduling, **File -System Implementation:** Directory Implementation: Linear List, Hash Table, Allocation Methods: Contiguous, Linked, Indexed Allocation, Free-Space Management: Bit Vector, Linked List, Grouping, Counting, Space Maps, Efficiency and Performance

#### TEXT BOOKS

[1] Abraham Silberschatz, Peter B. Galvin and Greg Gagne, “Operating System Concepts”, 10<sup>th</sup> Edition, John Wiley & Sons Pvt. Ltd, 2018.

#### REFERENCE BOOKS

[1] William Stallings, “Operating System: Internals and Design Principles”, 9<sup>th</sup> Edition, PHI 2018.

[2] Andrew S.Tanenbaum, “Modern Operating Systems”, 4<sup>th</sup> Edition, PHI, 2016.

[3] Dhananjay M Dhamdhere, “Operating Systems – A Concept Based Approach”, 3<sup>rd</sup> Edition, McGraw Hill Publication, 2012

[4] Harvery M Deitel, Paul J Deitel & David R Choffnes, "Operating System", 3<sup>rd</sup> Edition, Pearson Education, 2007

#### E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Prof Santanu Chattopadhyay - NPTEL Course on Operating Sytems @  
<https://nptel.ac.in/courses/106/105/106105214/> Available on 25-7-19

[2] Stanford University - Lecture Notes on Operating Systems @  
<https://www.scs.stanford.edu/21wi-cs140/notes/> Available on 21-05-21

[3] IIT Bombay – Lecture Notes on Operating Systems @  
<https://www.cse.iitb.ac.in/~mythili/os/> Available on 21-05-21

**20AI&DS4351****DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	1
<b>Course Type:</b>	Labratory	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 2
<b>Co - requisites:</b>	20AI&DS3305	<b>Continuous Evaluation:</b>	30
	Data Structures	<b>Semester end Evaluation:</b>	70
	and Algorithms	<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Implement efficient binary trees, M-way search trees, graph traversal and shortest path algorithms.	3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3
<b>CO2</b>	Use divide and conquer, and greedy methods for implementing solutions for problems.	3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3
<b>CO3</b>	Implement solutions for problems using dynamic programming and backtracking.	3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3
<b>CO4</b>	Apply Branch and Bound techniques to write programs for different problems.	3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2									2	2	1	3
<b>CO2</b>	2	3									2	2	1	3
<b>CO3</b>	2	3									2	2	1	3
<b>CO4</b>	2	3									2	2	1	3

**COURSE CONTENT**

Task 1:String Matching algorithm: Naïve string matching, Rabin-Karp algorithm

Task 2:Divide and conquer: find maximum and minimum

Task 3:Divide and conquer: Strassen's matrix multiplication

Task 4:Shortest path algorithms: Dijkstra algorithms.

Task 5: Minimum spanning tree: Kruskal algorithms.

Task 6: Solve Knapsack problems using greedy method

Task 7: Matrix chain multiplication using dynamic programming.

Task 8: Dynamic programming: Optimal binary search tree algorithms

Task 9: N-queen and subset sum problems using backtracking technique.

Task 10: Graph coloring for a connected graph using backtracking technique.

Task 11: Traveling salesperson using branch and bound technique.

Task 12: 0/1 knapsack problems using branch and bound technique.

### **TEXT BOOKS**

- [1] T.H.Cormen, C.E.Leiserson, R.L.Rivest and C.Stein, "Introduction to Algorithms", 2/e, PHI Pvt. Ltd., Pearson Education, 2009.
- [2] Ellis Horowitz, Satraj Sahni and Rajasekharan, "Fundamentals of Computer Algorithms", Galgotia Publications Pvt. Ltd, 2008.

### **REFERENCE BOOKS**

- [1] M.T.Goodrich and R.Tomassia, "Algorithm Design: Foundations, Analysis and Internet examples", John Wiley and sons, 2006.
- [2] Allen Weiss, "Data structures and Algorithm Analysis in C++", Third Edition, Pearson Education, 2007.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] N. Garg, IIT Delhi, Dec 31, 2009, Data Structures and Algorithms, NPTEL, Available:  
<http://nptel.ac.in/courses/106102064/25>.
- [2] A. G. Ranade, S. Viswanathan, and A. A. Diwan, IIT Bombay, Dec 31, 2009, Design and Analysis of Algorithms, NPTEL, Available:  
<https://nptel.ac.in/courses/106/101/106101060/>
- [3] E. Demaine, S. Devadas, and N. Lynch, MIT, Design and Analysis of Algorithms, MIT OpenCourseWare, Available:  
<https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/>
- [4] Timroughgarden.org. TimRoughgarden's Online Courses. Available :  
<http://timroughgarden.-org/videos.html>.

**20AI&DS4352****ADVANCED JAVA PROGRAMMING LABORATORY**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	1.5
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 3
<b>Prerequisites:</b>	20AI&DS3352	<b>Continuous Evaluation:</b>	30
	Java	<b>Semester end Evaluation:</b>	70
	Programming Lab	<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI****Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Design enterprise level web applications with necessary business logic	K3	1.7.1, 2.7.1 3.8.2, 3.8.3
<b>CO2</b>	Implement server-side technologies to create dynamic web pages.	K3	1.7.1, 3.5.6, 3.8.2, 5.4.2
<b>CO3</b>	Create reusable java bean software components.	K6	1.7.1, 3.5.6, 3.8.2, 5.4.2
<b>CO4</b>	Demonstrate a java application with the database using Java Database Connectivity (JDBC)	K4	1.7.1, 3.5.6, 3.8.2, 5.4.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	2	3										1	1
<b>CO2</b>	1		2		3								2	1
<b>CO3</b>	1		2		3								2	1
<b>CO4</b>	1		2		3								2	2

**COURSE CONTENT**

- Task 1: Design a static web page with HTML5 basic elements
- Task 2: Design a static web page with HTML forms
- Task 3: Create a DTD and XML Schema
- Task 4: Deploy a basic servlet
- Task 5: Deploy a servlet for link statistics of browser
- Task 6: Deploy a servlet for uploading the file
- Task 7: Design a JSP page to keep a page counter of how many times it has been visited
- Task 8: Design a JSP page with the usage of JavaBeans, getProperty and setProperty actions
- Task 9: Design a JSP page using a Tag Handler and TLD
- Task 10: Write some simple code to accomplish two things: test the Hibernate setup and also look at a basic example of how to use Hibernate.
- Task 11: Developing TimesheetManager using Hibernate
- Task 12: Develop a user interface using spring.

### **TEXT BOOKS**

- [1] Jim Keogh, "J2EE: The Complete Reference", McGraw Hill, 2002. (Unit I)
- [2] Jayson, Falkner, and Jones Kevin. "Servlets and Java Server Pages: The J2EE Technology Web Tier.", Addison-Wesley, 2004. (Unit II, III)
- [3] Hemrajani, Anil. Agile Java Development with Spring, Hibernate and Eclipse. Sams publishing, 2006. (Unit IV)

### **REFERENCE BOOKS**

- [1] Hans Bergsten, "JavaServer Pages", 3rd Edition, O'Reilly Media, Inc., 2003.
- [2] Christian Bauer, Gavin King, "Hibernate in Action", Manning Publications, 2005.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Java EE: Servlets and JavaServer Pages (JSP)  
<https://www.linkedin.com/learning/java-ee-servlets-and-javascript-server-pages-jsp>
- [2] Building Cloud Services with the Java Spring Framework  
<https://in.coursera.org/learn/cloud-services-java-spring-framework>



**20AI&DS4353****COMPUTER NETWORKS LABORATORY**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	1
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 2
<b>Co - requisites:</b>	20AI&DS3305	<b>Continuous Evaluation:</b>	30
	Data Structures	<b>Semester end Evaluation:</b>	70
	and Algorithms	<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Investigate OSI and TCP reference models in action	K4	1.2.1, 1.7.1, 2.8.1
<b>CO2</b>	Develop java programs for CRC and RSA algorithms	K4	1.2.1, 1.7.1, 2.8.1, 3.6.2, 4.6.1, 5.4.1
<b>CO3</b>	Demonstrate routing algorithms, congestion control & QoS techniques used at network layer	K4	1.2.1, 1.7.1, 2.5.2, 5.5.2
<b>CO4</b>	Implement different protocols used at transport layer and Application layer.	K4	1.2.1, 1.7.1, 2.5.2, 5.5.2

**Contribution of Course Outcomes towards achievement of Program**

**Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>		1											1	
<b>CO2</b>	3	2	1		2								1	2
<b>CO3</b>		3							3				1	
<b>CO4</b>	2	1	3						3				1	

**COURSE CONTENT**

**Task 1:**

Installation of Packet Tracer & environment

Network Representation (PT 1.5.5)

**Task 2:**

Investigate OSI and TCP reference models in action

Part 1: Examine HTTP Web Traffic (PT 3.5.5)

Part 2: Display Elements of the TCP/IP Protocol Suite

**Task 3:**

**Basic Switch and End Device Configuration**

Configure Initial Switch Settings (PT 2.5.5)

Basic Switch and End Device Configuration (PT 2.9.1)

**Task 4:**

Physical Layer

Connect a Wired and Wireless LAN (PT 4.6.5)

Connect the Physical Layer (PT 4.7.2)

**Task 5:**

Basic Router Configuration

Configure Initial Router Settings (PT 10.1.4)

Connect a Router to a LAN (PT 10.3.4)

Troubleshoot Default Gateway Issues (10.3.5)

Basic Device Configuration (PT 10.4.3)

**Task 6:**

Data Link Layer Protocols

Identify MAC and IP Addresses (PT 9.1.3)

Examine the ARP Table (PT 9.2.9)

**Task 7:**

IPv4 Addressing

Subnet an IPv4 Network (PT 11.5.5)

Subnetting Scenario (PT 11.7.5)

**Task 8:**

VLSM

VLSM Design and Implementation Practice (PT 11.9.3)

Design and Implement a VLSM Addressing Scheme (PT 11.10.1)

**Task 9:**

IPv6 Addressing

Configure IPv6 Addressing (PT 12.6.6)

Implement a Subnetted IPv6 Addressing Scheme (PT 12.9.1)

**Task 10:**

ICMP for network testing

Verify IPv4 and IPv6 Addressing (PT 13.2.6)

Use Ping and Traceroute to Test Network Connectivity (PT 13.2.7)

Use ICMP to Test and Correct Network Connectivity (PT 13.3.1)

**Task 11:**

Transport Layer

TCP and UDP Communications (PT 14.8.1)

**Task 12:**

Device Security

Configure Secure Passwords and SSH (PT 16.4.6)

Secure Network Devices (PT 16.5.1)

Installing Wireshark & Using Wireshark to View Network Traffic

**Supplementary Coding Tasks:**

1. Compute Cyclic Redundancy Check (CRC) for a given data frame using the three CRC polynomials – CRC 12, CRC 16 & CRC CCITT.
2. Implement Dijkstra's algorithm to compute the Shortest path for a given graph
3. Obtain Routing table at each node using Distance Vector Routing (DVR) algorithm for a given subnet

**TEXT BOOKS**

[1] Andrew S Tanenbaum, David J Wetherall “Computer Networks”, 5th Edition, Pearson Education

**REFERENCE BOOKS**

[1] Kurose and Ross, “Computer Networks – A Top-down Approach Featuring the Internet”, Pearson Education.

[2] Behrouz A.Fourozan, “Data Communications and Networking”. 4th Ed, TATA McGraw Hill.

[3] Nader F.Mir, Computer and Communication Networks. PHI Publications

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Prof Sowmya Kanti Ghosh, IIT Kharagpur, NPTEL Lectures, 18th April 2018, Video Lectures, Available: <https://nptel.ac.in/courses/106/105/106105183/>

[2] MIT Open Courseware, MIT, 14th May 2015, Video Lectures, Available: <http://ocw.mit.edu/courses/electricalengineering-and-computer-science/6-033-computer-systemengineering-spring-2009/video-lectures/>

[3] Dheeraj, IIT Kharagpur, 14th May 2015, Lecture Notes, Available: <http://www.cse.iitk.ac.in/users/dheeraj/cs425>

**20TP4106****ENGLISH FOR PROFESSIONALS**

<b>Course Category:</b>	Soft Skills - 2	<b>Credits:</b>	1
<b>Course Type:</b>	Learning by Doing	<b>Lecture -Tutorial-Practice:</b>	0 – 0 – 2
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	100
		<b>Semester end Evaluation:</b>	0
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI****Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Present themselves effectively in the professional world	K2	1.2.1, 1.7.1, 2.8.1
<b>CO2</b>	Introduce themselves as well as others appropriately.	K2	1.2.1, 1.7.1, 2.8.1, 3.6.2, 4.6.1, 5.4.1
<b>CO3</b>	Use vocabulary to form sentences and narrate stories by using creative thinking skills	K3	1.2.1, 1.7.1, 2.5.2, 5.5.2
<b>CO4</b>	Involve in practical activity oriented sessions.	K3	1.2.1, 1.7.1, 2.5.2, 5.5.2
<b>CO5</b>	Learn about various expressions to be used in different situations.	K2	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>										3	3			
<b>CO2</b>										3	3			
<b>CO3</b>										3	3			
<b>CO4</b>								2		3	3			
<b>CO5</b>								2						

**COURSE CONTENT****UNIT I**

1. Beginners, Functional, Situational Conversations: Introduction, Importance of spoken English in the placements and Group Discussion Beginners Conversation, Self Introduction Introducing Self, Introducing each other in a team (Pair Activity) Functional Conversation, Seeking Permission from Seniors

Teachers and other superiors (Team Activity), Asking Direction-Direction from stranger or from Helpline, Making Requests, Requests for borrowing books, applications, or any other help from office staff in college or outside.

2. Just a minute: Give a topic and ask the student to talk impromptu, To present the topic in a structured manner

## **UNIT II**

3. Structuring and forming sentences: Structure of mother tongue and pit falls in translation to English, Formation of sentences in English

4. Errors in Usage: Difficulty in right usage of words, Difficulty in Pronunciation-Phonetic differences in mother tongue and English –areas to improve, Idioms and Phrase –Frequently used Idiom and Phrases which help to enhance the quality of presentation and make the presentation meaningful, Meaning of frequently used Idioms and Phrases

## **UNIT III**

5. Introduction to different ways of speaking: Elocution, Debate and Extempore, Principles of Elocution and its challenges practice in session, Principles of Debates and its challenges – practice session, Principles of Extempore - its pitfalls- practice sessions.

## **UNIT IV**

7. Etiquette: Need of Etiquette in Social arena, Dining Etiquette, Social Etiquette in conversation -formal and informal gathering, Book a table etc.

8. Versant Test: Mode of versant Test, Aim of the test and various methods it follows, Practice session.

## **METHODOLOGY**

Audio—Visuals / Hand Outs (Compiled/Created by Training Division, T&P Cell, VR Siddhartha Engineering College), Board & Chalk and Interactive Sessions.

## **Text Books and Reference Books**

[1]. KamaleshSadanand, “A Spoken English”, VOL 1&2; Orient BlackSwan, Second Edition,2014.

[2]. “Communicative English”; Pearson; 2010

**20AI&DS4607**  
**INDUSTRY STANDARD CODING PRACTICE – I**

<b>Course Category:</b>	Skill Oriented Course - 1	<b>Credits:</b>	2
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial-Practice:</b>	1-0-2
<b>Prerequisites:</b>	20AI&DS3305 Data Structures and Algorithms	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand test and development aspects of programming by solving problems at Industry standards.	2	1.2.1, 1.7.1, 2.5.1, 4.6.3
<b>CO2</b>	Apply domain skills and mathematical knowledge to solve any given problem.	3	1.2.1, 2.5.1, 2.5.3, 4.4.1
<b>CO3</b>	Apply methods to optimize solutions for any given problem.	3	1.2.1, 2.5.3, 4.4.1
<b>CO4</b>	Apply elementary data structures to solve problems with test driven development	3	1.2.1, 2.5.3, 4.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3	3		2										
<b>CO2</b>	3	3		2									2	2
<b>CO3</b>	3	3		2									2	2
<b>CO4</b>	3	3		2									2	2

## **COURSE CONTENT**

### **UNIT I**

Problem solving through Competitive Coding, Problem solving using control structures, Numeric series and patterns, Code Complexity analysis, Linear/ Logarithmic/ Super linear/ Polynomial/ Exponential/ Factorial Algorithms, Problem solving on rotations of data, Problem solving on Order statistic problems, Problem Solving Examples Problem solving on matrix data, Memory manipulation techniques using pointers. Memory Arithmetic, Problem solving implementing pointer to an array, Memory Layout, overcoming the segmentation faults, Runtime memory allocation, Coding comparisons of Linear list data structure and Pointers, examples and Practice problems.

### **UNIT II**

Problem solving on string data, Problem solving on String manipulations, coding problems using string handling functions, Problem solving on Multi-String Problems, Problem Solving for long strings, Examples, Practice problems. Problem solving using modular programming, Inter module communications, scopes of data in the code, Problem solving approaches using recursions, Evaluation of Recursive algorithms, Significance of mathematical Recurrence Relations, Evaluation of recurrence relations, Time Analysis, Examples, Practice problems.

### **UNIT III**

Problem solving on operational and traversal logics on linked lists, Problem solving to compare linked lists, detection of a cycle/merge point, Merging sorted linked lists, coding problems on circular linked lists/Double linked lists, Examples, Practice problems. Problem Solving Problem solving through Linked list coding, traversals, Problem solving to compare linked lists, detection of a cycle/merge point, Merging sorted linked lists, Circular linked list formation, Double linked list formation, Examples, Practice problems.

### **UNIT IV**

Problem solving through testing, implementing various testing approaches: Test strategy, Test development, Test execution, Bug fixing, Examples, Practice problems, Problem solving Methods and techniques. Understanding the problem as

math abstract, formation of the logic, Identifying the corner cases, Examples, Practice problems, Version control systems, Git repositories and working trees, adding new version of the files to a Git repository, Examples, practice problems

### **TEXT BOOKS**

- [1] Halim, Steven and Halim, Felix, Competitive Programming 3, 2013.
- [2] Ahmed Shamsul Arefin, Art of Programming Contest, ACM Solver, Second Edition, 2012

### **REFERENCE BOOKS**

- [1] Programming Challenges: The Programming Contest Training Manual By Steven S Skiena, Miguel A. Revilla
- [2] Guide to Competitive Programming: Learning and Improving Algorithms Through Contests By Antti Laaksonen

### **E- RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Topcoder tutorials - <https://www.topcoder.com/community/data-science/data-science-tutorials/>
- [2] Nite Nimajneb's site - <http://comscigate.com/Books/contests/icpc.pdf>
- [3] Slides from a Stanford Course - <http://web.stanford.edu/class/cs97si/>
- [4] Halim, Steven and Halim, Felix, Competitive Programming 3, 2013. Ebook available at lulu.com. Site associate with with the book is <http://cpbook.net>



**20MC4108B**  
**INDIAN CONSTITUTION**

<b>Course Category:</b>	Mandatory Course	<b>Credits:</b>	-
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	2-0- 0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	100
		<b>Semester end Evaluation:</b>	0
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Know the fundamental law of the land	K2	
<b>CO2</b>	Understand how fundamental rights are protected	K2	
<b>CO3</b>	Perceive the structure and formation of the Indian Government System	K2	
<b>CO4</b>	Explain when and how an emergency can be imposed and what are the consequences.	K2	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>										2				
<b>CO2</b>														
<b>CO3</b>							1							
<b>CO4</b>							2					3		

**COURSE CONTENT**

**UNIT I**

**Introduction to Constitution of India:** Meaning of the Constitution Law and Constitutionalism, Historical perspective of constitution of India, Salient features of Constitution of India.

**UNIT II**

**Fundamental Rights:** Scheme of the fundamental rights, scheme of the fundamental right to equality, scheme of the fundamental right to certain freedoms under Article 19, scope of the right of life and personal liberty under Article 21, writs jurisdiction

### **UNIT III**

**Nature of the Indian Constitution:** Federal structure and distribution of legislative and financial powers between the Union and states

**Parliamentary form of Government in India:** The Constitution powers and status of the President of India, Amendment of the Constitutional powers and Procedure, Historical Perspectives of the constitutional amendments in India

**Local Self Government:** Constitutional Scheme in India

### **UNIT – IV**

**Emergency Provisions:** National Emergency, President rule, Financial Emergency

#### **TEXT BOOKS**

[1] Dr. J.N. Pandey, Constitutional Law of India published by Central law Agency, Allahabad, Edition 2018

#### **REFERENCE BOOKS**

[1] V.N Shukla's, Constitution of India Eastern Book Company, Lucknow.

[2] M.P. Jain, Indian Constitution Law, Wadhwa and Company, Nagpur.

[3] D.D. Basu, Constitution of India, Wadhwa and Company, Nagpur

#### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

# **SEMESTER V**

**20AI&DS5301**  
**ARTIFICIAL INTELLIGENCE**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS4302 Design and Analysis of Algorithms	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the techniques and applications of Artificial Intelligence.	<b>K2</b>	1.2.1,1.7.1, 2.5.2
<b>CO2</b>	Apply rules to represent knowledge of real world problems	<b>K3</b>	1.6.1,1.7.1, 2.5.1, 3.5.1
<b>CO3</b>	Apply filler structures for different sentences and know the concepts of Natural Language Processing.	<b>K3</b>	1.6.1,1.7.1, 2.5.1, 3.5.1
<b>CO4</b>	Analyze the key aspects of Expert Systems and apply the concepts of Connectionist Models for complex problems	<b>K4</b>	1.6.1,1.7.1, 2.5.1, 2.7.1,3.5.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	1	2												1
<b>CO2</b>	1	2	3											1
<b>CO3</b>	1	2	3											1
<b>CO4</b>	2	2	3											1

**COURSE CONTENT**

**UNIT I**

**Problems, Problem Spaces And Search:** Defining the Problem as a State space Search, Production Systems, Problem Characteristics, Production system characteristics.

**Heuristic Search Techniques:** Generate-and-test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

**UNIT II**

**Knowledge Representation Issues:** Representations and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation.

**Using Predicate Logic:** Representing Simple Facts in logic, Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution.

**Representing Knowledge Using Rules** - Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning, Matching.

**UNIT III**

**Weak Slot-and-Fillers Structures:** Semantic Nets, Frames

**Strong Slot-and- Fillers Structures:** Conceptual Dependency, Scripts.

**Natural Language Processing:** Introduction, syntactic processing, Semantic analysis, Discourse and pragmatic processing.

**UNIT IV**

**Connectionist Models:** Introduction: Hopfield Networks, Learning in Neural Networks, Applications of Neural Networks.

**Expert Systems:** Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

**TEXT BOOKS**

[1] Elaine Rich, Kevin Knight, Shivashankar B Nair, "*Artificial Intelligence*", 3rd Edition, Tata McGraw Hill Edition,.

**REFERENCE BOOKS**

[1] Patrick Henry Winston 'Artificial Intelligence', 3<sup>rd</sup> Edition, Prentice Hall, 1992

[2] Stuart Russell and Peter Norvig, 'Artificial Intelligence', 3<sup>rd</sup> Edition, Prentice Hall of India, 2009.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Basu, A., & Sarkar, S. (2014, June 29). Artificial Intelligence. NPTEL.  
<https://nptel.ac.in/courses/106105077>.(Last accessed on June 2, 2022.)

[2] Hashimoto, T. (n.d.). CS221: Artificial Intelligence: Principles and Techniques.Stanford University.

<https://stanford-cs221.github.io/spring2022/>.(Last accessed on June 2, 2022.)

**20AI&DS5302**  
**MACHINE LEARNING**

<b>Course Category:</b>	<b>Programme Core</b>	<b>Credits:</b>	<b>3</b>
<b>Course Type:</b>	<b>Theory</b>	<b>Lecture -Tutorial-Practice:</b>	<b>3 - 0 - 0</b>
<b>Prerequisites:</b>	<b>20AI&amp;DS4302</b> <b>Design and Analysis of Algorithms</b>	<b>Continuous Evaluation:</b> <b>Semester end Evaluation:</b> <b>Total Marks:</b>	<b>30</b> <b>70</b> <b>100</b>

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the concepts of computational intelligence in machine learning	<b>K2</b>	1.2.1, 1.6.1, 1.7.1, 2.5.3
<b>CO2</b>	Apply dimensionality reduction techniques for feature selection	<b>K3</b>	1.2.1, 1.6.1, 1.7.1, 2.6.2, 2.6.4, 2.7.2, 3.6.2, 4.4.2
<b>CO3</b>	Apply appropriate machine learning techniques to address the real time problems	<b>K3</b>	1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.7.2, 3.6.1, 3.6.2, 4.4.2, 4.6.1, 5.4.2
<b>CO4</b>	Analyze ensemble models to solve classification problems	<b>K4</b>	1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.7.2, 3.6.1, 3.6.2, 4.4.2, 4.6.1, 5.4.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	1	1											1	1
<b>CO2</b>	2	2		2									1	1
<b>CO3</b>	2	2	2	2	2								1	2
<b>CO4</b>	1	2	2	2	2								1	2

## COURSE CONTENT

### Unit I

**Introduction to Machine Learning:** Introduction. Different types of learning, Examples of Machine Learning Applications

**Supervised Learning:** Learning a Class from Examples, Probably Approximately Correct Learning, Learning multiple classes, Model selection and generalization

**Regression:** Linear regression, Multiple Linear regression, Logistic Regression

**Dimensionality reduction :** Feature Selection, subset selection, Principal Component Analysis, Linear Discriminant Analysis

### UNIT II

**Decision tree learning:** Introduction, Decision tree representation, appropriate problems for decision tree learning, the basic decision tree algorithm, issues in decision tree learning

**Artificial Neural Networks** – Neural network representation, Appropriate problems for neural network learning, Perceptrons: Gradient descent and the Delta rule, Multilayer networks and the back propagation algorithm

**Basics of Sampling theory:** Error Estimation and Estimating Binomial Proportions, The Binomial Distribution, Mean and Variance, Estimators, Bias, and Variance, Confidence Intervals

### UNIT III

**Bayesian learning:** Introduction , Bayes Theorem, Naïve Bayes Classifier, Bayes optimal classifier, Bayesian Belief networks, Conditional independence, Learning Bayesian belief networks

**Parametric Methods:** Maximum Likelihood Estimation

**Non paramteric methods:** K nearest neighbor

**Support Vector Machine:** Introduction, Optimal Separating Hyperplane , The Nonseparable Case: Soft Margin Hyperplane , Defining Kernels

### UNIT IV

**Ensembles:** Introduction, Bagging and Boosting, Random forest

**Clustering:** Introduction, K-means clustering, Expectation maximization algorithm, Hierarchical clustering, Density based clustering: DBSCAN, Choosing the Number of Clusters

**Algorithm evaluation methods:** Classification Accuracy, Confusion Matrix

### TEXT BOOKS

1. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.
2. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.



**REFERENCE BOOKS**

1. Stephen Marsland, “Machine learning An algorithmic Perspective”, Second Edition, CRC Press, 2015
2. Jiawei Han, Jian Pei, Hanghang Tong, Data Mining Concepts and Techniques, fourth edition, Elsevier Science, 2022
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

1. Prof. Balaraman Ravindran, Introduction to Machine Learning  
[https://onlinecourses.nptel.ac.in/noc22\\_cs29/preview](https://onlinecourses.nptel.ac.in/noc22_cs29/preview) last accessed on 20-12-2022
2. Andrew Ng, Machine Learning Specialization  
<https://www.coursera.org/specializations/machine-learning-introduction> last accessed on 20-12-2022

**20HS5103****ENGINEERING ECONOMICS AND MANAGEMENT**

<b>Course Category:</b>	Humanities and Social Sciences	<b>Credits:</b>	2
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2 - 0 - 0
<b>Prerequisites:</b>		<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI****Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand various forms of organizations and principles of management	K2	1.2.1, 1.7.1, 2.8.1
<b>CO2</b>	Understand the various aspects of business economics.	K2	1.2.1, 1.7.1, 2.8.1, 3.6.2, 4.6.1, 5.4.1
<b>CO3</b>	Perceive the knowledge on Human resources and Marketing functions	K2	1.2.1, 1.7.1, 2.5.2, 5.5.2
<b>CO4</b>	Evaluate various alternatives economically.	K4	1.2.1, 1.7.1, 2.5.2, 5.5.2

**Contribution of Course Outcomes towards achievement of Program****Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3											3		3
<b>CO2</b>	3				3							3		3
<b>CO3</b>	3											3		3
<b>CO4</b>	3				3							3		3

**COURSE CONTENT****UNIT - I**

**Forms of Business Organization:** Salient Features of Sole Proprietorship, Partnership, Joint Stock Company, Co-operative Society and Public Sector.

**Management:** Introduction to Management, Functions of Management, Principles of Scientific Management, Modern Principles of Management.

**UNIT - II**

**Introduction to Economics:** Introduction to Basic Economic Concepts, Utility Analysis: Marginal Utility and Total Utility, Law of Diminishing Marginal Utility, Law of Equi Marginal Utility.

**Demand Analysis:** Theory of Demand: Demand Function, Factors Influencing Demand, Demand Schedule and Demand Curve, Shift in Demand, Elasticity of Demand: Elastic and Inelastic Demand, Types of Elasticity.

**Supply Analysis:** Supply Schedule and Supply Curve, Factors Influencing Supply, Supply Function.

**UNIT – III**

**Human Resource Management:** Meaning and difference between Personnel Management and Human Resource Management, Functions of Human Resource Management.

**Marketing Management:** Concept of Selling And Marketing – Differences, Functions of Marketing, Product Life Cycle, Concept of Advertising, Sales Promotion, Types of Distribution Channels, Marketing Research, Break-Even Analysis.

**UNIT – IV**

**Financial Management:** Functions of Financial Management, Time value of money with cash flow diagrams, Concept of Simple and Compound Interest.

**Depreciation:** Causes of depreciation, Factors influencing depreciation, common methods of Depreciation: Straight Line Method, Declining Balance Method, Sum of Year's Digits Method –Problems.

**Economic Alternatives:** Methods of Evaluating Alternatives under Present worth method, Future worth method, Annual Equivalent method - Problems.

**TEXT BOOKS**

[1] M. Mahajan Industrial Engineering and Production Management Dhanpat Rai

Publications 2nd Edition.

[2] Martand Telsang'' Industrial & Business Management'' S.Chand publications

**REFERENCE BOOKS**

- [1] R.Paneer selvam “Production and Operations Management” PHI
- [2] Philip Kotler & Gary Armstrong “Principles of Marketing” ,pearson prentice Hall, New Delhi,2012 Edition.
- [3] IM Pandey, “Financial Management” Vikas Publications 11th Edition
- [4] B.B Mahapatro, “Human Resource Management”,New Age International, 2011

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1]<https://www.toppr.com/guides/fundamentals-of-economics-and-management/supply/supply-function/>
- [2]<https://keydifferences.com/difference-between-personnel-management-and-human-resource-management.html>
- [3] <http://productlifecyclestages.com/>
- [4] <https://speechfoodie.com/cash-flow-diagrams/>

**20AI&DS5404A**  
**AI IN HEALTHCARE**

<b>Course Category:</b>	Program Elective I	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS4302 Design and Analysis of Algorithms	<b>Continuous Evaluation:</b> <b>Semester end Evaluation:</b> <b>Total Marks:</b>	30 70 100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the basics of Artificial Intelligence in Health Care.	K2	1.2.1,1.6.1
<b>CO2</b>	Understand the concepts in Digitalization of Health Care.	K2	1.2.1,1.6.1,2.5.1,2.5.2
<b>CO3</b>	Apply Artificial Intelligence concepts for developing the applications related to Health Care.	K3	1.2.1,1.6.1,2.5.1,2.5.2
<b>CO4</b>	Analyze to scale Artificial intelligence for e-Health Care with optimized cost.	K4	2.5.1,2.5.2,3.5.5

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1												1	2
<b>CO2</b>	1	2											1	2
<b>CO3</b>	1	2											1	2
<b>CO4</b>		2	1										1	2

**COURSE CONTENT**

**UNIT I**

**Monitoring + AI = Rx for Personal Health:** Prescription (Rx) for Personal Health, Three Realms Influencing Healthcare, Ambient Computing and Healthcare, Continuous Monitoring Using AI. Continuous Monitoring, Beeps, Chimes, Dings, and Dongs, Health Continuum, Application of IoT and AI to Medical Care, Health Determinants and Big Data.

**UNIT II**

**Digital Transformation and AI: Digital Transformation of Healthcare:** -Path A: Creating Digital Operations and Processes, Path B: Building New Capabilities, Path C: Transforming Business Processes, Paths to the Digital Transformation of Healthcare.

**Digital Healthcare:**-AI Applied to Digital Healthcare, AI, Digitization, and Big Tech. **Preventive and Chronic Disease Management:**-AI and Prevention, AI and Chronic Disease, AI and Mental Health. AI and Telemedicine, **Medication Management and AI Medication Adherence,** Digital Medication, AI and Digitization Applied to Administrative Tasks

**UNIT III****Emerging Applications in Healthcare Using AI:**

Improving Human Health, Improving Human Lives, Making Technology Work for Healthcare, Ambient Intelligence, From a Patient's Perspective, From a Doctor's Perspective, From a Hospital System's Perspective ,From an Insurer's Perspective, Emerging Applications and Services, Coordination of Care Platform, Disease State Management Platform, Human to Machine Experience Services ,Customer Journey Platform .Clinician Decision Support Tools, Ambient Intelligence Environments, Digital Twin Platform, Real-Time Healthcare.

**UNIT IV**

**AI at Scale for Healthcare Organizations:** Achieving AI at scale, Transforming Healthcare

The Chasm, Invisible Engines—Healthcare Platforms, Inpatient Care. The Road to a Healthcare Platform .Ecosystems, Application Programming Interfaces (APIs)

**TEXT BOOKS**

[1] Kerrie L. Holley and Siupo Becker, M.D -AI-First Healthcare, Published by O'Reilly Media, Inc, April 2021: First Edition

**REFERENCE BOOKS**

[1] Edward H. Shortliffe; Leslie E. Perreault, Medical Informatics – Computer Applications in Healthcare and Biomedicine, Springer-Verlag New York Inc.Publishers, 2014.

[2] Arnold, M. (2016). Digital health news update: Machine learning meets health search. Decision Resources Group

[3] Blenner, S. R., Köllmer, M., Rouse, A. J., Daneshvar, N., Williams, C., Andrews, L. B. (2016) Privacy Policies of Android Diabetes Apps and Sharing of Health Information. JAMA, 315(10), 1051.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] <https://www.udacity.com/course/ai-for-healthcare-nanodegree--nd320> (AI for Healthcare).

[2] <https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare> (Surgical robots, new medicines and better care: 32 examples of AI in healthcare).

[3] <https://healthtechmagazine.net/article/2020/02/future-artificial-intelligence-healthcare> (Future of Artificial Intelligence in Healthcare).

**20AI&DS5404B****BUSINESS INTELLIGENCE AND DATA VISUALIZATION**

<b>Course Category:</b>	<b>Program Elective I</b>	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3-0-0
<b>Prerequisites:</b>	20AI&DS3303 Database Systems	<b>Continuous Evaluation: Semester end Evaluation:</b>	30 70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand the need and value of business intelligence	K2	1.6.1,1.7.1
<b>CO2</b>	Understand business intelligence environment and models	K2	1.6.1, 1.7.1
<b>CO3</b>	Apply data visualization anatomy for data representation and presentation	K3	1.6.1,1.7.1, 2.7.1
<b>CO4</b>	Analyse the data visualization methods.	K4	1.6.1,1.7.1,2.7.1, 2.6.4,2.6.5

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	1												1	1
<b>CO2</b>	2												2	2
<b>CO3</b>	2	2											2	2
<b>CO4</b>	2	2											2	2

**COURSE CONTENT****UNIT I**

**Business Intelligence and Information Exploitation:** Introduction to Business Intelligence ,The Information Asset ,Exploiting Information ,Business Intelligence and Program Success , Actionable Knowledge.



**The Value of Business Intelligence:** The Information Asset and Data Valuation, Actionable Knowledge-Return on Investment, Business Intelligence Applications, The Intelligence Dashboard Business Intelligence Adds Value .

## UNIT II

**The Business Intelligence Environment:** The Business Case, The Business Intelligence Process, System Infrastructure, Information Access, Delivery, and Analysis, Services.

**Business Models and Information Flow:** Information Processing and Information Flow, The Information Flow Model, Usage in Practice ,Modeling Frameworks .

## UNIT III

**The Context of Data Visualization :** Visualization as a discovery tool, The bedrock of visualization knowledge, Defining data visualization, Visualization skills for the masses, The data visualization methodology.

**Conceiving and Reasoning Visualization Design Options:** Data visualization design is all about choices, The visualization anatomy – data representation, The visualization anatomy – data presentation

## UNIT IV

**Taxonomy of Data Visualization Methods:** Data visualization methods, Choosing the appropriate chart type, Comparing categories, Dot plot ,Bar chart, Floating bar,Pixelated bar chart,Histogram, SlopeGraph, Radial chart,Glyph chart,Assessing hierarchies and part-to-whole relationships,Pie chart,Stacked bar chart,Square pie,Tree map,Circle packing diagram,Bubble hierarchy,Tree hierarchy,Showing changes over time,Line chart,Sparklines,Area chart,Plotting Connections and Relationships,Scatterplot,Bubble plot,Heat map,Case studies-coca-cola: shaping the essence of analytics, linkedin: empowering of the sales team.

## TEXT BOOKS

- [1] Loshin, David. Business intelligence: the savvy manager's guide,Newnes, 2012. [UNIT-I,II]
- [2] Kirk, Andy. Data Visualization: a successful design process,Packt publishing LTD, 2012. [UNIT-III, IV]

**REFERENCE BOOKS**

- [1] Kemper, Hans-Georg, Walid Mehanna, and Carsten Unger “Business Intelligence-Grundlagen und praktische Anwendungen” Wiesbaden: Vieweg+ Teubner, Third Edition 2010.
- [2] Moss, Larissa T., and Shaku Atre. “ Business intelligence roadmap: the complete project lifecycle for decision-support applications”. Addison-Wesley Professional, 2003.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Business Intelligence Concepts, Tools, and Applications by Jahangir Karimi, University of Colorado.  
<https://www.coursera.org/learn/business-intelligence-tools>  
(Last Accessed on 15-10-2022)
- [2].Introduction to learning analytics by Ramkumar Rajendran, IIT Bombay  
<https://freevideolectures.com/course/4041/nptel-introduction-to-learning-analytics/11> (Last accessed on 15-10-2022)
- [3].<https://datarootlabs.com/blog/complex-data-visualization-with-tableau-use-cases> (Last accessed on 15-10-2022)

**20AI&DS5404C**  
**CRYPTOGRAPHY AND NETWORK SECURITY**

<b>Course Category:</b>	Programme Elective I	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS4304 Computer Networks	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand fundamental principles of security and symmetric encryption	K2	1.7.1, 2.6.4
<b>CO2</b>	Apply asymmetric encryption techniques and Cryptographic Hash functions	K3	1.7.1, 2.5.2, 2.6.4, 3.6.2
<b>CO3</b>	Apply Authentication applications and Transport Layer Security mechanisms	K3	1.7.1, 2.5.2, 2.6.4
<b>CO4</b>	Understand the protocols for network security and methods to safeguard the network	K2	1.7.1, 2.5.3, 2.6.3, 3.6.2, 5.4.2

**Contribution of Course Outcomes towards achievement of Program Outcomes  
(1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3	3												
<b>CO2</b>	2	3	3											2
<b>CO3</b>	2	2												
<b>CO4</b>		2	3		3									2

## COURSE CONTENT

### UNIT I:

**Overview:** Security attacks, Services, A model for network security; Basics of Cryptography, Cryptanalysis. Symmetric cipher model.

**Classical encryption techniques:** Substitution Techniques: Caesar Cipher, Mono alphabet Cipher, Playfair Cipher Transposition Techniques: Rail Fence, Row & Column Transposition,

**Block Cipher:** Stream and Block Cipher, DES, Strength of DES, AES

**Block cipher Operations:** Multiple Encryption, ECM, CBC, CFM, OFM, CTR

### UNIT II:

**Number Theory:** Prime Numbers, Fermat's theorem, Euler's Theorem

**Public Key Cryptography:** Principles of Public Key Crypto System, RSA algorithm, Diffie-Hellman Key Exchange, Problems, Elliptic Curve Cryptography

**Cryptographic Hash Functions:** Applications-Message Authentication, Digital signatures, SHA- 512 Logic, Round Functions

### UNIT III:

**Key Management and Distribution:** Distribution of Public Keys, X.509 Certificates,

**User Authentication:** Kerberos: Motivation, Kerberos Version 4, Kerberos Version 5

**Transport Level Security:** Web Security Threats, Web Traffic Security Approaches.

**Transport Layer Security:** TLS - TLS Architecture, Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol, Cryptographic Computations

**HTTPS:** Connection Initiation, Connection Closure

### UNIT IV:

**Email Security:** S/MIME - Operational Description, S/MIME Message Content Types, Approved Cryptographic Algorithms, PGP

**IP Security:** Overview: Applications, Benefits, IPsec Documents, IPsec Services, Transport and Tunnel Modes, Encapsulating Security Payload - ESP Format, Encryption and Authentication Algorithms, Padding, Anti-Replay Service, Transport and Tunnel Modes

**Malicious Software:** Types – Viruses, Backdoor, Logic Bomb, Trojan Horses  
**Firewalls:** The Need for Firewalls, Characteristics, Types of Firewalls - Packet Filtering Firewall, Stateful Inspection Firewalls, Application-Level, Gateway Circuit-Level Gateway, Firewall Basing- Bastion Host, Host-Based Firewalls, Personal Firewall.

### **TEXT BOOKS**

- [1] William Stalligs, Cryptography and Network Security: Principles and Practice. 5th & 7th ed, Pearson Education, 2017.  
[2] J. Katz and Y. Lindell, “Introduction to Modern Cryptography”, CRC Press, 2008

### **REFERENCE BOOKS**

- [1] Cryptography and Network Security: ForouzanMukhopadhyay, McGraw Hill, 2<sup>nd</sup> Edition  
[2] Network Security and Cryptography, Bernard Menezes, CENGAGE Learning  
[3] Cryptography & Network Security, AtulKahate, McGraw Hill

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] nptelonlinecourse.com, ”Cryptography and network Security”, 2021. [Online]. Available: <https://nptel.ac.in/courses/106/105/106105162/>  
Accessed on 02/12/2021.  
[2]cybrary.com, “Cryptography”, 2021, [Online]. Available: <https://www.cybrary.it/course/fundamental-cryptography-data-protection/>. Accessed on 02/12/2021

**20AI&DS5404D**  
**MICROPROCESSORS & MICROCONTROLLERS**

<b>Course Category:</b>	Program Elective I	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20ES3102 Digital Logic & Computer Design	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the fundamental concepts, internal Architecture and interrupts of 8086 $\mu$ P.	K2	1.7.1
<b>CO2</b>	Apply 8086 Microprocessor Programming Knowledge to solve the problems.	K3	1.7.1,2.7.1,3.8.3
<b>CO3</b>	Apply Interfacing on different peripherals with Microprocessor.	K3	1.7.1,2.7.1,3.8.3
<b>CO4</b>	Understand the internal architecture & programming of 8051 microcontroller.	K2	1.7.1,2.7.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2													2
<b>CO2</b>	1	2	3											2
<b>CO3</b>	2	3	3											2
<b>CO4</b>	2	2												2

**COURSE CONTENT**

**UNIT I****The 8086 Microprocessor:**

Overview of microcomputer structure & operation, overview of 8086 microprocessor family, features of advanced Pentium processors, 8086 internal architecture, Machine language Vs assembly language, 8086 addressing modes. 8086 pin diagram, 8086 minimum mode and maximum mode

**UNIT II****8086 Instruction Set & Programming:**

Data transfer instructions, arithmetic instructions, bit manipulation instructions, string instructions, program execution transfer instructions, and processor control instructions, Assembler directives.

Standard 8086 assembly language program structure, Assembly language program development tools, writing simple programs in 8086 assembly language, Writing and using procedures and assembler macros

**UNIT III**

**Interrupts:** 8086 interrupts and interrupt responses, 8259A priority interrupt controller

**Interfacing With 8086 Microprocessor**

Programmable parallel ports and hand shake input/output, the programmable peripheral interface 8255A: modes of operation and initialization, Basics of D/A and A/D converters. Interfacing of DAC and ADC to 8086 microprocessor.

**UNIT IV**

**The 8051 Microcontroller:** 8051 micro controller hardware, inputs/ outputs pins, ports and circuits, counters and timers, serial data input/output, interrupts.

**Programming The 8051:**

Addressing Modes, External data moves, code memory read only data moves, PUSH and POP op codes, data exchanges, byte level and bit level logical operations rotate and swap operations, arithmetic operations jumps, calls & subroutines Interrupts & returns

**TEXT BOOKS**

[1] Douglas V Hall, "Microprocessor and Interfacing", 3rd edition, McGraw Hill, 2016.

[2] Kenneth J. Ayala, “8051 Micro Controller Architecture” 3rd ed. ThomsonDelmar Learning, 2007

### **REFERENCE BOOKS**

[1] K M Bhurchandi, A.K.Ray, “Advanced Microprocessors and Peripherals”, 3rd edition, McGraw Hill, 2014

[2] A.Nagoor Kani, “Microprocessors and Microcontrollers”, 2nd edition, McGraw Hill, 2015

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] [Prof. Krishna Kumar](#), IISc Bangalore “Microprocessors and Microcontrollers” [Web Content].

Available: <http://nptel.ac.in/courses/106108100/> (Accessed on 23.11.2022)



**20AI&DS5404E**  
**DISTRIBUTED COMPUTING FOR DATA SCIENCE**

<b>Course Category:</b>	Program elective 1	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS4309 Operating Systems	<b>Continuous Evaluation:</b> <b>Semester end Evaluation:</b> <b>Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand the concepts of data Science with distributed computing.	K2	1.6.1, 1.7.1
<b>CO2</b>	Analyse data in distributed Frame works.	K4	1.6.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.6.5
<b>CO3</b>	Analyse data in distributed environment using visualization tools.	K4	1.6.1, 1.7.1, 2.5.2, 2.6.3, 2.6.5, 5.4.1
<b>CO4</b>	Apply data modelling with Hadoop.	K3	1.6.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.6.5

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2													
<b>CO2</b>	2	2											1	
<b>CO3</b>	2	2			1								1	
<b>CO4</b>	2	2											1	

**COURSE CONTENT**

**UNIT I**

**Introduction to Data Science:** What Is Data Science, Example: Search Advertising, A Bit of Data Science History, Becoming a Data Scientist, Building a

Data Science Team, The Data Science Project Life Cycle.

**Use Cases for Data Science:** Big Data—A Driver of Change, Business Use Cases.

**Hadoop and Data Science:** What Is Hadoop, Hadoop's Evolution, Hadoop Tools for Data Science, Why Hadoop Is Useful to Data Scientists.

## UNIT II

**Getting Data into Hadoop:** Hadoop as a Data Lake, The Hadoop Distributed File System (HDFS), Direct File Transfer to Hadoop HDFS, Importing Data from Files into Hive Tables, Importing Data into Hive Tables Using Spark, Using Apache Sqoop to Acquire Relational Data, Using Apache Flume to Acquire Data Streams.

**Data Munging with Hadoop:** Why Hadoop for Data Munging, Data Quality, The Feature Matrix.

## UNIT III

**Exploring and Visualizing Data :** Why Visualize Data, Creating Visualizations, Using Visualization for Data Science, Popular Visualization Tools, Visualizing Big Data with Hadoop.

**Machine Learning with Hadoop:** Overview of Machine Learning, Terminology, Task Types in Machine Learning, Big Data and Machine Learning, Tools for Machine Learning, The Future of Machine Learning and Artificial Intelligence

## UNIT IV

**Predictive Modeling:** Overview of Predictive Modeling, Classification Versus Regression, Evaluating Predictive Models, Supervised Learning Algorithms, Building Big Data Predictive Model Solutions.

**Anomaly Detection with Hadoop:** Uses of Anomaly Detection, Types of Anomalies in Data, Approaches to Anomaly Detection, Tuning Anomaly Detection Systems, Building a Big Data Anomaly Detection Solution with Hadoop.

## TEXT BOOKS

[1] Ofer Mendeleevitch, Casey Stella, Douglas Eadline : Practical Data Science with Hadoop and Spark, Addison Wesley - 2017.

**REFERENCE BOOKS**

- [1] Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, “Distributed and cloud computing from Parallel Processing to the Internet of Things”, Morgan Kaufmann, Elsevier, 2012
- [2] George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Distributed Systems - Concepts and Design, Addison Wesley - 2012

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Big Data Computing By Prof. Rajiv Misra, IIT Patna  
[https://onlinecourses.nptel.ac.in/noc20\\_cs92/preview](https://onlinecourses.nptel.ac.in/noc20_cs92/preview)  
(last accessed on 12-11-2022)
- [2] Cloud Computing and Distributed Systems, IIT Patna  
Dr.Rajiv Misra <https://nptel.ac.in/courses/106104182>  
(last accessed on 12-11-2022)
- [3] Introduction to Distributed Systems  
<https://www.digimat.in/nptel/courses/video/106106168/L01.html>  
(last accessed on 12-11-2022)

**20AI&DS5404F**  
**INFORMATION RETRIEVAL SYSTEMS**

<b>Course Category:</b>	Program Elective I	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS3303 Database Systems	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the overview of information Retrieval	<b>K2</b>	1.2.1,1.2.2,1.6.1, 1.7.1
<b>CO2</b>	Apply different techniques for compression of an index including the dictionary and its posting list	<b>K3</b>	2.5.1,2.6.4,2.7.1,4.6.1
<b>CO3</b>	Apply appropriate method for text classification or clustering	<b>K3</b>	1.2.1,1.2.2,1.6.1, 1.7.1,2.5.1,2.6.4, 2.7.1,4.6.1
<b>CO4</b>	Understand the basics of web search	<b>K2</b>	1.2.1,1.6.1,1.7.12.8.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2	2	1											1
<b>CO2</b>	2		2	3	2									1
<b>CO3</b>	2	1	2	3										1
<b>CO4</b>	2	2	1											1

## COURSE CONTENT

**UNIT I: Fundamentals of Information Retrieval(IR), Models and Index construction and compression:** Boolean retrieval, The term vocabulary and postings lists, Dictionaries and tolerant retrieval, Index construction and compression, Scoring, term weighting, and the vector space model, Computing scores in a complete search system, Introduction to Relevance feedback and query expansion.

**Probabilistic information retrieval:** Review of basic probability theory, The probability ranking principle, The binary independence model.

**Language models for information retrieval:** Language modeling versus other approaches in information retrieval

### UNIT II: Text Classification

**Text classification and Naive Bayes:** The text classification problem, Naive Bayes text classification, Properties of Naive Bayes, The Bernoulli model, Feature selection, Evaluation of text classification.

**Vector space classification:** Document representations, Measures of relatedness in vector spaces, Rocchio classification, k nearest neighbour, Linear versus nonlinear classifiers, Classification with more than two classes.

Support vector machines (SVM) and machine learning on documents, Evaluation in information retrieval.

### UNIT III: Text Clustering, Matrix decompositions and latent semantic indexing

**Flat clustering:** Clustering in information retrieval, Problem statement, Evaluation of clustering, K-means, Model-based clustering.

**Hierarchical clustering:** Hierarchical agglomerative clustering, Single-link and complete-link clustering, Group-average agglomerative clustering, Centroid clustering, Optimality of hierarchical agglomerative clustering, Divisive clustering, Cluster labelling.

**Matrix decompositions and latent semantic indexing:** Term–document matrices and singular value decompositions, Low-rank approximations, Latent semantic indexing.

**UNIT IV:Web Information Retrieval**

**Web search basics:** Web search basics, Web characteristics, Index size and estimation, Near duplicates and shingling

**Web Crawling and Indexes:** Crawling, Distributing Indexes, Connectivity servers.

**Link Analysis:** Web as a graph, PageRank, Hubs and authorities.

**TEXT BOOKS**

[1] Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze, “An Introduction to Information Retrieval”, Cambridge University Press,2008.

**REFERENCE BOOKS**

[1] Stefan Büttcher, Charles L, A. Clarke, Gordon V. Cormack, “Information Retrieval: Implementing and evaluating search engines”, MIT Press, 2010

[2] David A. Grossman, OphirFrieder, “Information Retrieval: Algorithms and Heuristics”, Springer, 2004

[3] Frakes, “Information Retrieval: Data Structures and Algorithms”, Pearson, 2009

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Information Retrieval and Web Search <https://web.stanford.edu/class/cs276/>  
(Last accessed on 12-11-2-022)

**20AI&DS5205A****INTRODUCTION TO TOOLKITS FOR MACHINE LEARNING**

<b>Course Category:</b>	Open Elective 1	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2-0-2
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand PyTorch fundamentals used in various AI applications	K2	1.7.1, 2.5.2, 2.6.3,5.4.1
<b>CO2</b>	Understand the Scikit-learn software libraries used in machine learning	K2	1.7.1, 2.5.2, 2.6.3,5.4.1
<b>CO3</b>	Apply TensorFlow concepts to build and deploy models in the real world	K3	1.7.1, 2.5.2, 2.6.3,2.7.1, 5.4.1
<b>CO4</b>	Apply the Pytorch concepts to build neural networks	K3	1.7.1, 2.5.2, 2.6.3,2.7.1,5.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	1			1									1
<b>CO2</b>	1	1			1									1
<b>CO3</b>	2	2			2									2
<b>CO4</b>	2	2			2									2

**COURSE CONTENT****UNIT I**

Introduction to Pytorch basics, installing Pytorch, creating tensors in pytorch, manipulating data type and shape of a tensor, applying mathematical operations to tensors, split, stack, and concatenate tensors,

Building input pipelines in pytorch, creating a pytorch loader from existing loaders, combining tensors into a joint dataset, shuffle, batch and repeat

## **UNIT II**

Machine learning classifiers using Scikit- Learn: Choosing a classification algorithm, first steps with Scikit-learn- training a perceptron, modelling class abilities via logistic regression, modelling class probabilities via logistic regression, logistic regression and conditional probabilities, learning the model weights via the logistic loss function, training a logistic regression model with Scikit-learn , tackling over fitting vi regularization

## **UNIT III**

Introduction to tensorflow: basic of tensorflow, tensorflow implementation, tensorflow pipeline, tensorboard visualization

Regression using Tensorflow: Introduction, training linear regression model, training linear regression with tensorflow, data import using pandas, data import using numpy, data import using tensorflow

## **UNIT IV**

Building an NN model in pytorch , the pytorch neural network model, building a linear regression model , model training via torch modules,

Building a multilayer perceptron for classifying the dataset, evaluating the model , saving the model, and reloading the model

## **TEXT BOOKS**

[1] Introduction to Machine Learning, by Jeeva Jose, Khanna Book Publishing, 2020.

[2] Sebastian Raschka, Yuxi (Hayden) Liu, Vahid Mirjalili, Dmytro Dzhulgakov , Machine Learning with PyTorch and Scikit-Learn Develop Machine Learning and Deep Learning Models with Python 2022

## **REFERENCE BOOKS**

[1] Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurelien Geron, O'Reilly 2019



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## **E-RESOURCES AND OTHER DIGITAL MATERIAL**

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[1] Nadav Eiron, Machine learning tools from Google 2021 | Keynote, <https://www.youtube.com/watch?v=ysOeGe0SCls> ,

last accessed on 30-11-2022

[2] Chrittopher Manning, Lecture 7: Introduction to TensorFlow, Stanford University School of Engineering,

<https://www.youtube.com/watch?v=PicxU81owCs>,

last accessed on 30-11-2022

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**20AI&DS5205B****VIRTUAL REALITY TECHNOLOGIES & AR DEVELOPMENT**

<b>Course Category:</b>	<b>Open Elective I</b>	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	2-0-2
<b>Prerequisites:</b>	--	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the concepts of virtual reality and Communication Media	K2	1.2.1,1.6.1,2.6.1,2.7.1
<b>CO2</b>	Understand about the human perceptual system.	K2	1.2.1,1.6.1,2.6.1,2.7.1
<b>CO3</b>	Understand about various input and output devices used in the virtual reality	K2	1.2.1,1.6.1,2.6.1,2.7.1
<b>CO4</b>	Apply the concepts of Representation and Rendering of the Virtual World.	K3	1.2.1,1.6.1,2.6.1,2.7.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	2											1	
<b>CO2</b>	1	2											1	
<b>CO3</b>	1	2											1	
<b>CO4</b>	1	2											1	

**COURSE CONTENT**

**UNIT-I**

**INTRODUCTION TO VIRTUAL REALITY (VR):** Defining Virtual Reality, Five key elements of the virtual reality experience, Virtual Reality, Telepresence, Augmented Reality and Cyberspace, History of Virtual Reality.

**VR-THE MEDIUM:** Communicating through a Medium, Communication: Conveyance of Ideas, Common Issues of Human Communication Media.

**UNIT-II**

**THE HUMAN IN THE LOOP:** The Human Perceptual System: Sensation-The Physiological Side of Perception, Visual Perception, Aural Perception, Haptic Perception, Vestibular Perception, Olfactory Perception, Gustation Perception, Cross-Sensory Effects and Virtual Reality.

**PRESENCE AND EMBODIMENT:** The Concept of Presence, The Determinants and Responses of Presence, Measuring Presence, Embodiment.

**UNIT-III**

**Interfacing the Participant(s) with the Virtual World (INPUT):** Input Technologies-Input Classifications, Position-Tracking Technologies, Using Inputs within a Virtual Reality System-Position Tracking the Body, Physical Input Devices, Body Posture and Gesture Recognition, Speech Recognition (Audio Input).

**INTERFACING THE VIRTUAL WORLD WITH THE PARTICIPANT(S)(OUTPUT):** Visual

Displays-Nonocclusive Head-Based Displays, Smartphone-Virtual Reality Head-Based Displays, Handheld Virtual Reality, Summary of Visual Display Paradigms; Aural Displays-Properties of Aural Displays, Aural Display Paradigms; Haptic Displays-Properties of Haptic Displays, Haptic Display Paradigms, Tactile Haptic Displays, End-Effector Displays.

**UNIT-IV**

**PRESENTING THE VIRTUAL WORLD:** Representation of the Virtual World- Verisimilitude, Human Perception, choosing a Mapping, Quantitative and Qualitative Representations; Visual Representation in VR, Aural Representation in VR, Haptic Representation in VR; Rendering Systems- Visual Rendering Systems, Sonic Rendering Systems, Haptic Rendering Systems.

**THE VIRTUAL REALITY EXPERIENCE:** Immersion, providing the Context, Physical/Sensory Immersion, Mental Immersion, the virtual World: Substance of the Virtual World, Object Modelling and World Layout.

### **TEXT BOOKS**

[1] William R. Sherman and Alan B. Craig, *Understanding Virtual Reality Interface, Application, and Design*, 2<sup>nd</sup> Edition, Morgan Kaufmann Publishers, Elsevier, 2019.

### **REFERENCE BOOKS**

- [1] Rajesh K. Maurya, *Computer Graphics with Virtual Reality System*, 3rd Edition, Wiley Publication, 2018.
- [2] Grigore C. Burdea, Philippe Coiffet, *Virtual Reality Technology*, 2nd Edition, Wiley, 2017.
- [3] K.S. Hale and K. M. Stanney, *Handbook on Virtual Environments*, 2nd Edition, CRC Press, 2015

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Virtual Reality, IIT Madras Prof Steven LaValle <https://nptel.ac.in/courses/106106138> - Accessed on 17-11-2022
- [2] Dr M. Manivannan, Professor, Department of Applied Mechanics, IIT Madras. <https://elearn.nptel.ac.in/shop/iit-workshops/completed/foundation-course-on-virtual-reality-and-augmented-reality/> - Accessed on 17-11-2022

**20AI&DS5205C**  
**DESIGNING HUMAN INTERFACES**

<b>Course Category:</b>	Open Elective 1	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2 - 0 - 2
<b>Prerequisites:</b>	--	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the key terms of interactive graphical systems.	K2	1.6.1, 1.7.1, 2.5.2, 2.6.1, 2.6.2
<b>CO2</b>	Apply appropriate device and screen based controls for presenting information.	K3	2.5.1, 2.5.2, 2.6.1, 2.6.2, 2.7.1
<b>CO3</b>	Apply design principles for developing sophisticated User interfaces.	K3	2.7.1, 2.7.2, 3.6.1, 3.7.1
<b>CO4</b>	Analyze faults in the interfaces and suggest alternative designs.	K4	2.6.1, 2.7.2, 3.6.2, 3.7.1, 3.8.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2												1	1
<b>CO2</b>		3											2	1
<b>CO3</b>		3	2										1	1
<b>CO4</b>		3	2										2	1

**COURSE CONTENT**

## UNIT I

**Introduction:** Importance of user Interface – definition, importance of good design, benefits of good design, a brief history of screen design.

**The Graphical User Interface:** Popularity of graphics, the concept of direct manipulation, graphical system, characteristics.

**Web User Interface:** Popularity, principles and characteristics.

## UNIT II

**Design process:** Understanding how people interact with computers, Important Human Characteristics in Design, Human Considerations in Design, Human interaction speeds.

**Screen designing:** Interface design goals, screen meaning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow, visually pleasing composition, amount of information, focus and emphasis, presenting information simply and meaningfully, technological considerations in interface design.

## UNIT III

**Windows:** Characteristics, components, operations, Selection of devices based and screen based controls.

**Components:** Icons and images, Multimedia.

## UNIT IV

**Organize and Layout windows and pages:** General Guidelines, Organization guidelines, control navigation, window guidelines, web page guidelines.

**Testing User interfaces:** The purpose of Usability testing, Importance of Usability testing, Scope of Testing, prototypes and kind of Tests, Developing and Conducting the Test .

## TEXT BOOKS

[1] Wilbert O Galitz, “The Essential Guide to User Interface Design- An Introduction to GUI Design Principles and Techniques”, 3rd Edition, Wiley DreamaTech, 2017.

**REFERENCE BOOKS**

- [1] Steven Jacobs, Ben Shneiderman, Catherine Plaisant, Maxine Cohen, “Designing the User Interface: Strategies for Effective Human - Computer Interaction” 6th Edition, Pearson Education Asia, 2017.
- [2] Alan Dix, Janet Finckay, Greg Goryd, Abowd and Russell Bealg, “Human Computer Interaction”, 2nd Edition, Pearson Education.
- [3] Scott Mackenzie, “Human-Computer Interaction: An Empirical Research Perspective” 2016, Elsevier Publications.
- [4] Rogers, “Interaction Design: Beyond Human - Computer Interaction”, Third Edition, Wiley Publications, 2013.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Dr. Samit Battacharya IIT Guwahati, Department of Computer Science & Engineering, NPTEL Videos,  
Available:<https://nptel.ac.in/courses/106103115/> Last accessed on August 2018.
- [2] Prof. Pradeep Yammiyavar IIT Guwahati, Department of Design, NPTEL Videos, Available:<https://nptel.ac.in/courses/106103115/> Last accessed on August 2018.

**20AI&DS5205D**  
**PROGRAMMING FOR DATA SCIENCE**

<b>Course Category:</b>	Open Elective I	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2 - 0 - 2
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the fundamentals of Data Science concepts	K2	1.2.1, 1.7.1
<b>CO2</b>	Apply various pre-processing techniques in Data Science	K3	1.2.1, 1.7.1 2.5.2, 2.6.4, 2.8.1
<b>CO3</b>	Apply various schemas and operations of the Data Warehouse.	K3	1.2.1, 1.7.1 2.5.2, 2.6.4, 2.8.1, 3.6.1
<b>CO4</b>	Analyze different types of data science algorithms to solve real life problems.	K4	1.2.1, 1.7.1 2.5.2, 2.6.4, 2.8.1,3.5.1, 3.6.1, 3.7.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3												1	1
<b>CO2</b>	1	3											1	1
<b>CO3</b>	1	3	2										1	1
<b>CO4</b>	1	2	3										1	1

**COURSE CONTENT****UNIT I**

**Introduction:** AI, Machine Learning and Data Science;

**What is data Science:** Extracting Meaningful patterns, Building representative models, Combination of statistics, Machine learning and Computing, learning



algorithms, Associated fields.

**Case for Data Science:** Volume, Dimensions, Complex Questions; **Data Science Classification;** **Data Science Algorithms**

**Getting to Know your Data:** Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity

## UNIT II

**Data Science Process:** Prior Knowledge, Data Preparation, Modeling, Evaluation, Deployment

**Data Preprocessing:** An Overview; **Data Cleaning-** Missing Values, Noisy data;

**Data Integration-** Entity Identification problem, Redundancy and Correlation Analysis;

**Data Reduction-** Overview of Data Reduction Strategies, Wavelet Transformation, Principal Components Analysis; **Attribute Subset selection;**

**Data Transformation** -Data Transformation Strategies Overview, Data Transformation by Normalization,

## UNIT III

**Data Warehouse Basic Concepts-** What Is a Data Warehouse, Differences between Operational Database Systems and Data Warehouses, Data Warehousing: A Multitiered Architecture, Data Warehouse Models: Enterprise Warehouse, Data Mart, and Virtual Warehouse, Extraction, Transformation, and Loading, Metadata Repository

**Data Warehouse Modeling: Data Cube and OLAP** - Data Cube: A Multidimensional Data Model, Stars, Snowflakes, and Fact Constellations: Schemas for Multidimensional Data Models, Dimensions: The Role of Concept Hierarchies, Measures: Their Categorization and Computation, Typical OLAP Operations

## UNIT IV

**Mining Frequent Patterns, Associations-**Market Basket Analysis: A Motivating Example, Frequent Item sets, Closed Item sets, and Association, Apriori Algorithm: Finding Frequent Item sets by Confined Candidate Generation, Generating Association Rules from Frequent Item sets.

**Classification:** What Is Classification, Decision Tree Induction, Attribute

Selection Measures.

**Cluster Analysis:** What Is Cluster Analysis?, Requirements for Cluster Analysis, k-Means Algorithm

**Model Evaluation:** Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Over fitting – Under Fitting.

### **TEXT BOOKS**

- [1] Jiawei Han, Micheline Kamber, Jian Pei , Data mining : concepts and techniques, 2012. Third edition
- [2] Vijay Kotu and Bala Deshpande, Data Science concepts and Practice, 2019, Second Edition

### **REFERENCE BOOKS**

- [1] Joel Grus , Data Science from Scratch, 2019, 2nd Edition
- [2] Emily Robinson and Jacqueline Nolis, Build a Career in Data Science, Manning, 2020

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Google's Machine Learning Crash Course, last accessed on 11-02-2022, <https://developers.google.com/machine-learning/crash-course>
- [2] IBM's Machine Learning with Python, last accessed on 11-02-2022, <https://cognitiveclass.ai/courses/machine-learning-with-python>

**20AI&DS5351****ARTIFICIAL INTELLIGENCE LABORATORY**

<b>Course Category:</b>	Program Core	<b>Credits:</b>	1.5
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial-Practice:</b>	0 - 0 – 3
<b>Prerequisites:</b>	20AI&DS4302 Design and Analysis of Algorithms	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Apply artificial intelligence techniques to solve problems	K3	1.2.1,1.7.1, 2.5.2
<b>CO2</b>	Apply knowledge representation approaches to solve problems	K3	1.6.1,1.7.1, 2.5.1, 3.5.1
<b>CO3</b>	Apply natural language processing on real world scenarios.	K3	1.6.1,1.7.1, 2.5.1, 3.5.1
<b>CO4</b>	Apply the concepts of connectionist Models for complex problems.	K3	1.6.1,1.7.1, 2.5.1, 2.7.1,3.5.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2											1	1
<b>CO2</b>	2	2	2										1	1
<b>CO3</b>	2	2	2										1	1
<b>CO4</b>	2	2	2										1	1

**COURSE CONTENT/TASKS**

**TASK 1:** Write a program to implement Water Jug Problem .

**TASK 2:** Write a program to implement Monkeys and Bananas problem.

TASK 3: Write a program to implement Breadth First search algorithm.

TASK 4: Write a program to implement Travelling Salesperson problem.

TASK 5: Write a program to implement Hill climbing algorithm.

TASK 6: Write a program to implement Best first search algorithm

TASK 7: Write a program to represent knowledge using predicate logic.

TASK 8: Write a program to implement semantic analysis.

TASK 9: Write a program to implement a perceptron connectionist model.

TASK 10: Write a program to implement backpropagation algorithm.

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### **TEXT BOOKS**

[1] Elaine Rich, Kevin Knight, Shivashankar B Nair, “*Artificial Intelligence*”, 3rd Edition, Tata McGraw Hill Edition.

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### **REFERENCE BOOKS**

- [1] Patrick Henry Winston ‘Artificial Intelligence’, 3<sup>rd</sup> Edition, Prentice Hall, 1992  
[2] Stuart Russell and Peter Norvig, ‘Artificial Intelligence’, 3<sup>rd</sup> Edition, Prentice Hall of India, 2009.

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### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Basu, A., & Sarkar, S. (2014, June 29). Artificial Intelligence. NPTEL.  
<https://nptel.ac.in/courses/106105077>.(Last accessed on June 2, 2022.)

[2] Hashimoto, T. (n.d.). CS221: Artificial Intelligence: Principles and Techniques.Stanford University.  
<https://stanford-cs221.github.io/spring2022/>.(Last accessed on June 2, 2022.)

**20AI&DS5352**  
**MACHINE LEARNING LABORATORY**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	1.5
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial-Practice:</b>	0- 0-3
<b>Prerequisites:</b>	20AI&DS3305	<b>Continuous Evaluation:</b>	30
	Data Structures	<b>Semester end Evaluation:</b>	70
	and Algorithms.	<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Demonstrate the concepts of computational intelligence in machine learning	<b>K3</b>	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3 ,3.5.1,3.6.2,5.4.2
<b>CO2</b>	Choose the dimensionality reduction techniques for feature selection	<b>K5</b>	1.2.1, 2.6.2, 2.6.4,2.7.2,4.6.4,5.4.2
<b>CO3</b>	Choose the machine learning techniques to solve real time problems	<b>K5</b>	1.6.1, 2.5.2, 2.6.3, 2.6.4, 2.7.2,3.6.1, 3.6.2 ,4.4.2, 4,6,1, 5.4.2
<b>CO4</b>	Build ensemble models to solve classification problems	<b>K6</b>	1.6.1, 2.5.2, 2.6.3, 2.6.4, 2.7.2,3.6.1, 3.6.2 ,4.4.2, 4,6,1, 5.4.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	1			2								1	1
<b>CO2</b>	2	2	2	2	2								1	2
<b>CO3</b>	2	2		2	2								1	1
<b>CO4</b>	1	2	2	2	2								1	2

**TASKS**

Task 1: Implement Linear Regression and logistic regression and calculate sum of residual error.

Task 2: Program to implement Principle Component Analysis

Task 3: Program to implement decision tree learning and evaluate the algorithm

Task 4. Program to implement perceptron for different learning task and evaluate the algorithm

Task 5: Programs on Covariance, Correlation, Covariance Matrix and Correlation Matrix

Task 6: Program to construct Bayesian Network on a sample dataset and evaluate the algorithm

Task 7. Program to implement K nearest neighbour classifier and evaluate the algorithm

Task 8 Program to implement classification task using Support Vector machine and evaluate the algorithm

Task 9. Program to implement Random Forest and evaluate the algorithm

Task 10. Program to implement Expectation maximization algorithm

### **TEXT BOOKS**

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.

### **REFERENCE BOOKS**

1. Jason Brownlee, Machine Learning Mastery With Python, Understand Your Data, Create Accurate Models and Work Projects, 2021
2. Stephen Marsland, “Machine learning An algorithmic Perspective”, Second Edition, CRC Press, 2015
3. Jiawei Han, Jian Pei, Hanghang Tong, Data Mining Concepts and Techniques, fourth edition, Elsevier Science, 2022
4. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

1. Prof. Balaraman Ravindran | IIT Madras Introduction to Machine Learning [https://onlinecourses.nptel.ac.in/noc22\\_cs29/preview](https://onlinecourses.nptel.ac.in/noc22_cs29/preview) last accessed on 16-12-2022
2. Andrew Ng, Machine Learning Specialization <https://www.coursera.org/specializations/machine-learning-introduction> last accessed on 16-12-2022

**20HS5153****ENGLISH COMMUNICATION SKILLS LABATORY**

<b>Course Category:</b>	Institutional Core	<b>Credits:</b>	1
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial-Practice:</b>	0- 0-2
<b>Prerequisites:</b>	20TP4106 English for Professionals	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL**

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

<b>CO1</b>	Execute rational pronunciation of speech sounds including accentuation.	K3
<b>CO2</b>	Apply elements of listening comprehension in professional environments.	K4
<b>CO3</b>	Develop the abilities of rational argumentation and skills of public speaking.	K4
<b>CO4</b>	Demonstrate proficiency in the elements of professional communication including the competitive examination	K4

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>										3		3		
<b>CO2</b>								1		3	2	3		2
<b>CO3</b>										3	2	3		2
<b>CO4</b>						1		1		3	2	3		2

**COURSE CONTENT/TASK**

**UNIT:I :Elements of Spoken Expression and processes of Listening Comprehension:**

- Speech Mechanism
- Articulation of vowels and consonants

- Patterns of Accentuation

Types and processes of Listening comprehension

### **UNIT II: : Patterns of Substantiation and Refutation in Public Speaking:**

- Group Discussion(Open and Monitored)
- Pyramid Discussion
- PNI

Seminar Talk and Power Point Presentation

### **UNIT III: Professional Communication:**

- Self Affirmation
- Advanced Composition including Memo and e-mail
- Résumé Preparation

Corporate ethic of Non-Verbal Communication

### **UNIT IV: Life Skills and Vocabulary for Competitive Examinations:**

- Select Life Skills(50)
- Select Logies, Isms, Phobias and Manias (25 each)
- Sentence Completion and Double Unit Verbal Analogies (50 items)

Fundamentals of Syllogisms(Descriptive and Pictorial)

### **TEXT BOOKS**

- [1] Martin Cutts, Oxford Guide to Plain English, 7<sup>th</sup> Impression, OUP, 2011
- [2] Exercises in Spoken English, Prepared by Department of Phonetics and Spoken English, CIEFL, OUP, 21<sup>st</sup> Impression, 2003

### **REFERENCE BOOKS**

- [1] Stephen R Covey, The 7 Habits of Highly Effective people, II edition, (Pocket Books) Simon & Schuster UK Ltd, 2004
- [2] Eclectic Learning Materials offered by the Department

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] ODll Language Learner's Software, 27-6-2012 Orell Techno Systems
- [2] Visionet Spears Digital Language Lab software Advance Pro, 28-01-2015
- [3] [www.natcorp.ox.ac.uk](http://www.natcorp.ox.ac.uk), British National Corpus accessed on 28-11-2017



**20AI&DS5354****ENGINEERING PROJECT FOR COMMUNITY SERVICES**

<b>Course Category:</b>	Project Work/Internship	<b>Credits:</b>	1.5
<b>Course Type:</b>	<b>Lab</b>	<b>Lecture -Tutorial- Practice:</b>	0-0-3
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b> <b>Semester end Evaluation:</b> <b>Total Marks:</b>	30 70 100

**COURSE OUTCOMES****BTL****POI****Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Identify societal problem from the villages or towns with well-defined objectives.	K2	
<b>CO2</b>	Build a model for the problem chosen using modern tools and technology.	K5	
<b>CO3</b>	Organize the Technical report effectively.	K2	
<b>CO4</b>	Demonstrate the prototype/model to the identified client	K4	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	3	1	2	2	3	3	3	3		1	2	1	2
<b>CO2</b>	2	2	2	2	3	1		2	2		1	1	2	1
<b>CO3</b>						1		2	2		1	1	2	1
<b>CO4</b>	1	3	1	2	2	3	3	3	3		1	2	1	2

**COURSE CONTENT**

Guidelines: **EPICS:** Engineering Project for community services will be carried out during summer vacation for a period of six weeks after IV Semester and the report shall be submitted in V Semester. Students will go to the society (Villages/ Hospitals/Towns, etc..) to identify the problem and survey the literature for a feasible solution. The student(s) is encouraged to solve real life

problems leading to innovative model building.. This can be done in a group of students or as an individual. Students need to take up a real life problem leading to innovative model building.

**TEXT BOOKS****REFERENCE BOOKS****E-RESOURCES AND OTHER DIGITAL MATERIAL**

**20TP5106****PERSONALITY DEVELOPMENT**

<b>Course Category:</b>	Soft Skills - 3	<b>Credits:</b>	1
<b>Course Type:</b>	Learning by Doing	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 2
<b>Prerequisites:</b>	20TP4106 English for Professionals	<b>Continuous Evaluation:</b>	100
		<b>Semester end Evaluation:</b>	0
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL**

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

<b>CO1</b>	Understand the corporate etiquette	K2
<b>CO2</b>	Make presentations effectively with appropriate body language	K2
<b>CO3</b>	Be composed with positive attitude.	K3
<b>CO4</b>	Understand the core competencies to succeed in professional and personal life.	K2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>								2		3				
<b>CO2</b>									2	3				
<b>CO3</b>										3				
<b>CO4</b>									2	3				

**COURSE CONTENT****UNIT I**

Analytical Thinking and Communication Skills: Self-Introduction, Shaping Young Minds - A Talk by Azim Premji (Listening Activity), Self-Analysis, Developing Positive Attitude, Perception; Verbal Communication, Non Verbal Communication (Body Language)

**UNIT II**

Self-Management Skills and Etiquette: Anger Management, Stress Management,

Time Management, Six Thinking Hats, Team Building, Leadership Qualities; Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

### **UNIT III**

Standard Operation Methods and Verbal Ability: Note Making, Note Taking, Minutes Preparation, Email Letter Writing; Synonyms, Antonyms, One Word Substitutes-Correction of Sentences-Analogies, Spotting Errors, Sentence Completion, Course of Action -Sentences Assumptions, Sentence Arguments, Reading Comprehension, Practice work

### **UNIT IV**

Career-Oriented Skills: Group Discussion, Mock Group Discussions, Resume Preparation, Interview Skills, Mock Interviews

### **METHODOLOGY**

Audio—Visuals / Hand Outs (Compiled/Created by Training Division, T&P Cell, VR Siddhartha Engineering College), Board & Chalk and Interactive Sessions.

### **REFERENCE BOOKS**

1. Mitra, B. K. (2011). Personality development and soft skills (Vol. 156). Oxford University Press.
2. Dhanavel, S. P. (2011). English and Soft Skills. Orient Blackswan Pvt Limited.
3. Aggarwal, R. S. (2018). A Modern Approach to Verbal & Non Verbal Reasoning. S. Chand.
4. Meenakshi, R. & Sharma, S. (2011). Technical Communication Principles and Practice. Oxford University Press.

### **E-RESOURCES AND OTHER DIGITAL MATERIALS**

1. Aptitude Questions and Answers. (n.d.). IndiaBIX. <https://www.indiabix.com/>. Last accessed on June 5, 2022.
2. Placement Papers of all IT Companies. (n.d.). Freshersworld. <https://placement.freshersworld.com/placement-papers>. Last accessed on June 5, 2022.

**20AI&DS5607****INDUSTRY STANDARD CODING PRACTICE – II**

<b>Course Category:</b>	Skill Oriented Course - 2	<b>Credits:</b>	1
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial- Practice:</b>	1-0-2
<b>Prerequisites:</b>	20AI&DS4607 Industry Standard coding practice-1	<b>Continuous Evaluation: Semester end Evaluation: Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Able to understand test and development aspects of programming by solving problems at Industry standards.	K2	1.2.1, 1.7.1, 2.8.1
<b>CO2</b>	Able to interpret any given problem using required domain skills, mathematics.	K3	1.2.1, 1.7.1, 2.8.1, 3.6.2, 4.6.1, 5.4.1
<b>CO3</b>	Able to learn and apply methods to optimize solutions for any given problem.	K3	1.2.1, 1.7.1, 2.5.2, 5.5.2
<b>CO4</b>	Able to solve problems using elementary data structures with test driven development	K4	1.2.1, 1.7.1, 2.5.2, 5.5.2

**Contribution of Course Outcomes towards achievement of Program****Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	2	1											
<b>CO2</b>		3											2	2
<b>CO3</b>		1							2				3	3
<b>CO4</b>	2	3											2	2

**COURSE CONTENT****UNIT I**

Problem solving through Competitive Coding, Problem solving using control structures, Numeric series and patterns, Code Complexity analysis, Linear/ Logarithmic/ Super linear/ Polynomial/ Exponential/ Factorial Algorithms, Problem solving on rotations of data, Problem solving on Order statistic

problems, Problem Solving Examples Problem solving on matrix data, Memory manipulation techniques using pointers. Memory Arithmetic, Problem solving implementing pointer to an array, Memory Layout, overcoming the segmentation faults, Runtime memory allocation, Coding comparisons of Linear list data structure and Pointers, examples and Practice problems.

## **UNIT II**

Problem solving on string data, Problem solving on String manipulations, coding problems using string handling functions, Problem solving on Multi-String Problems, Problem Solving for long strings, Examples, Practice problems. Problem solving using modular programming, Inter module communications, scopes of data in the code, Problem solving approaches using recursions, Evaluation of Recursive algorithms, Significance of mathematical Recurrence Relations, Evaluation of recurrence relations, Time Analysis, Examples, Practice problems.

## **UNIT III**

Problem solving on operational and traversal logics on linked lists, Problem solving to compare linked lists, detection of a cycle/merge point, Merging sorted linked lists, coding problems on circular linked lists/Double linked lists, Examples, Practice problems. Problem Solving Problem solving through Linked list coding, traversals, Problem solving to compare linked lists, detection of a cycle/merge point, Merging sorted linked lists, Circular linked list formation, Double linked list formation, Examples, Practice problems.

## **UNIT IV**

Problem solving through testing, implementing various testing approaches: Test strategy, Test development, Test execution, Bug fixing, Examples, Practice problems, Problem solving Methods and techniques. Understanding the problem as math abstract, formation of the logic, Identifying the corner cases, Examples, Practice problems, Version control systems, Git repositories and working trees, adding new version of the files to a Git repository, Examples, practice problems.

## **TEXT BOOKS**

- [1] Halim, Steven and Halim, Felix, Competitive Programming 3, 2013.
- [2] Ahmed Shamsul Arefin, Art of Programming Contest, ACM Solver, Second Edition, 2012

## **REFERENCE BOOKS**

- [1] Programming Challenges: The Programming Contest Training Manual By Steven S Skiena, Miguel A. Revilla
- [2] Guide to Competitive Programming: Learning and Improving Algorithms Through Contests By Antti Laaksonen

## **E- RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Topcoder tutorials - <https://www.topcoder.com/community/data-science/data-science-tutorials/>
- [2] Nite Nimajneb's site - <http://comscigate.com/Books/contests/icpc.pdf>
- [3] Slides from a Stanford Course - <http://web.stanford.edu/class/cs97si/>
- [4] Halim, Steven and Halim, Felix, Competitive Programming 3, 2013. Ebook available at [lulu.com](http://lulu.com). Site associate with with the book is <http://cpbook.net>

**20MC5108A**  
**BIOLOGY FOR ENGINEERS**

<b>Course Category:</b>	Humanities Elective	<b>Credits:</b>	-
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	2 - 0 - 0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b> <b>Semester end Evaluation:</b> <b>Total Marks:</b>	100 0 100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Describe the fundamental Principles and methods of engineering	K2	
<b>CO2</b>	Identify the functions of different types in bio-molecules	K3	
<b>CO3</b>	Describe mechanisms underlying the working of molecular biological processes including enzyme catalysis, metabolic pathways, gene expression.	K2	
<b>CO4</b>	Use Excel, MATLAB and other computational tools to quantitatively analyze biological processes.	K4	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2	3												
<b>CO2</b>		3												
<b>CO3</b>		2		3										
<b>CO4</b>		1		2	3									

**COURSE CONTENT**

**Unit-I Introduction and Classification of Living organisms**

**Introduction:**

Fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Biology as an independent scientific discipline. Discuss how biological observations of 18th



Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.

**Classification:**

Classification of living organisms based on (a) Cellularity- Unicellular or multicellular (b) Ultrastructure- prokaryotes or eukaryotes. (c) Energy and Carbon utilization -Autotrophs, heterotrophs, lithotrophs (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitat- aquatic, terrestrial (e) Molecular taxonomy- three major kingdoms of life.

**Unit-II Biomolecules and Enzymes****Biomolecules:**

Biomolecules: Structures of sugars(Glucose and Fructose), starch and cellulose. Nucleotides and DNA/RNA. Amino acids and lipids. Proteins- structure and functions- as enzymes, transporters, receptors and structural elements.

**Enzymes:**

Enzyme classification. Mechanism of enzyme action.

Enzyme kinetics and kinetic parameters.

**Unit-III Genetics and Gene information Transfer****Genetics:**

“Genetics is to biology what Newton’s laws are to Physical Sciences” Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Concepts of recessiveness and dominance. Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring.

**Information Transfer:**

DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

**Unit-IV Metabolism and Microbiology****Metabolism:**

Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of  $K_{eq}$  and its relation to standard free energy. ATP as an energy

currency. Breakdown of glucose to CO<sub>2</sub> + H<sub>2</sub>O (Glycolysis and Krebs cycle) and synthesis of glucose from CO<sub>2</sub> and H<sub>2</sub>O (Photosynthesis). Energy yielding and energy consuming reactions.

### **Microbiology:**

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Growth kinetics. Ecological aspects of single celled organisms. Microscopy.

### **TEXT BOOKS**

- [1] Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
- [2] Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
- [3] Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
- [4] Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher, Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] [https://bee.cals.cornell.edu/sites/bee.cals.cornell.edu/files/shared/documents/Career\\_Bee\\_Final-for-Web.pdf](https://bee.cals.cornell.edu/sites/bee.cals.cornell.edu/files/shared/documents/Career_Bee_Final-for-Web.pdf)
- [2] <https://www.teachengineering.org/subjectareas>

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Prof. Sudarshan Iyengar, Prof. Sanatan Sukhija, Introduction to Deep learning, <https://nptel.ac.in/courses/106/106/106106184/>

Last accessed on 19<sup>th</sup> November 2023.

- [2] Ian Goodfellow , Adversarial Deep Learning, <https://www.youtube.com/watch?v=OcbPg1VtsSM> , Last accessed on 19<sup>th</sup> November 2023

# **SEMESTER VI**

**20AI&DS6301**  
**BIG DATA ANALYTICS**

<b>Course Category:</b>	Program Core	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3-0-0
<b>Prerequisites:</b>	20AI&DS3303	<b>Continuous Evaluation:</b>	30
	Database Systems	<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the concepts of Big Data Analytics and hadoop	K2	2.5.1, 2.5.2,2.6.3,2.6.4
<b>CO2</b>	Analyze large dataset with Hadoop Distributed File System and MapReduce techniques to optimize storage space.	K4	2.5.1,2.5.2,2.6.3, 2.7.1,3.5.1,3.8.2
<b>CO3</b>	Apply MapReduce, Pig, and Hive tools for data analytics.	K3	2.5.1, 2.5.2,2.6.4 3.5.1,3.8.2
<b>CO4</b>	Apply Sqoop, and Zookeeper tools for solving the Data Analysis problems.	K3	2.5.1, 2.5.2,2.6.3, 3.5.1,3.6.2,3.8.2

**Contribution of Course Outcomes towards achievement of Program Outcomes**  
**(1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	2											2	2
<b>CO2</b>	1	2	3										2	2
<b>CO3</b>		2	3		2								2	2
<b>CO4</b>		2	3		2								2	2

**COURSE CONTENT**

**UNIT I**

**Introduction to Big Data Analytics:** Big Data Overview, State of the Practice in Analytics, Key Roles for the New Big Data Ecosystem, Examples of Big Data Analytics.

**Data Analytics Lifecycle:** Data Analytics Lifecycle Overview, Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalize.

**Introduction to Hadoop:** Data storage and analysis, Comparison with other systems, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem.

## UNIT II

**Hadoop Distributed File system:** The Design of HDFS, HDFS concepts, Command-Line Interface, Hadoop file systems, The Java Interface, Data Flow, Hadoop Archives.

**Hadoop I/O:** Data Integrity in HDFS, LocalFileSystem, ChecksumFileSystem, Compression, Serialization, File-Based Data Structures, SequentialFile, Map File.

## UNIT III

**MapReduce:** A Weather Dataset, Analyzing the data with Hadoop, Map and Reduce, Java Map and Reduce, Scaling Out, Hadoop Streaming, Hadoop Pipes.

**MapReduce Types and Formats:** MapReduce Types, Input Formats, Output Formats.

**MapReduce Features:** Counters, Sorting, Joins, Side Data Distribution and MapReduce Library Classes.

## UNIT IV

**Pig:** Pig-Installation and Running of Pig, Execution Types, Running Pig Programs, Pig Latin Editors, Comparison with databases, Pig Latin, Functions, Data Processing Operators.

**Hive:** Installing Hive, An Example, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data.

**Zookeeper:** Zookeeper Service, Building applications with Zookeeper, Zookeeper in production.

**Sqoop:** Database Imports, working with Imported Data, Importing Large Objects, Performing an Export.

## TEXT BOOKS

- [1] “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, EMC Education Services, John Wiley & Sons, Inc.,2015.
- [2]Tom White, “Hadoop, The Definitive Guide”, 3rd Edition, O’Reilly Publications, 2012.

### **REFERENCE BOOKS**

- [1] BartBaesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publications, 2014.
- [2] Anil Maheswari, “Data Analytics”, Tata McGraw Hill, 1stEdition, 2017.
- [3] Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman , Mining of Massive Datasets, Cambridge University Press, 2014

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Frank Kane, Sundog Education Team, “Big Data Analytics”,Udemy.  
[https://www.udemy.com/topic/big- data/](https://www.udemy.com/topic/big-data/) Available: Last accessed on November 2022.
- [2] Prof. Rajiv Misra. (14th September 2020), Department of Computer Science & Engineering, I.I.T.,Patna, “ Big Data Computing”,  
[https://onlinecourses.nptel.ac.in/noc20\\_cs92/preview](https://onlinecourses.nptel.ac.in/noc20_cs92/preview), NPTEL videos.

## 20AI&DS6302 DEEP LEARNING

<b>Course Category:</b>	<b>Program Core</b>	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3-0-0
<b>Prerequisites:</b>	20AI&DS5302 Machine Learning	<b>ContinuousEvaluation: Semester end Evaluation:</b>	30 70
		<b>Total Marks:</b>	100

COURSE OUTCOMES		BTL	POI
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand the fundamentals of Applied Math for deep learning	K2	1.2.1, 1.7.1, 2.8.1
<b>CO2</b>	Apply various Neural Networks in TensorFlow	K3	1.2.1, 1.7.1, 2.8.1, 3.6.2, 4.6.1, 5.4.1
<b>CO3</b>	Understand various Architectures of Deep Networks	K2	1.2.1, 1.7.1, 2.5.2, 5.5.2
<b>CO4</b>	Understand various Tuning techniques for deep networks	K2	1.2.1, 1.7.1, 2.5.2, 5.5.2

### Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	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
<b>CO1</b>	1	1											1	1
<b>CO2</b>	1	2	3	2	2								2	2
<b>CO3</b>	1	2			2								1	1
<b>CO4</b>	1	2			2								1	1

### COURSE CONTENT

#### UNIT I: INTRODUCTION

**The Math Behind Machine Learning:** Scalars, Vectors, Matrices, Tensors, Hyperplanes, Mathematical Operations, Probabilities, Distributions, Resampling methods

Overview of machine learning: linear classifiers

**Foundations of Neural Networks and Deep Learning:** Neural Networks The Biological Neuron The Perceptron Multilayer Feed-Forward Networks Training Neural Networks Backpropagation Learning

Activation Functions: Sigmoid, Softmax, Rectified Linear Unit

**Loss Functions:** Loss Function Notation ,Loss Functions for Regression, Loss Functions for Classification, Loss Functions for Reconstruction

Hyperparameters: Learning Rate ,Regularization , Momentum, Sparsity

## **UNIT II:**

**Implementing Neural Networks in TensorFlow:** What Is TensorFlow? How Does TensorFlow Compare to Alternatives? Installing TensorFlow , Creating and Manipulating TensorFlow Variables, TensorFlow Operations , Placeholder Tensors , Sessions in TensorFlow Navigating Variable Scopes and Sharing Variables , Managing Models over the CPU and GPU, Specifying the Logistic Regression Model in TensorFlow, Logging and Training the Logistic Regression Model

## **UNIT III:**

### **Fundamentals of Deep Networks**

Define Deep learning, Deep networks, Common Architectural Principles of Deep Networks, Building Blocks of Deep Networks

**Major Architectures of Deep Networks:** Convolutional Neural Networks (CNNs):CNN Architecture Overview, Layers and Applications of CNNs

**Recurrent Neural Networks:** General Recurrent Neural Network Architecture, LSTM Networks, Applications

**Unsupervised Pretrained Networks:** Deep Belief Networks (DBNs) Generative Adversarial Networks (GANs)

## **UNIT IV:**

**Deep Learning applications:** Image segmentation, Natural Language Processing, Healthcare.

**Tuning techniques for deep networks:** Basic Concepts in Tuning Deep Belief Networks (DBNs) Convolutional Neural Networks (CNNs) and Recurrent



## Neural Networks

### **TEXT BOOKS**

- [1] Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly, 2017.[Unit1,II,III,IV]
- [2] Buduma, Nikhil, and Nicholas Locascio. Fundamentals of deep learning: Designing next generation machine intelligence algorithms. " O'Reilly Media, Inc.", 2017 [Unit I]

### **REFERENCE BOOKS**

- [1] Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2017
- [2] Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer, 2018.
- [3] Gulli, Antonio, and Sujit Pal. Deep learning with Keras. Packt Publishing Ltd, 2017.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Prof. Sudarshan Iyengar, Prof. Sanatan Sukhija, Introduction to Deep learning, <https://nptel.ac.in/courses/106/106/106106184/>  
Last accessed on 19<sup>th</sup> November 2023.
- [2] Ian Goodfellow , Adversarial Deep Learning, <https://www.youtube.com/watch?v=OcbPg1VtsSM> , Last accessed on 19<sup>th</sup> November 2023

**20AI&DS6303**  
**SOFTWARE ENGINEERING**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	2
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	1 - 1 - 0
<b>Prerequisites:</b>	20AI&DS4309	<b>Continuous Evaluation:</b>	30
	Operating Systems	<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the different software engineering process models.	<b>K2</b>	1.7.1,2.5.1, 2.5.2, 2.6.4,2.7.1
<b>CO2</b>	Apply analysis model for any given application.	<b>K3</b>	1.7.1,2.5.1,2.7.1, 3.5.1,3.5.2,3.5.6
<b>CO3</b>	Apply design model for any given application.	<b>K3</b>	1.7.1,2.5.1,2.6.4 3.5.1,3.8.1
<b>CO4</b>	Apply different testing techniques	<b>K3</b>	1.7.1,2.5.1,2.6.4, 3.5.1,3.6.2,3.8.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2	3											2	2
<b>CO2</b>	2	2	3										1	2
<b>CO3</b>	2	2	3										1	2
<b>CO4</b>	2	2	3										1	2

**COURSE CONTENT****UNIT I**

**The Nature of Software:** The Nature of Software, The changing nature of software.

**Software engineering:** The Software Process, Software Engineering Practice, Software Development Myths.

**The Software Process:** Software Process Structure. A Generic Process Model, Defining a framework activity, identifying a task set, Process patterns, Process Assessment and Improvement.

**Process models:** Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models.

**Agile Development:** What Is Agility? Agility and the Cost of Change, What Is an Agile Process? Extreme Programming (XP) Other Agile Process Models, A Tool Set for the Agile Process.

## UNIT II

**Understanding Requirements:** Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Analysis Model, Negotiating Requirements, Requirements monitoring, and Validating Requirements.

**Requirements Modelling:** Scenario Based Methods: Requirements Analysis, Scenario-Based Modelling, UML Models That Supplement the Use Case.

Requirements Modelling: Class based methods, Identifying Analysis classes, Specifying attributes, Defining operators, Class-Responsibility-Collaborator Modelling, Associates and Dependencies, Analysis Packages

Requirements Modelling: Behaviour, Patterns, And Web apps: Creating a Behavioural Model, Identifying events with Use Cases, State Representations, Patterns for Requirements Modelling, Requirements Modelling for Web and Mobile Apps.

## UNIT III

**Design Concepts:** Design within the Context of Software Engineering, the Design Process, Design Concepts, the Design Model.

**Architectural Design:** Software Architecture, Architectural Genres, Architectural Styles, Architectural Considerations, Architectural Decisions, Architectural Design.

**Component-Level Design:** What Is a Component? Designing Class-Based Components, Conducting Component Level Design, and Component level design for Web Apps, Component Level Design for Mobile Apps.

**User Interface Design:** The Golden Rules, User Interface Analysis and Design,

Interface Analysis, Interface Design Steps, Webapp and Mobile Interface Design.

#### **UNIT IV**

**Software Testing Strategies:** A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object-Oriented Software, Test Strategies for WebApps, Test Strategies for MobileApps, Validation testing, System testing, the art of debugging.

**Testing Conventional Applications:** Software Testing Fundamentals, Internal and External Views of Testing, White Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing.

#### **TEXT BOOKS**

[1] Roger S. Pressman, Bruce R. Maxim, "Software Engineering a practitioners approach" 8th edition, McGraw-Hill Publication 2019

#### **REFERENCE BOOKS**

- [1] Ian Somerville, "Software Engineering". 9th ed, Pearson Education. 2011.  
[2] Carlo Ghezzi, Mehdi Jazayeri and Dino Mandrioli, "Fundamentals of Software Engineering". 2 ed, PHI. 2009  
[3] Rajib Mall, Fundamentals of Software Engineering. 3 ed, PHI. 2009.

#### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Lecture Series on Software Engineering by Prof.N.L. Sarda, Prof. Umesh Bellur, Prof.R.K.Joshi and Prof.Shashi Kelkar, Department of Computer Science & Engineering ,IIT Bombay <https://nptel.ac.in/courses/106101061/2>  
[2] Software Engineering By Dr. B. LAVANYA, Assistant Professor | University of Madras  
[https://onlinecourses.swayam2.ac.in/cec20\\_cs07/preview](https://onlinecourses.swayam2.ac.in/cec20_cs07/preview).  
[3] Software Engineering Basics  
<https://www.youtube.com/watch?v=sB2iQSvrcG0>

**20AI&DS6404A**  
**BIOINFORMATICS**

<b>Course Category:</b>	Programme Elective II	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20MC5108A Biology for Engineers	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the biological sequence and structural databases.	K2	1.7.1,6.5.2
<b>CO2</b>	Understand the genome information and DNA sequence analysis	K2	2.5.1,2.7.1, 6.5.2
<b>CO3</b>	Analyze the pair-wise and multiple sequence alignment methods	K4	2.5.1,2.7.1, 6.5.2
<b>CO4</b>	Analyze secondary structure DNA data.	K4	2.5.1,2.7.1, 6.5.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1					3							2	
<b>CO2</b>		2				3							3	2
<b>CO3</b>		2				3							3	2
<b>CO4</b>		2				3							1	1

**COURSE CONTENT****UNIT I**

**Introduction:** Definitions, Sequencing, Biological sequence/structure, Genome Projects, Pattern recognition and prediction, Folding problem, Sequence Analysis,

Homology and Analogy.

**Protein Information Resources:** Biological databases, Primary sequence databases, Protein Sequence databases, Secondary databases, Protein pattern databases, and Structure classification databases.

## UNIT II

**Genome Information Resources:** DNA sequence databases, specialized genomic resources.

**DNA Sequence Analysis:** Importance of DNA analysis, Gene structure and DNA sequences, Features of DNA sequence analysis, EST (Expressed Sequence Tag) searches, Gene hunting, Profile of a cell, EST analysis, Effects of EST data on DNA databases.

## UNIT III

### **Pair wise Alignment Techniques:**

Database searching, Alphabets and complexity, Algorithm and programs, Comparing two sequences, sub-sequences, Identity and similarity, The Dot plot, Local and global similarity, different alignment techniques, Dynamic Programming, Pair wise database searching.

### **Multiple Sequence Alignment:**

Definition and Goal, The consensus, computational complexity, Manual methods, Simultaneous methods, Progressive methods, Databases of Multiple alignments and searching.

## UNIT IV

**Secondary Database Searching:** Importance and need of secondary database searches, secondary database structure and building a sequence search protocol

**Analysis Packages:** Analysis package structure, commercial databases, commercial software, comprehensive packages, packages specializing in DNA analysis, Intranet Packages, Internet Packages

## TEXT BOOKS

- [1] T. K. Attwood and D. J. Parry-Smith, Addison Wesley Longman, Harlow, "An Introduction to Bioinformatics", 2007.
- [2] Zhumur Ghosh and Bibekanand Mallick, "Bioinformatics: Principles and Applications", Oxford University Press, 2008.
- [3] Arthur M. Lesk, "Introduction to Bioinformatics", Oxford University Press, Fourth Edition 2014.

**REFERENCE BOOKS**

- [1] Jean-Michel Claverie and Cedric Notredame “Bioinformatics – A Beginners Guide”, Wiley , Dreamtech India Pvt. Ltd. 2003
- [2] RASTOGI, S.C., RASTOGI, PARAG, MENDIRATTA, NAMITA Bioinformatics, Fifth Edition, Methods And Applications - Genomics, Proteomics And Drug Discovery, PHI Learning Pvt. Ltd. 2022

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Prof. Todd Mezzulo, June 29, 2003, “Sequence analysis”  
<https://www.bioinformatics.org/>
- [2] Protein Secondary Structure Databases :  
<http://cybionix.com/bioinformatics/databases/> Last accessed on 01-06-2019
- [3] Dong Xu, , Protein Databases on the Internet <https://www.ncbi.nlm.nih.gov/>  
Last accessed on 01-06-2019

**20AI&DS6404B**  
**DATA ANALYTICS FOR CYBER SECURITY**

<b>Course Category:</b>	Programme Elective II	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20BS4101G – Numerical Methods for Data Analysis	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand Cybersecurity and sources of Cybersecurity Data	K2	1.2.1, 2.5.3, 3.5.1
<b>CO2</b>	Understand need of big data analytics and anomaly detection for Cybersecurity	K2	1.7.1, 2.8.1, 4.4.2
<b>CO3</b>	Apply anomaly detection methods to Spatiotemporal and Graph Data	K3	1.2.2, 2.5.2, 4.6.4
<b>CO4</b>	Apply data analytics techniques to prevent and mitigate risks of Cyberattack.	K3	1.7.1, 2.5.3, 4.5.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	3	1											1
<b>CO2</b>	1	2		3										1
<b>CO3</b>	1	3		2										1
<b>CO4</b>	2	3		1										1



## COURSE CONTENT

### UNIT I:

**Introduction:** Cybersecurity, Handling Cyberattacks, Data Analytics.

**Sources of Cybersecurity Data:** End-to-End Opportunities for Data Collection, Sources of Cybersecurity Data – Log Data, Raw Payload Data, Network Topology Data, User System Data, Other Datasets, Integrated Use of Multiple Datasets.

**Data Mining:** Knowledge Discovery and Data Mining Process Models, Data Pre-processing, Data Mining.

### UNIT II:

**Big Data Analytics and Its Need for Cybersecurity:** Big Data, Big Data in Cybersecurity, Landscape of Big Data Technologies, Mahout and Spark Comparative Analysis, Complex Nature of Data, Change Detection in Massive Traffic Datasets, Multipronged Attacks, Privacy and Security Issues in Big Data.

**Types of Cyberattacks:** Types of Attacks, Computational Data Model for Social Engineering, Attributes of Advanced Persistent Threat, Data Analytics Methods for Persistent Threats.

**Anomaly Detection for Cybersecurity:** Anomalies, Anomalies, Motivating Example: BGP Hijacking, Challenges in Understanding Anomalies, Interpretation, Treating Anomalies.

### UNIT III:

**Anomaly Detection Methods:** Statistical Outlier Detection Tests, Density-Based Outlier Detection: OPTICS-OF Identifying Local Outliers, Distance-Based Outlier Detection, Outlier Detection through Clustering.

Cybersecurity through Time Series and Spatial Data: Spatial and Temporal Data, Some Key Methods for Anomaly Detection in Spatial and Temporal Data, Cybersecurity through Spatiotemporal Analysis, Temporal Behaviors in Evolving Networks.

**Cybersecurity through Network and Graph Data:** Graph Properties, Understanding Evolving Network Communication, Similarity-Based Redundancy in Router Connectivity.

#### **UNIT IV:**

**Human-Centered Data Analytics for Cybersecurity:** Phishing, Insider Threat, User/Employee Viewpoint, Attacker Viewpoint: Anomaly Detection Methods.

**Future Directions in Data Analytics for Cybersecurity:** Data Analytics in Cyberphysical Systems, Multidomain Mining, Advanced Machine Learning Models, Ethical Thinking in the Data Analytics Process.

#### **TEXT BOOKS**

[1] Vandana P. Janeja. "Data Analytics for Cybersecurity", Cambridge University Press, 2022.

#### **REFERENCE BOOKS**

[1] Talabis, Mark, Robert McPherson, Inez Miyamoto, and Jason Martin. "Information security analytics: finding security insights, patterns, and anomalies in big data". Syngress, 2014.

[2] Mehak Khurana, Shilpa Mahajan. "Security Analytics: A Data Centric Approach to Information Security". CRC Press, 2022.

#### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Certified Cybersecurity Analyst, <https://www.udemy.com/course/ccsa-certified-cybersecurity-analyst/> Last Accessed: 28.04.2023.

**20AI&DS6404C**  
**CYBER SECURITY**

<b>Course Category:</b>	<b>Program Elective III</b>	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3-0-0
<b>Prerequisites:</b>	20AI&DS4304 – Computer Networks	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand classification of cyber crimes.	K2	1.7.1, 2.6.4
<b>CO2</b>	Understand the impact of cyber attacks	K2	1.7.1, 8.3.1
<b>CO3</b>	Apply tools and methods used in cyber crime	K3	1.7.1, 5.4.1, 5.5.1
<b>CO4</b>	Understand organizational implications of cyber security	K2	3.6.2, 8.3.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3													1
<b>CO2</b>	2							2						2
<b>CO3</b>	2				3									1
<b>CO4</b>			2					2						2

## COURSE CONTENT

### UNIT I: INTRODUCTION

Introduction of Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrimes: E-Mail Spoofing, Spamming, Internet Time Theft, Salami Attack/Salami Technique, Data Diddling, Forgery, Web Jacking, Newgroup Spam, Industrial Espionage, Hacking, Online Frauds, Pornographic Offenses, Software Piracy, Computer Sabotage, E-Mail bombing, computer network intrusions, password sniffing, credit card frauds, identity theft.

**UNIT II:**

**Cyber offenses:** Criminals Plan: Categories of Cybercrime Cyber Attacks: Reconnaissance, Passive Attack, Active Attacks, Scanning/Scrutinizing gathered Information, Attack, Social Engineering: Classification of Social Engineering. **Cyberstalking:** Types of Stalkers, Working of Stalking, Real-Life Incident of Cyber stalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Botnet, Attack Vector, Attacks on mobile/cell phones – Theft, viruses, mishing, vishing, smishing, hacking Bluetooth.

**UNIT III:**

**Tools and Methods:** Introduction, Proxy Servers and Anonymizers, how phishing works, password cracking, keyloggers and spywares, types of viruses, steganography, DoS and DDoS attacks – classification, types, tools used for launch, DDoS attacks, protection, SQL injection – steps and prevention, Buffer Overflow – types and minimizing attack, Attacks on Wireless Networks.

**UNIT IV:**

**Organizational Implications** –Introduction –Insider threats, Privacy, Key challenges to organizations, Cost of Cybercrimes and IPR issues

**Incident Handling:** Definitions, Organizations need Incident Response systems, Examples of incidents, what organizations can do to protect, best practices for organizations.

**TEXT BOOKS**

[1] Nina Godbole, Sunit Belapur, “Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, 2nd edition, Wiley India Publications, April, 2015

**REFERENCE BOOKS**

- [1] James Graham, R Howard, R Olson, "Cyber Security Essentials" CRC Press, 2018
- [2] Michael E Whitman, Herbert J Mattord, "Principles of Information Security", 4th Edition, Cengage Learning, 2012
- [3] William Stallings, “Cryptography and Network Security- Principles and Practice”, 7<sup>th</sup> Edition, Pearson Education, 2017

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] MITOPENCOURSEWARE Computer Systems Security

[https://ocw.mit.edu/courses/6-858-computer-systems-security-fall-2014/video\\_galleries/video-lectures/](https://ocw.mit.edu/courses/6-858-computer-systems-security-fall-2014/video_galleries/video-lectures/) accessed on 9th Jan 2023

[2]Oxford Home Study Center, Cyber Security short course available @ <https://www.oxfordhomestudy.com/courses/cyber-security-courses/free-cyber-security-online> accessed on 9th Jan 2023

**20AI&DS6404D****ARTIFICIAL INTELLIGENCE FOR INTERNET OF THINGS**

<b>Course Category:</b>	Programme Elective II	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS5301 – Artificial Intelligence	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI****Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the building blocks of Internet of Things	K2	1.6.1, 1.7.1
<b>CO2</b>	Understand the Fundamentals of AIOT & Eco System.	K2	1.6.1, 1.7.1,5.4.1
<b>CO3</b>	Understand various AI-based technologies integrated into IoT	K2	1.7.1,5.4.1
<b>CO4</b>	Apply AIoT methods and techniques to solve various challenging IoT problems.	K3	2.7.1,4.6.1, 5.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2													2
<b>CO2</b>	2				2								1	
<b>CO3</b>	2				2									2
<b>CO4</b>		2		2	2									2

**COURSE CONTENT**

**Unit I:**

**Introduction to IoT:** Definition and 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 and M2M** – Introduction, M2M, Difference between IoT and M2M

**Unit II:**

**Introduction to AIoT:** Introduction, Industry 5.0 Paradigm, Artificial Intelligence (AI) in the Internet of Things (IoT), AI-Based Trustworthiness in IoT Systems, AI Tools for IoT, Applications of the Internet of Things, Open Research Challenges for AI-Based IoT Systems,

**IoT Ecosystem:** core components of an IoT ecosystem, IoT Knowledge Hierarchy, Paradigms of Intelligent IoT-Generalized Fog-Edge-Cloud-Enabled IoT, Machine Learning-Enabled IoT Intelligence, Applications of IoT Ecosystems.

**Unit III:**

**Machine Learning Techniques in Internet of Things:** introduction, Evolution of Machine Learning Techniques, Internet of Things and Cloud Applications, Machine Learning Techniques for IoT-Based Cloud Applications, Challenges in Internet of Things (IoT)-Based Cloud Applications

**Deep Learning Frameworks for Internet of Things:** Introduction, Architecture for Deep Neural Network, Framework for Deep Neural Network, Deep Reinforcement Learning Approaches, Applications of Deep Learning in IoT Scenarios, Challenges

**Unit IV:****Applications of AIOT:**

**Personal and Home IoT:** Personal IoT, IoT and Smart homes, **AI For Industrial IoT:** Introduction to AI powered industrial IoT, Predictive maintenance using AI, electrical load forecasting in industry.

**AI For Smart cities IoT:** introduction, components of smart city, apply IoT for smart cities and the necessary steps, challenges.

**TEXT BOOKS**

- [1] Vijay Madiseti and ArshdeepBahga, “Internet of Things (A Hands-on Approach)”, 1st Edition, University Press Private Limited, 2017 (UNIT I)
- [2]Souvik Pal, Debashis De ,Rajkumar Buyya “Artificial Intelligence-based Internet of Things Systems” springer,2022 (UNIT II)
- [3] Amita Kapoor “ Hands-on Artificial Intelligence for IoT” Packet publishers, 2019 (UNIT III,IV)

**REFERENCE BOOKS**

- [1] Michael Roshak “Artificial Intelligence for IoT” Packet publishers, 2021

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] AIOT Foundations: <https://www.udacity.com/course/aiot-foundations--ud074>  
(Accessed on 25/03/23)
- [2] Internet of Things and AI Cloud specialization:  
<https://www.coursera.org/specializations/internet-of-things>  
(Accessed on 25/03/23)



**20AI&DS6404E**  
**HIGH PERFORMANCE COMPUTING**

<b>Course Category:</b>	<b>Program Elective IV</b>	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3-0-0
<b>Prerequisites:</b>	20AI&DS3305	<b>Continuous Evaluation:</b>	30
	Data Structures and Algorithms	<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand parallel programming platforms and parallel algorithms on parallel computer systems.	K2	1.2.1, 1.7.1, 2.5.3
<b>CO2</b>	Analyze the performance of a parallel program to outfit a particular platform.	K4	1.6.1, 2.5.2, 2.6.3, 2.6.4, 2.7.2, 3.6.1, 3.6.2, 4.4.2, 4.6.1, 5.4.2
<b>CO3</b>	Understand the accelerated technologies of Multicore processor systems using MPI, Open MP and threading techniques.	K2	1.2.1, 2.6.2, 2.6.4, 2.7.2, 4.6.4
<b>CO4</b>	Apply the concepts of dense matrix, sorting and graphs.	K3	1.6.1, 2.5.2, 2.6.3, 2.6.4, 2.7.2, 3.6.1, 3.6.2, 4.4.2, 4.6.1, 5.4.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	1												1
<b>CO2</b>	2	2	2	2	2									2
<b>CO3</b>	2	2		2										1
<b>CO4</b>	1	2	2	2	2									2

**COURSE CONTENT**

**UNIT I**

**Parallel Programming Platforms: Implicit parallelism:** Trends in Microprocessor Architectures, Limitations of memory system performance,

Dichotomy of parallel computing platforms, physical organization of parallel platforms, Routing mechanisms for interconnection networks.

**Principles of Parallel Algorithm Design:** Preliminaries, decomposition Techniques, Characteristics of tasks and interactions, mapping techniques for load balancing, parallel algorithm models.

## UNIT II

**Basic communication operations:** One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather.

**Analytical modelling of parallel programs:** sources of overhead in parallel programs, performance metrics for parallel systems, The Effect of granularity on performance, scalability of parallel systems.

## UNIT III

**Programming using the message passing paradigm:** Principles of Message passing programming, the building blocks: Send and Receive Operations, MPI: the message passing interface, Overlapping communication with computation, collective communication and computation Operations.

**Programming shared address space platforms:** Thread Basics, why Threads, Thread Basics: Creation and Termination, Synchronization primitives in Pthreads, OpenMP: a standard for Directive based Parallel Programming.

## UNIT IV

**Dense Matrix Algorithms:** Matrix-Vector Multiplication, Matrix – Matrix Multiplication, Quick sort.

**Sorting:** Issues in Sorting on Parallel Computers, Sorting Networks, Bubble sort and its variants.

**Graph Algorithms: Minimum Spanning Tree:** Prim's Algorithm, Single-Source shortest paths: Dijkstra's Algorithm, all-pairs shortest paths, Transitive closure, connected components.

## TEXT BOOKS

[1] AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Second Edition Pearson Education, 2016.

**REFERENCE BOOKS**

- [1] Michael J. Quinn, Parallel Programming in C with MPI and OpenMP McGraw-Hill International Editions, Computer Science Series, 2004.
- [2] Joseph Jaja, "An Introduction to Parallel Algorithms", Addison-wesley, 1992.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] High Performance Computing, IISc Bangalore, Prof. Mathew Jacob, accessed 03 May 2023, <http://nptel.ac.in/courses/106108055>.
- [2] NVIDIA Accelerated Computing - Training, accessed 03 May 2023, <https://developer.nvidia.com/accelerated-computing-training>.
- [3] Google Cloud's HPC solutions, accessed 03 May 2023, <https://cloud.google.com/solutions/hpc>.
- [4] OpenCL Developer Manual, accessed 03 May 2023, <https://opencl.org/projects/developer-manual>.

**20AI&DS6404F**  
**NATURAL LANGUAGE PROCESSING**

<b>Course Category:</b>	Programme Elective II	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20ES2103C - Programming Essentials in Python	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	<b>Understand</b> linguistic phenomena to model formal grammars.	K2	1.6.1, 1.7.1
<b>CO2</b>	<b>Understand</b> proper experimental methodology for training and evaluating empirical NLP systems	K2	1.6.1, 1.7.1, 2.7.1, 2.8.3, 2.8.4
<b>CO3</b>	<b>Apply</b> probabilities to construct statistical models over strings and trees and analyze NLP Algorithms.	K3	1.6.1, 1.7.1, 2.7.1, 3.8.3
<b>CO4</b>	<b>Apply</b> different language modeling Techniques	K3	1.6.1, 1.7.1, 2.7.1, 5.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1												1	2
<b>CO2</b>	2	2											1	2
<b>CO3</b>	2	2	2		2								1	2
<b>CO4</b>	2	1			2								1	2

## COURSE CONTENT

### UNIT I:

**Finding the Structure of Words:** Words and Their Components: Tokens, Lexemes, Morphemes, Typology, Issues and Challenges: Irregularity, ambiguity, Productivity, Morphological Models: Dictionary Lookup, Finite-State Morphology, Unification based Morphology, Functional Morphology, Morphology Induction.

**Finding the Structure of Documents:** Introduction: sentence boundary detection, Topic boundary detection, Methods: Generative Sequence Classification Methods, Discriminative Local Classification Methods, Discriminative Sequence Classification Methods, Hybrid Approaches, Extensions for Global Modeling for Sentence Segmentation, Complexity of the Approaches, Performances of the Approaches

### UNIT II:

**Syntax Analysis:** Parsing Natural Language, **Tree banks:** A Data-Driven Approach to Syntax, **Representation of Syntactic Structure:** Syntax Analysis Using Dependency Graphs, Syntax Analysis Using Phrase Structure Trees, **Parsing Algorithms:** Shift-Reduce Parsing, Hypergraphs and Chart Parsing, Minimum Spanning Trees and Dependency Parsing, **Models for Ambiguity Resolution in Parsing:** Probabilistic Context-Free Grammars, Generative Models for Parsing, Discriminative Models for Parsing, **Multilingual Issues :** Tokenization, Case, and Encoding, Word Segmentation, Morphology

### UNIT III:

**Semantic Parsing:** Introduction, Semantic Interpretation: Structural Ambiguity Word Sense, Entity and Event Resolution, Predicate-Argument Structure, Meaning Representation, System Paradigms, Word Sense Systems: Resources, Systems, Software

**Predicate-Argument Structure:** Predicate-Argument Structure: Resources, Systems, Software, Meaning Representation Systems: Resources, Systems, Software

**UNIT IV:**

**Discourse Processing:** Cohension, Reference Resolution, Discourse Cohension and Structure **Language Modeling:** Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Cross lingual Language Modeling

**TEXT BOOKS**

- [1] Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M. Bikel and Imed Zitouni, Pearson Publication,2012(UNIT:1,2,3)
- [2] Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary,2008(UNIT-4)

**REFERENCE BOOKS**

- [1] Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2rd Edition, 2008.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] [https://onlinecourses.nptel.ac.in/noc23\\_cs45/preview](https://onlinecourses.nptel.ac.in/noc23_cs45/preview)
- [2] <https://web.stanford.edu/~jurafsky/slp3/> Accessed on 24 December 2022

**20AI&DS6205A****ARTIFICIAL INTELLIGENCE IN WEB DEVELOPMENT**

<b>Course Category:</b>	Open Elective - 2	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	2 - 0 - 2
<b>Prerequisites:</b>	20ES2103C – Programming Essentials in Python 20AI&DS5301 - Artificial Intelligence	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI****Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand the fundamentals of Artificial Intelligence in World Wide Web.	K2	1.7.1,2.5.1,2.5.2
<b>CO2</b>	Apply principles of web intelligence and information retrieval on a given web application.	K3	1.7.1,2.5.1,2.5.2,2.6.3, 2.7.1,3.5.1,
<b>CO3</b>	Analyse different Social and Semantic web applications.	K3	1.7.1,2.5.1, 2.5.2,2.6.3,2.6.4 3.5.1,
<b>CO4</b>	Apply a fundamental concepts of Social network intelligence and web knowledge management.	K3	1.7.1,2.5.1, 2.5.2,2.6.3,2.6.4, 3.5.1,4.6.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	2	2											
<b>CO2</b>	2	2	3										2	2
<b>CO3</b>	2	2	3										2	2
<b>CO4</b>		2	3	1									2	2

## COURSE CONTENT

### UNIT I:

**Introduction to World Wide Web:** Brief history of the Web and the Internet, Blogs, Tweets, Wikis, Collaborative mapping, Aggregation technologies, Open platforms, application programming interface, and programming tools, Web intelligence, Intelligence in web applications, Organization of this book.

**Overview of constituents for the new artificial intelligence:** Foundations of the new artificial intelligence and knowledge-based system, Fuzzy systems, Artificial neural networks, Genetic algorithms and evolutionary computing, Rough sets, Soft computing, Benefits of the new AI to World Wide Web.

### UNIT II:

**Web intelligence:** Internet, web, grid, and cloud, Introduction to web intelligence, Perspectives of WI, Levels of WI, Goal of WI, Characteristics of web intelligence, Challenges and issues of WI, Wisdom web, Web-based support systems, Designing an intelligent web, Future of WI.

**Web information retrieval:** Introduction, Typical web search engines, Architecture of a web crawler, Distributed crawling, Focused spiders/crawlers, Collaborative crawling, Some tools and open source for web crawling, Information retrieval: beyond searching, Models of information retrieval, Performance measures in IR, Natural language processing in conjunction with IR, Knowledge-based system for information retrieval, Research trends.

### UNIT III:

**Web mining:** Introduction to web mining, Evolution of web mining techniques, Process of web mining, Web content mining, Web usage mining, Web structure mining,

**Sensor web mining:** architecture and applications, Web mining software, Opinion mining, Other applications using AI for web mining, Future research directions.

**Semantic web:** Introduction to semantic web, Metadata, Layered architecture of semantic web, Refined architecture of semantic web, Ontology and ontology constructs, Meta-ontology, Ontology tools and editors, Annotation tools, Inference engines, Semantic web applications, Semantic web interoperability and web mining, Semantic web and social communities, Semantic web and intelligent search, Semantic web research issues.



**UNIT – IV**

**Web knowledge management:** Web knowledge management, Web knowledge management, Web knowledge management, Utilization of knowledge management methodologies on semantic web, Exchanging knowledge in virtual entities

**Social network intelligence:** Introduction to social networking, Friend-of-a-friend, Semantically interlinked online communities, Social network analysis, Social network data, hCard and XFN, Advantages and disadvantages of social networking, Social graph application programming interface, Social search and artificial intelligence

**TEXT BOOKS**

[1] Priti Srinivas Sajja, Rajendra Akerkar, " Intelligent Technologies for Web Applications ", Chapman and Hall Publishers , September 23, 2019

**REFERENCE BOOKS**

[1] Andrea Isoni, "Machine Learning For Web", PACKT Publishers, 2016.

[2] Tshepo Chris Nokeri, "Web App Development and Real-Time Web Analytics with Python", APress Publications, 2021.

[3] Julie C Meloni, "HTML, CSS and JavaScript All in One", Second Edition, SAMS Publishers USA.

[4] Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-India, 2020.

[5] Charles Song, Subhashini Tripuraneni, "Artificial Intelligence on Amazon Web Services", PACKT Publishers, 2019.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Courseera: Abhishek Jha, "Build a website using Wix Artificial Design Intelligence", Guided Project Instructor at Coursera.

<https://in.coursera.org/projects/build-website-using-wix-artificial-design-intelligence>

[2] Udemy : "Full stack web development and AI with Python (Django)", John Harper, Cambridge University

<https://www.udemy.com/course/mern-stack-front-to-back/>

**20AI&DS6205B****ARTIFICIAL INTELLIGENCE IN AGRICULTURE**

<b>Course Category:</b>	Open Elective - 2	<b>Credits:</b>	3
<b>Course Type:</b>	Elective	<b>Lecture -Tutorial-Practice:</b>	2 - 0 - 2
<b>Prerequisites:</b>	20AI&DS5301 ARTIFICIAL INTELLIGENCE	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI****Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand Smart Precision Agriculture and adoption of Wireless Sensor Network (WSN).	K2	1.6.1
<b>CO2</b>	Understand the idea of Agriculture powered by AI/ML	K2	1.6.1
<b>CO3</b>	Analyze the use of AI, ML and IoT in Agricultural data driven and decision support system.	K4	1.6.1,2.5.1,2.5.2,2.6.3, 2.7.1,3.5.1,3.8.2
<b>CO4</b>	Analyze agriculture 5.0 and its effects on social and economic systems.	K4	1.6.1,2.5.1,2.5.2,2.6.3, 2.7.1,3.5.1,3.8.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2													2
<b>CO2</b>	2													2
<b>CO3</b>	1	2	2											2
<b>CO4</b>	1	2	2											2

**COURSE CONTENT**

## **UNIT I**

### **Introduction to Precision Agriculture**

History of Precision Agriculture and its Global Adoption, Precision Agriculture – introduction, Need and Scope of Precision Agriculture, Components of Precision Agriculture, Tools and Techniques, Site-Specific Crop Management (SSCM), Variable Rate Application (VRA) and Variable Rate Technology (VRT), Adoption of Smart Precision Agriculture, Some Misconceptions About Precision Agriculture

### **Smart Intelligent Precision Agriculture**

Modern Day Agriculture, Digitization of Agriculture-Digital Farming, Transition to Smart Intelligent Precision Agriculture, Benefits of Smart Intelligent Precision Agriculture

### **Adoption of Wireless Sensor Network (WSN) in Smart Precision Agriculture**

Sensors and Wireless Sensor Network, Evolution of Wireless Sensor Networks, Introduction of WSN in Agriculture, Features of Agriculturally Based Sensors, Types of Sensors Used for WSN Agricultural System, Intelligent Sensors Versus Smart Sensors, Impact of the Wireless Sensors on Traditional Agriculture, Sensor Based Variable Rate Application, Applications of WSN in Precision Agriculture, Security Issues and Challenges for WSN Implementation

## **UNIT II**

### **IoT (Internet of Things) Based Agricultural Systems**

Introduction, Architecture of IoT, Brief Overview of IoT Network, Characteristics of Internet of Things, Inter-Operability Challenges, Applications of IoT in Smart Agriculture, Challenges for the Implementation of IoT in Smart Farming, Security and Privacy Issues of an IoT, Fusion of Cloud Platform with IoT

### **AI (Artificial Intelligence) Driven Smart Agriculture**

Artificial Intelligence (AI) – Introduction, Categories of AI, Subsets of AI, Life Cycle of an Artificial Intelligence-Based, Prerequisites for Building an ML/AI-Based Agricultural Model, Advantages of A.I in Agriculture

**UNIT III****Machine Learning (ML) Driven Agriculture**

Cognitive Technologies, Introduction to Machine Learning, Types of ML, Artificial Neural Networks and Deep Learning, General Applications of Machine Learning, Scope of Artificial Intelligence and Machine Learning in Agriculture, Applications of A.I and M.L in Agriculture,

**Data-Driven Smart Farming**

Introduction, Collection and Management of Real-Time Agricultural Big Data, Transforming Field Data into Meaningful Insights, Processing and Predictive Analysis of Agricultural Data, Predictive Modeling

**Decision-Making and Decision-Support Systems**

Introduction, Intelligent Agricultural Decision Support Systems (ADSS), Features and Workings of an Intelligent Agricultural Decision Support System (ADSS), Intelligent Decision-Making using AI, ML, and IoT for Farmers

**UNIT IV****Agriculture 5.0 – The Future**

Introduction to Agriculture 4.0, Nanotechnology and Smart Farming, Blockchain-Securing the Agriculture Value Chain, Edge-Fog Computing for Smart Farming, Role of Big Data in Agriculture , Transition to Agriculture 5.0

**Social and Economic Impacts**

Societal and Economic Impact of AI, ML, and IoT in Intelligent Precision Farming, Existence of Forums for Innovation and Commercialization of Intelligent Precision Farming Technology (IPFT) - Cost-Benefit Analysis of IPFT, Likelihood of Farmers Towards the Technology ICAR–NAARM Policy, Farmers Perception and Concern

**Environmental Impact and Regulations**

Potential Impact on the Environment with Different IPFT, Policy Making and Governance, Current Policy Trends and Regulation in India, Research and Development Needed in India.

**TEXT BOOKS**

[1] Latief Ahmad, Firasath Nabi Agriculture 5.0; Artificial Intelligence, IoT and Machine Learning, CRC Press, 2021

**REFERENCE BOOKS**

- [1] Suchismita Satapathy, Debesh Mishra, Arturo Realyvásquez Vargas Innovation in Agriculture with IoT and AI Springer 2022
- [2] Satapathy, Mishra, Debesh, Chatterjee, Prasenjit Soft Computing and Optimization Techniques for Sustainable Agriculture (Smart Computing Applications) De Gruyter 2022

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Prof. Somsubhra Chakraborty, IIT Kharagpur, "Machine Learning for Soil and Crop Management"  
[https://onlinecourses.nptel.ac.in/noc22\\_ag05/preview](https://onlinecourses.nptel.ac.in/noc22_ag05/preview), Accessed on 03.05.2023

## 20AI&DS6205C CLOUD COMPUTING

<b>Course Category:</b>	Open Elective - 2	<b>Credits:</b>	3
<b>Course Type:</b>		<b>Lecture -Tutorial-Practice:</b>	2 - 0 - 2
<b>Prerequisites:</b>	Computer Networks	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Understand Cloud Computing technologies and virtualization	K1	1.7.1,2.5.1
<b>CO2</b>	Understand the architecture and infrastructure of cloud computing.	K2	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4
<b>CO3</b>	Analyze different Cloud Platforms and cloud applications	K4	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1,5.4.2
<b>CO4</b>	Apply security and legal issues in cloud computing	K3	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3	2												
<b>CO2</b>	3	2												
<b>CO3</b>	1	3	2		2								1	2
<b>CO4</b>	3	2	3										1	2

## COURSE CONTENT

### UNIT I:

**Introduction to Cloud Computing** - Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks

**Migrating into a Cloud** - Introduction, Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud

### UNIT II:

**Virtualization:** Introduction, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques - Execution Virtualization, Other types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples – Xen, VMware, Microsoft Hyper-V.

### Cloud Simulators- CloudSim and GreenCloud

Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture (User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud

### UNIT III:

#### Cloud Platforms and Applications:

Amazon web services - Compute services, Storage services, Communication services and Additional Services. Google AppEngine - Architecture and core concepts, Application life cycle, Cost model, Observations. Microsoft Azure – Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance

#### Cloud Applications:

Scientific Applications – Healthcare, Biology, Geoscience, Business and Consumer Applications – CRM and ERP, Productivity, Social Networking, Media Applications, Multiplayer Online Gaming

### UNIT IV:

**Data Security in the Cloud** - Introduction, Current State, Homo Sapiens and Digital Information, Cloud Computing and Data Security Risk, Cloud

## Computing and Identity, The Cloud, Digital Identity, and Data Security

**Legal Issues in Cloud Computing** - Introduction, Data Privacy and Security Issues, Cloud Contracting models, Jurisdictional Issues Raised by Virtualization and Data Location

### TEXT BOOKS

[1] Rajkumar Buyya, James Broberg, Andrzej M. Goscinski "Cloud Computing: Principles And Paradigms" , Wiley, 2013.

[2] Rajkumar Buyya, Christian Vecchiola, S Tamarai Selvi "Mastering Cloud Computing Foundations And Applications Programming" , McGraw Hill Education, 2016

### REFERENCE BOOKS

[1] Kai Hwang, Geoffrey C Fox, Jack J Dongarra, "Distributed and Cloud Computing - From Parallel Processing to the Internet of Things", Morgan Kaufman Publishing, 2012

[2] Barrie Sosinsky, "Cloud Computing Bible", Wiley Publishers, 2012.

[3] Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture", 1st Ed, Pearson, 2014

### E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Cloud computing By Prof. Soumya Kanti Ghosh | IIT Kharagpur  
[https://onlinecourses.nptel.ac.in/noc21\\_cs14/preview](https://onlinecourses.nptel.ac.in/noc21_cs14/preview) last accessed on 28-02-2023.

[2] Cloud Computing Applications Part 1:Cloud Systems and Infrastructure-University of Illinois at Urbana

<https://in.coursera.org/learn/cloud-applications-part1?specialization=cloud-computing#about> last accessed on 28-02-2023.

[3] Architecting Software For The Cloud Dept. of Computer Science and Engineering at IIT Ropar and IIT Kanpur

<https://www.youtube.com/user/arch4cloud/playlists> last accessed on 04-03-2023.



**20AI&DS6205D**  
**FUNDAMENTALS OF ROBOTICS**

<b>Course Category:</b>	Open Elective - 2	<b>Credits:</b>	3
<b>Course Type:</b>	Open Elective	<b>Lecture -Tutorial-Practice:</b>	2 - 0 - 2
<b>Prerequisites:</b>	20AI&DS5302 – Machine Learning	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	<i>Understand</i> the genealogy of artificial beings and robot operation systems.	K2	1.2.1, 1.7.1, 2.5.2, 2.8.1
<b>CO2</b>	<i>Understand</i> different robot making processes, basics on social robots and human-robot interaction.	K2	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.8.1, 3.5.1, 3.6.2, 3.8.1, 5.4.1, 8.3.1
<b>CO3</b>	<i>Apply</i> machine learning algorithms for decision making and approaches for risk assessment and mitigation.	K3	1.2.1, 1.2.2, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.8.1, 3.5.1, 3.6.1, 3.6.2, 3.8.2, 4.4.1, 4.4.2, 4.4.3, 4.6.1, 5.4.1, 8.3.1
<b>CO4</b>	<i>Analyze</i> algorithms related to robot movements and Multi robot systems.	K4	1.2.1, 1.2.2, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.8.1, 3.5.1, 3.6.1, 3.6.2, 3.8.2, 4.4.1, 4.4.2, 4.4.3, 4.6.1, 5.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	1												1
<b>CO2</b>	2	2	1		1			1					1	2
<b>CO3</b>	2	2	2	2	1			1					1	2
<b>CO4</b>	2	2	2	2	1								1	2

**COURSE CONTENT**

## UNIT I

**Genealogy of Artificial Beings:** Robot, Early Automata, Industrial revolutions, Modern robotics, social robotics, Robotics futures and Trans-robotics.

**The Robot Operating System:** Introduction, ROS, Key Features from the Core, Additional Useful Features, Linux for Robotics

**Mathematical Building Blocks:** Introduction, Basic Geometry and Linear Algebra, Geometric Transformations, Basic Probability, Derivatives, Basic Statistics.

## UNIT II

**Robots Making:** Introduction, Sensing the world with sensors, Common Sensors in Robotics, Moving about with Actuators, Computer Vision in Robotics.

**Social Robots:** Introduction, Cobots, Social Robots and Human–Robot Interaction, Conduct Research, Research Variables, Sampling, Reliability and Validity, Ethics: Ethical Principles in Research, Data, Analysis and Interpretation, Common Mistakes and Pitfalls

## UNIT III

**Managing the World Complexity:** Introduction, Definitions, Linear Regression, Training Generalizable Models, Deep Neural Networks, Gradient Backpropagation, Convolutional Neural Network, Recurrent Neural Networks and their applications, Deep Reinforcement Learning and its applications.

**Safety of Robotic Systems:** Introduction, Terms and Definitions, Industrial Risk Assessment and Mitigation

## UNIT IV

**Control, Navigation and Path Planning:** Introduction, Mobile Robots, Controlling robots, Path Planning, Obstacle Avoidance.

**Localization and Mapping:** Introduction, Robot Localization Problem, Robot Mapping Problem, Simultaneous Localization and Mapping.

**Multi-robot Systems:** Introduction, Types of multi-robot systems, Swarm Programming, Deployment of Real-world swarm systems

## TEXT BOOKS

[1] Herath, D., & St-Onge, D. (2022). Foundations of Robotics: A Multidisciplinary Approach with Python and ROS. Springer Nature Singapore

## REFERENCE BOOKS

- [1] Selig, J. M. (2005). Geometric fundamentals of robotics (Vol. 128). New York: Springer.
- [2] Xie, M. (2003). Fundamentals of robotics: linking perception to action (Vol. 54). World Scientific.
- [3] Yoshikawa, T. (1990). Foundations of robotics: analysis and control. MIT press.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Khatib. O. (n.d.). CS223A - Introduction to Robotics. Stanford University. Retrieved April 2, 2023, from <https://see.stanford.edu/course/cs223a>.
- [2] Pratihari, D. K. (2019, September 29). Robotics. Swayam. Retrieved April 2, 2023, from [https://onlinecourses.nptel.ac.in/noc19\\_me74/preview](https://onlinecourses.nptel.ac.in/noc19_me74/preview).
- [3] Khedekar. P. (2023, February). Best Starter Course: Robotics & ROS Introduction. UdeMy. Retrieved April 2, 2023, from <https://www.udemy.com/course/robotic-system-ros-foundations/>.

**20AI&DS6351**  
**BIG DATA ANALYTICS LABORATORY**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	1.5
<b>Course Type:</b>	Lab	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 3
<b>Prerequisites:</b>	20AI&DS3303 Database Systems	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Analyze large dataset with Hadoop Distributed File System to optimize storage space.	<b>K4</b>	1.6.1,1.7.1,2.5.1, .5.2,2.6.3, 2.7.1,3.5.1,3.8.2
<b>CO2</b>	Apply MapReduce tools to solve on real time applications.	<b>K3</b>	1.6.1,1.7.1,2.5.1, 2.5.2,2.6.4,3.5.1,3.8.2, 5.4.1, 5.4.2
<b>CO3</b>	Use Hadoop ecosystem for analysing data.	<b>K3</b>	1.6.1,1.7.1,2.5.1, 2.5.2,2.6.3,3.5.1, 3.6.2,3.8.2, 5.4.1, 5.4.2
<b>CO4</b>	Apply Hive tools for quering the Data Analysis problems.	<b>K3</b>	1.6.1,1.7.1,2.5.1, 2.5.2,2.6.3,3.5.1, 3.6.2,3.8.2, 5.4.1, 5.4.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	2	3										1	2
<b>CO2</b>	1	2	3		2								1	2
<b>CO3</b>	1	2	3		2								1	2
<b>CO4</b>	1	2	3		2								1	2

## COURSE TASKS

### *Task 1:*

#### **Hadoop Installation and shell commands:**

- a) Installing Hadoop environment
- b) Executing basic shell commands.

### *Task :2*

#### **Hadoop file management:**

- a) Writing a file from local file system to Hadoop Distributed file system.
- b) Reading a file from HDFS to the local file system.

### *Task 3:*

**Word Count application:** Implementation of Word Count Program using MapReduce Paradigm

### *Task 4:*

**Weather Data Analysis :**Implementation of Map reduce algorithm for analyzing hot and cold days.

### *Task 5:*

**Map reduce Application:**Implement a Map reduce program to identify “common friends” among all pairs of users.

### **Task 6:**

**Pig Latin scripts :** To sort ,group, join for a given dataset .

### *Task 7:*

**Joins using HIVE:** Implementation of Inner Join,Left Outer Join, Right outer join and Full outer join using HIVE.

### *Task 8:*

**Database manipulation using Hive:** To create, alter, drop databases and views

### *Task 9:*

**Functions and indexes in Hive:** To create functions and indexes in hive

## TEXT BOOKS

[1] “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, EMC Education Services, John Wiley & Sons, Inc.,2015.

[UNIT-I]

[2]Tom White, “Hadoop, The Definitive Guide”, 3rd Edition, O’Reilly

Publications, 2012 [UNIT-II, III, IV]

### **REFERENCE BOOKS**

- [1] BartBaesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publications, 2014.
- [2] Anil Maheswari, “Data Analytics”, Tata McGraw Hill, 1stEdition, 2017.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Frank Kane, Sundog Education Team, “Big Data Analytics”,Udemy.  
[https://www.udemy.com/topic/big- data/](https://www.udemy.com/topic/big-data/) Available: Last accessed on November 2022.
- [2] Prof. Rajiv Misra, Department of Computer Science & Engineering, I.I.T.,Patna, “ Big Data Computing”,  
[https://onlinecourses.nptel.ac.in/noc20\\_cs92/preview](https://onlinecourses.nptel.ac.in/noc20_cs92/preview), NPTEL videos.  
(Last accessed on 14th September 2022)

**20AI&DS6352****DEEP LEARNING LABORATORY**

<b>Course Category:</b>	Program Core	<b>Credits:</b>	1.5
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial- Practice:</b>	0-0-3
<b>Prerequisites:</b>	20AI&DS5302 Machine Learning	<b>ContinuousEvaluation: Semester end Evaluation: Total Marks:</b>	30 70 100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Apply deep learning techniques for object identification and segmentation	K3	1.2.1, 1.7.1, 2.8.1
<b>CO2</b>	Design various Neural Networks for classification using TensorFlow Framework	K6	1.2.1, 1.7.1, 2.8.1, 3.6.2, 4.6.1, 5.4.1
<b>CO3</b>	Evaluate different deep learning models for optimized solution of hyper-parameter tuning	K5	1.2.1, 1.7.1, 2.5.2, 5.5.2
<b>CO4</b>	Implement Autoencoders and GAN for real time applications	K4	1.2.1, 1.7.1, 2.5.2, 5.5.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	1									1	1	1	1
<b>CO2</b>	1	2	3	2	2						1	1	2	2
<b>CO3</b>	1	2			2						1	1	1	1
<b>CO4</b>	1	2			2						1	1	1	1

**COURSE CONTENT/TASKS**

1. Familiarization of cloud based computing like Google colab
2. Implementation of Multilayer Neural Network for a sample dataset using Keras
3. Build a deep neural network model with linear regression using single and

multiple variables

4. Write a program to implement image segmentation using deep learning techniques.
5. Implement SVM algorithm on a sample dataset using Softmax classifier
6. Study the effect of batch normalization and dropout in neural network classifier
7. Implement Yolo Algorithm for Object detection
8. Write a program for object recognition using RNN and compare it with CNN.
9. Write a program to develop a GAN for Generating MNIST Handwritten Digits
10. Write a program for Time-Series Forecasting with the LSTM Model.

### **TEXT BOOKS**

- [1] Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly, 2017
- [2] Buduma, Nikhil, and Nicholas Locascio. Fundamentals of deep learning: Designing next generation machine intelligence algorithms. " O'Reilly Media, Inc.", 2017

### **REFERENCE BOOKS**

- [1] Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press, 2017
- [2] Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer, 2018.
- [3] Gulli, Antonio, and Sujit Pal. Deep learning with Keras. Packt Publishing Ltd, 2017.
- [4] Buduma, Nikhil, and Nicholas Locascio. Fundamentals of deep learning: Designing

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] <https://nptel.ac.in/courses/106/106/106106184/>

Last accessed on 19<sup>th</sup> November 2022.

- [2] Ian GoodFellow, Introduction to Deep Learning, 19<sup>th</sup> November 2022.



**20AI&DS6353**  
**SOFTWARE ENGINEERING LABORATORY**

<b>Course Category:</b>	Programme Core	<b>Credits:</b>	1.5
<b>Course Type:</b>	Laboratory	<b>Lecture -Tutorial-Practice:</b>	0- 0-3
<b>Prerequisites:</b>	20AI&DS4309	<b>Continuous Evaluation:</b>	30
	Operating	<b>Semester end Evaluation:</b>	70
	Systems	<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Compare different software engineering process models.	K4	1.7.1,2.5.1, 2.5.2, 2.6.4,2.7.1
<b>CO2</b>	Analyse the principles of requirement engineering.	K3	1.7.1,2.5.1,2.7.1, 3.5.1,3.5.2,3.5.6
<b>CO3</b>	Create architectural design for a given project.	K6	1.7.1,2.5.1,2.6.4 3.5.1,3.8.1
<b>CO4</b>	Apply different testing techniques	K3	1.7.1,2.5.1,2.6.4, 3.5.1,3.6.2,3.8.2, 4.4.3

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	3												
<b>CO2</b>	2	2	3										2	2
<b>CO3</b>	2	2	3										2	2
<b>CO4</b>		2	3	2	2								2	2

**TASKS**

Task 1: Overview of SDLC: A Study

Task 2: Studying various phases of waterfall model.

Task 3: Estimation of Project Metrics using COCOMO model

Task 4: Identifying the Software Requirement from problem statements

Task 5: Project Planning.

Task 6: Capturing use case and modelling use case diagram for the given problem

Task 7: System modelling.

Task 8: OOA: Identifying Domain Classes from the problem statement and State Transition Diagram.

Task 9: Interaction diagrams: Sequence and collaboration diagrams and Flow of events and activity diagram.

Task 10: Software Design: software architecture and object oriented design.

Task 11: Component and Deployment diagrams.

Task 12: Estimation of test coverage metrics and Structural Complexity.

Task 13: Software Testing.

Task 14: Design Test Suits.

### **TEXT BOOKS**

[1] Roger S. Pressman, Bruce R. Maxim, "Software Engineering a practitioners approach" 8th edition, McGraw-Hill Publication 2019

### **REFERENCE BOOKS**

[1] Ian Sommerville, "Software Engineering". 9th ed, Pearson Education. 2011.

[2] Carlo Ghezzi, Mehdi Jazayeri and Dino Mandrioli, "Fundamentals of Software Engineering". 2 ed, PHI. 2009

[3] Rajib Mall, Fundamentals of Software Engineering. 3 ed, PHI. 2009.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Lecture Series on Software Engineering by Prof.N.L. Sarda, Prof. Umesh Bellur, Prof.R.K.Joshi and Prof.Shashi Kelkar, Department of Computer Science & Engineering ,IIT Bombay <https://nptel.ac.in/courses/106101061/2>

[2] Software Engineering By Dr. B. LAVANYA, Assistant Professor| University of Madras  
[https://onlinecourses.swayam2.ac.in/cec20\\_cs07/preview](https://onlinecourses.swayam2.ac.in/cec20_cs07/preview).

**[3] Software Engineering Basics**

<https://www.youtube.com/watch?v=sB2iQSvrcG0>

**20TP6106**  
**QUANTITATIVE APTITUDE**

<b>Course Category:</b>	Soft Skills - 4	<b>Credits:</b>	1
<b>Course Type:</b>	Learning by doing	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 2
<b>Prerequisites:</b>		<b>Continuous Evaluation:</b>	100
		<b>Semester end Evaluation:</b>	0
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Effectively organize, summarize and present information in quantitative forms including tables,	K2	
<b>CO2</b>	Use mathematical based reasoning and to evaluate alternatives and make decisions	K3	
<b>CO3</b>	Think and reason logically and critically in any given situation.	K2	
<b>CO4</b>	Apply logical thinking to solve problems and puzzles in qualifying exams for companies and in other competitive exams	K2	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>										3	3			
<b>CO2</b>									3	3	3			
<b>CO3</b>										3	3			
<b>CO4</b>								2		3	3			

**COURSE CONTENT**

**UNIT I**

- Number system
- HCF & LCM,
- Average,
- Percentages,
- Profit & Loss

**UNIT II**

- Ratio & Proportion,
- Partnership,
- Chain Rule,
- Time & Distance,
- Time & Work

### **UNIT III**

- Pipes & Cistern,
- Problems on Trains,
- Problems on boats & Steams,
- Allegation,
- Simple interest and compound interest.

### **UNIT IV**

- Area, Volume and Surface areas,
- Races & Games of skills,
- Calendar & Clock,
- Stocks & Shares,
- Permutations & Combination, Probability.

### **TEXT BOOKS**

Learning Resources: Quantitative Aptitude by R.S..Aggarwal

### **REFERENCE BOOKS**

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

**20AI&DS6554**  
**MINI PROJECT - I**

<b>Course Category:</b>	Project	<b>Credits:</b>	1
<b>Course Type:</b>	Project	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 2
<b>Prerequisites:</b>	20AI&DS5354 EPICS	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Formulate Domain Analysis, Elaboration through Modeling and Implementation through state of the art technology available.	K2	
<b>CO2</b>	Develop generic and modular programs that includes Handling exceptional cases in providing reliable solutions	K4	
<b>CO3</b>	Testing and verification of programs for different scenarios	K3	
<b>CO4</b>	Conclude findings through oral presentations	K3	
<b>CO5</b>	Prepare proper documentation consisting of Software Requirements Specification (SRS), Modeling Techniques, Development Strategies, Implementation and Testing Strategies, use any Design Methodologies such as SSAD, OOAD and UML	K3	
<b>CO6</b>	Builds the spirit of team work in design process.	K4	
<b>CO7</b>	Become proficient in the programming languages	K4	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

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

<b>CO1</b>	<b>1</b>	<b>2</b>	<b>2</b>				<b>1</b>					<b>3</b>	<b>2</b>	<b>2</b>
<b>CO2</b>	<b>1</b>	<b>2</b>	<b>2</b>		<b>1</b>		<b>1</b>					<b>3</b>	<b>2</b>	<b>2</b>
<b>CO3</b>				<b>2</b>	<b>2</b>						<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO4</b>						<b>1</b>			<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>
<b>CO5</b>					<b>2</b>			<b>2</b>	<b>2</b>		<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO6</b>								<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO7</b>		<b>2</b>	<b>2</b>		<b>2</b>						<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>

## **COURSE CONTENT**

**Mini Project I could be done by a group of students; involves working under a faculty member and carry out detailed feasibility study, literature survey and prepare a detailed project report during VI semesters**

**20MC6107A****INNOVATION, IPR AND ENTREPRENEURSHIP**

<b>Course Category:</b>	<b>Mandatory</b>	<b>Credits:</b>	0
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	2-0-0
<b>Prerequisites:</b>	-	<b>ContinuousEvaluation: Semester end Evaluation:</b>	100
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Learn the innovation concepts related to business organizations.	K2	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.4
<b>CO2</b>	Understand the importance of innovation in new start-ups.	K2	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.4
<b>CO3</b>	Know fundamental aspects of Intellectual property Rights.	K2	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.4
<b>CO4</b>	Learn the basic concepts of entrepreneurship and its benefits	K2	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.4

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>		1						2	2		2			1
<b>CO2</b>		2						1	2		2			1
<b>CO3</b>		2						2	3		3			1
<b>CO4</b>		1						3	2		2			1

**COURSE CONTENT****UNIT – I**

Innovation Management: Introduction Innovation: Definition, Importance – The need to view innovation in an organizational context – Different types of innovation - Innovation and Invention – Popular views of innovation –



Innovation as a management process.

## **UNIT – II**

Innovation: New Product Development (NPD) Innovation Management and New Product Development – Considerations when developing as NPD strategy - NPD as a strategy for growth – What is new product? –Classification of new products – NPD as an industry innovation cycle.

## **UNIT – III**

Intellectual Property Rights (IPR) Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development.

## **UNIT – IV**

Entrepreneurship Concept and need of entrepreneurship - Characteristics and Types of Entrepreneurship -Entrepreneurship as a career - Entrepreneurship as a style of Management - The changing role of the entrepreneur - Entrepreneurial traits, factors affecting entrepreneurs.

## **TEXT BOOKS**

- [1] Paul Trott, Innovation Management and New Product Development, Pearson Education Limited, UK, 2017.
- [2] Nithyananda, K V., Intellectual Property Rights: Protection and Management, Cengage Learning India Private Limited, 2019.
- [3] Dr.S S Khanka, Entrepreneurial Development, S Chand, New Delhi, 2020

## **REFERENCE BOOKS**

- [1] Managing innovation: Integrating Technological, Market and Organizational Change, Joe Tidd, John Besant, 2018.
- [2] Neeraj, P., &Khusdeep, D, Intellectual Property Rights. PHI learning Private Limited, India, 2019.
- [3] Vasant Desai, The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, India, 2022.

## **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[https://edisciplinas.usp.br/pluginfile.php/5553082/mod\\_folder/content/0/Trott%20-%202017%20-%20%20roz%20Innovation-Management-and-New-Product-Development.pdf?forcedownload=1](https://edisciplinas.usp.br/pluginfile.php/5553082/mod_folder/content/0/Trott%20-%202017%20-%20%20roz%20Innovation-Management-and-New-Product-Development.pdf?forcedownload=1)

# **SEMESTER VII**

**20AI&DS7301**  
**AUTOMATA & COMPILER DESIGN**

<b>Course Category:</b>	Program Core	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20ES1103 - Programming for Problem Solving	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the basic concepts of formal languages and finite automata techniques	K2	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.4
<b>CO2</b>	Apply the parsing techniques for the given programming construct described in Context Free Grammar.	K3	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 3.2.1, 3.3.1
<b>CO3</b>	Identify the suitable intermediate representation based on the storage administration	K3	1.1.1, 1.3.1, 2.2.3, 2.2.4, 3.1.1, 3.3.1,
<b>CO4</b>	Generate the machine code by considering all the functionalities involved in different phases of the compilation process	K3	2.2.3, 2.2.4, 2.4.3, 3.2.1, 3.3.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2											1	
<b>CO2</b>	2	2	3										2	
<b>CO3</b>	2	3	3										2	
<b>CO4</b>	1	2	3										3	

## COURSE CONTENT

### UNIT-I

**Structure of Compiler:** Lexical Analysis, Syntax analysis, Intermediate Code generation, Code Optimization, Code generation, Bookkeeping, Error handling,

**Formal Language and Regular Expressions:** Languages, Definition Languages regular expressions, Finite Automata – DFA, NFA. Conversion of regular expression to NFA, NFA to DFA. Applications of Finite Automata to lexical analysis, lex tools. **Implementation of Lexical Analyzer (LTC)**

### UNIT-II

**Context Free grammars and parsing:** Context free grammars, derivations, parse trees, ambiguity, simplification of CFG, Normal Forms: CNF and GNF.

**Top Down and Bottom up Parsing:** LL(K) grammars and LL(1) parsing, Bottom up parsing, handle pruning, LR Parsing, parsing using ambiguous grammars. **Computing FIRST and FOLLOW terms (LTC)**

### UNIT-III

**Syntax Directed Translation:** S-attributed and L-attributed grammars, abstract syntax trees, **Intermediate Code:** types of intermediate code, Translation of simple assignment statements and control flow statements. Type checking, type conversions.

**Symbol Table:** The contents of a symbol table, Data structures for symbol tables, Representing scope information. **Generating Three address code (LTC)**

### UNIT-IV

**Storage organization:** Storage allocation strategies, scope access to non local names, language facilities for dynamics storage allocation.

**Code optimization:** Principal sources of optimization, optimization of basic blocks, flow graphs, peephole optimization.

**Code Generation:** Issues in the design of a Code generator, The Target language, A simple code generator, Code generation from DAG's.

**TEXT BOOKS**

- [1] John E. Hopcroft, Rajeev M & J D Ullman: “Introduction to Automata Theory Languages & Computation”, 3rd Edition, Pearson Education, 2007.
- [2] Alfred V. Aho, Jeffrey D. Ullman, ‘Principles of Compiler Design’, Narosa Publishing, 2002
- [3] Alfred V. Aho, Monica S Lam, Ravi Sethi, Jeffrey D Ullman, ‘Compilers Principles, Techniques and Tools’, Second Edition, Pearson Education India, 2014.

**REFERENCE BOOKS**

- [1] Tremblay J P, Sorenson G P: “The Theory & Practice of Compiler writing”, 1st Edition, BSP publication, 2010.
- [2] Louden, ‘Compiler Construction : Principle and Practice ‘Cengage Publications, 1997.
- [2] Jean-Paul Tremblay, Paul G. Sorenson, ‘The Theory and Practical of Compiler Writing’, BS Publications, 2009

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Compiler Design by Prof. Y.N. Srikant, Department of Computer Science and Automation, IISC Bangalore. <http://nptel.iitm.ac.in/courses/106108052> Last access date: 09.06.2021
- [2] NPTEL lectures by Professor Sanjeev K Agarwal, Dept. of CSE IIT Kanpur <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/compiler-design/ui/TOC.htm> Last access date: 09.06.2020

**20AI&DS7402A**  
**MEDICAL IMAGE ANALYSIS**

<b>Course Category:</b>	Program Elective III	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	Image Processing fundamentals, 20AI&DS5302: Machine Learning	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the basics of Medical Image Analysis	<b>K2</b>	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.4, 3.1.1, 3.3.1, 6.4.2
<b>CO2</b>	Apply Machine Learning and Deep learning approaches for image analysis	<b>K3</b>	1.1.1, 1.3.1, 2.2.3, 2.2.4, 3.1.1, 3.3.1, 6.4.2
<b>CO3</b>	Analyze image analysis ,segmentation and Interpretation	<b>K4</b>	1.7.1, 2.5.1, 2.5.2, 2.6.4, 2.7.1, 6.4.2
<b>CO4</b>	Analyze various forms of Medical Images and its correlations	<b>K4</b>	1.7.1, 2.5.1, 2.5.2, 2.6.4, 2.7.1, 6.4.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	2			3							1	1
<b>CO2</b>	2	3	3			2							3	3
<b>CO3</b>	2	3	2			1							2	2
<b>CO4</b>	2	1	2			2							2	2

**COURSE CONTENT**

**UNIT-I**

Classical Approaches: Introduction to image processing and medical imaging modalities, denoising and enhancement, Tissue and Cell Segmentation: clustering, active contours and level sets based approaches.

**UNIT-II**

Medical Image alignment: rigid and deformable registration [5 Lectures]  
Machine Learning and Deep Learning Approaches: Fundus Image analysis, Retinal Vessel Segmentation

**UNIT-III**

MRI image analysis and segmentation, 3D brain reconstruction from and MRI slices and analysis, Microscopic image analysis and interpretation

**UNIT-IV**

Ultrasonography image analysis X-Ray and CT image segmentation, diagnosis and prognosis of various diseases, Correlation between different medical imaging modalities and conversions, augmenting clinical measurements with medical imaging modalities for diseases diagnosis and prognosis

**TEXT BOOKS**

- [1] Prince, J. L., & Links, J. M. (2006). Medical imaging signals and systems. Upper Saddle River, NJ: Pearson Prentice Hall.
- [2] Suetens, P. (2017). Fundamentals of medical imaging. Cambridge university press.

**REFERENCE BOOKS**

- [1] Klaus D. Toennies, Guide to Medical Image Analysis Methods and Algorithms, Springer
- [2] Rasmus R. Paulsen, Thomas B. Moeslund, Introduction to Medical Image Analysis, Springer

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Prof Debdoot sheet-NPTEL Course on Medical Image Analysis @ [https://onlinecourses.nptel.ac.in/noc22\\_ee64/preview](https://onlinecourses.nptel.ac.in/noc22_ee64/preview)

**20AI&DS7402B**  
**VIDEO ANALYTICS**

<b>Course Category:</b>	Program Elective III	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	Image Processing fundamentals	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the Basics of Video compression and background modeling.	K2	1.7.1,5.4.1
<b>CO2</b>	Apply various tracking techniques on real time scenarios.	K2	1.7.1,2.6.3,2.6.4
<b>CO3</b>	Understand Surveillance Systems and camera Networking	K3	1.7.1,5.4.1
<b>CO4</b>	Apply multi-target tracking in video (MTTV) formulation.	K3	1.7.1,2.5.2,2.6.3

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1				2								1	2
<b>CO2</b>	1	2											1	2
<b>CO3</b>	1				2								1	2
<b>CO4</b>	1	2											1	2

**COURSE CONTENT****UNIT I****Basics of Video Compression and Motion Analysis**

Video Compression, Motion Segmentation, Optional Flow Methods,



## Applications

### **Background Modeling**

Background Modeling - Definition, Modeling Techniques – Non- Statistical & Statistical Background Modeling Methods, Shadow Detection and Removal

## **UNIT II**

### **Video Object Tracking**

Introduction, Kalman Filter, Region –based Tracking, Contour-Based Tracking, Feature –Based Tracking, Model – Based Tracking, KLT Tracker, Mean –Shift-Based Tracking, Applications of Tracking Algorithms

## **UNIT III**

### **Camera Network for Surveillance**

Types of CCTV Cameras, Smart Cameras, Smart Imagers, Multiple view geometry, Camera Network, Camera Calibration, Camera Placement, Camera Communication Multiple Camera Coordination and Cooperation

### **Surveillance Systems and Applications**

Introduction, Video Content Analytics, Baggage exchange detection, Fence-Crossing Detection, Military Applications, Transportation

## **UNIT IV**

### **Multi-target Tracking in Video – Part -I**

Introduction, Overview of MTTV Methods, State Model for Multi-target Approximate Inference, Fusing Information from Temporal and Bottom-up Detectors

### **Multi-target Tracking in Video – Part –II**

Introduction, Overview of the MTTV Data Association Mechanism, The Generative model for MTT, Approximating the Marginal Term, Approximating the Interactive Term, Hybrid Measurement Process

## **TEXT BOOKS**

[1] Kolekar, Maheshkumar H. Intelligent video surveillance systems: an

algorithmic approach. Chapman and Hall/CRC, 2018.

[2] Zheng, Nanning, and Jianru Xue. Statistical learning and pattern analysis for image and video processing. Springer Science & Business Media, 2009.

## REFERENCE BOOKS

[1] Graeme A. Jones, Nikos Paragios (Editor), Carlo S. Regazzoni (Editor) Video-Based Surveillance Systems: Computer Vision and Distributed Processing, Kluwer academic publisher, 2001

[2] Nilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), Applied Video Processing in Surveillance and Monitoring Systems (IGI global) 2016

[3] Zhihao Chen (Author), Ye Yang (Author), Jingyu Xue (Author), Liping Ye (Author), Feng Guo (Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, Create Space Independent Publishing Platform, 2014

[4] Caifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer, 2012 Barrie Sosinsky, "Cloud Computing Bible", Wiley Publishers, 2012.

## E-RESOURCES AND OTHER DIGITAL MATERIAL

1. Michael Karchevsky , Machine Learning Video Analysis, <https://www.toptal.com/machine-learning/machine-learning-video-analysis>, Last accessed on 18/06/2024
2. Javier Couto, Facundo Lezama, A Guide to Video Analytics: Applications and Opportunities <https://tryolabs.com/guides/video-analytics-guide>, Last accessed on 18/06/2024
- 3.. Rohit Kundu , A Practical Guide to Video Recognition ,<https://www.v7labs.com/blog/video-recognition-overview-and-tutorial>, Last accessed on 18/06/2024

**20AI&DS7402C**  
**BLOCKCHAIN TECHNOLOGY**

<b>Course Category:</b>	Program Elective III	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS5404C: Cryptography & Network Security	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the basics of blockchain, Mining, Consensus.	K2	1.71
<b>CO2</b>	Analyse the architecture of blockchain and Consensus agreement methods.	K4	1.71
<b>CO3</b>	Summarize blockchain components with the development tools.	K2	1.7.1, 5.4.1
<b>CO4</b>	Illustrate Integration of Block Chain with various technologies	K3	1.7.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3													
<b>CO2</b>	3													
<b>CO3</b>	2				2									
<b>CO4</b>	2													2

**COURSE CONTENT**

**UNIT I**

Basics of Blockchain: Introduction, History, Definition of Blockchain, Fundamentals of Blockchain, Characteristics, Public, Private, and Hybrid Blockchains, Distributed Ledger Technologies, Architecture of Blockchain.

**UNIT II**

Consensus: Introduction, Consensus Approach, Consensus Algorithms, Byzantine Agreement Methods, Consensus in Trust-Building Exercise.

Mining: Introduction, Mining Nodes, Mining the block, Validating a New Block, Blockchain Forks, Mining Hardware and Software

**UNIT III**

Blockchain Components: Introduction, Ethereum, History, Ethereum Virtual Machine, Working of Ethereum, Ethereum Clients, Key Pairs, Addresses, Wallets, Transactions, Development Tools.

**UNIT IV**

Blockchain Applications: Smart Contracts, Supply Chain Management, Finance, Blockchain Allied Technologies: Cloud Computing, Artificial Intelligence, IoT, Machine Learning, Robotic Process Automation

**TEXT BOOKS**

[1] A. Sourabh, A. Sexena, "Blockchain Technology: Concepts and Applications", Wiley, 2019.

[2] Melanie Swan, "Blockchain", O'Reilly, 2<sup>nd</sup> Ed, 2018

**REFERENCE BOOKS**

[1] Andreas M. Antonopoulos, "Mastering Bitcoin", O'Reilly, 2<sup>nd</sup> Ed, 2017.

[2] Manav Gupta, "Blockchain for Dummies", John Wiley & Sons, 2<sup>nd</sup> Ed, 2018

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] <https://www.cybrary.it/blog/blockchain-technology-in-information-security/> - Accessed on 17-11-2022

[2] Prof. Sandeep Chakraborty, IIT Kharagpur

<https://archive.nptel.ac.in/courses/106/105/106105184/> -

Accessed on 17-11-2022

**20AI&DS7402D**  
**PREDICTIVE ANALYTICS AND IOT**

<b>Course Category:</b>	Program Elective III	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS6301 Big Data Analytics	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Apply data analytics principles for IoT/M2M devices data	K3	2.7.1,4.6.1
<b>CO2</b>	Understand IoT Analytics and Networking protocols	K2	1.6.1,1.7.1
<b>CO3</b>	Apply strategies and techniques for collecting the data.	K3	2.7.1,4.6.1,5.4.1
<b>CO4</b>	Understand visual analysis for IoT data	K2	1.7.1, 4.6.1,5.4.1,12.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>		2		2									1	
<b>CO2</b>	2												1	
<b>CO3</b>		2		2	2									2
<b>CO4</b>	1			2	2							1		2

**COURSE CONTENT**

**UNIT I:**

**Data Acquiring, Organizing, Processing and Analytics in IoT** – Introduction, Data Acquiring and Storage, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems, Analytics, Analytics using Big Data in IoT/M2M, Knowledge Acquiring, Managing and Storing Processes.

**UNIT II:**

**IoT Analytics and Networking Protocols-** Defining IoT Analytics, IoT Analytics Challenges, Business value concerns, IoT Devices, IoT networking Connectivity protocols-Bluetooth, 6LoWPAN, ZigBee, NFC, Wi-Fi, Cellular, IoT networking data messaging protocols- MQTT, HTTP, CoAP, DDS, analyzing data to infer protocol and device characteristics.

**UNIT III:**

**IoT Analytics for the Cloud:** Building Elastic Analytics, Elastic Analytics Concepts, Scaling, Cloud Security and Analytics, AWS / Azure /Thing Worx overview, Designing data processing for analytics, Application of big data technology to storage, Exploring and visualizing data, solution for industry specific analysis problem.

**UNIT IV:**

**Visualization and Dashboarding** –Exploring and visualizing data, techniques to understand data quality, basic time series analysis, solving industry specific analysis problems. Adding internal data sets, adding external datasets. Designing visual analysis for IoT data- creating dashboard – creating and visualizing alerts

**TEXT BOOKS**

- [1] Raj Kamal, “Internet of Things, Architecture and Design Principles” 1st Edition, McGraw Hill Education Private Limited, 2017
- [2] Andrew Minter “Analytics for Internet of Things”, Packt Publications ,2017

**REFERENCE BOOKS**

- [1] Vijay Madiseti and ArshdeepBahga, “Internet of Things (A Hands-on Approach)”, 1st Edition, University Press Private Limited, 2017
- [2] Kai Hwang, Min Chen “Big Data Analytics for Cloud, IoT and Cognitive

Computing” Wiley,2017

## **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] IoT Data Analytics <https://www.udemy.com/course/iot-data-analytics/> Last accessed on 18/06/2024

[2] Predictive Analytics for IoT Solutions, <https://nextgeninvent.com/data-analytics/>, Last accessed on 18/06/2024

**20AI&DS7402E**  
**UI &UX DESIGN**

<b>Course Category:</b>	Program Elective III	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial- Practice:</b>	3-0-0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Understand Human factors and Psychology in design process of Interactive systems.	K2	1.6.1, 1.7.1, 2.5.2, 2.6.1, 2.6.2
<b>CO2</b>	Understand interaction and experience design in the different contexts.	K2	2.5.1, 2.5.2, 2.6.1, 2.6.2, 2.7.1
<b>CO3</b>	Apply techniques to design interactive systems and prototypes.	K3	2.7.1, 2.7.2, 3.6.1, 3.7.1
<b>CO4</b>	Apply the user experience from websites, mobile and smart devices to design interactive systems.	K3	2.6.1, 2.7.2, 3.6.2, 3.7.1, 3.8.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2												
<b>CO2</b>		3											2	
<b>CO3</b>		3	3										2	
<b>CO4</b>		3	3										2	

**COURSE CONTENT**

**UNIT I:**

**The Importance of the User Interface :** Defining the User Interface, The Importance of Good Design, A Brief History of the Human-Computer Interface, Introduction of the Graphical User Interface,

**Characteristics of Graphical and Web User Interfaces:** Interaction Styles, Command Line, Menu Selection, Form Fill-in, Direct Manipulation,



Anthropomorphic; The Graphical User Interface, The Web User Interface, The Merging of Graphical Business Systems and the Web, Principles of User Interface Design.

## **UNIT II:**

**The User Interface Design Process:** Obstacles and Pitfalls in the Development Path, Usability, Important Human Characteristics in Design, Human Considerations in the Design of Business Systems.

**Understand the Business Function:** Determining Basic Business Functions, Design Standards or Style Guides.

**Understand the Principles of Good Interface and Screen Design:** Human Considerations in Interface and Screen Design.

## **UNIT III:**

**Techniques for designing interactive systems:** Understanding requirements, Participative design, Interviews, Questionnaires, Probes, Card sorting techniques, Working with groups, Onsite working.

**Envisionment:** Basic techniques, Prototypes, Envisionment in practice.

**Design:** Introduction, Conceptual design, Metaphors in design, Physical design.

## **UNIT IV:**

**Agents and Avatars:** Agents, Adaptive systems, An architecture for agents, Applications of agent-based interaction, Avatars and conversational agents

**Mobile and Wearable devices:** Understanding in mobile computing, Designing for mobiles, Evaluation for mobile computing, Smart materials, Material design.

## **TEXT BOOKS**

[1] Wilbert O Galitz, The Essential Guide to User Interface Design, 2 ed, Wiley Dreamatech [UNIT I,II]

[2] David Benyon “Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design”3rd ed. Addison Wesley, 2013, [UNIT III, IV]

## **REFERENCE BOOKS**

[1] Alan Dix, Janet Finckay, GreGoryd, Abowd and Russell Bealg, Human Computer interaction. Pearson Education.

[2]Prece, Rogers, Sharps Interation Design. Wiley Dreamatech Soren Lauesen, User Interface Design. Pearson Education.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Dr.Samit Bhattacharya, CSEm IIT Guwahati, “Human Computer Interation” NPTEL videos <http://nptel.ac.in/syllabus/106103115/>

[2] Pradeep P Yammivayar , CSE, IIT Guwahati, NPTEL Videos <http://www.nptelvideos.com/video.php?id=1461&c=15>

**20AI&DS7402F**  
**MINING OF MASSIVE DATASETS**

<b>Course Category:</b>	Program Elective III	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS6301: Big Data Analytics	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand fundamentals of data mining.	K2	1.7.1, 2.5.1, 2.5.2, 2.6.1, 2.6.2, 2.7.1, 4.4.2, 5.5.2
<b>CO2</b>	Apply the concept of Map reduce and data streams for storing and processing of massive data sets	K3	1.7.1, 2.7.1, 2.7.2, 3.6.1, 3.7.1, 4.4.2, 5.5.2, 5.6.1
<b>CO3</b>	Analyze the different algorithms frequent item sets	K4	1.7.1, 2.7.1, 2.7.2, 3.6.1, 3.7.1, 4.4.2, 5.4.2, 5.5.2, 5.6.1
<b>CO4</b>	Analyze different clustering algorithms and analyze various decomposition techniques	K4	1.7.1, 2.7.1, 2.7.2, 3.6.1, 3.7.1, 4.4.2, 5.4.2, 5.5.2, 5.6.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2	2	2	2								1	1
<b>CO2</b>	3	3	2	2	2								1	1
<b>CO3</b>	2	2	3	2	2								1	1
<b>CO4</b>	3	3	3	2	2								2	2

**COURSE CONTENT**

**UNIT I**

Data Mining: Introduction, Statistical Modeling, Machine Learning, Computational Approaches to Modeling, Feature Extraction, Statistical Limits on Data Mining, Hash Functions, Indexes, Natural Logarithms, Power Laws.

**UNIT II**

Map Reduce and the New Software Stack: Distributed File Systems, Map Reduce, Algorithms Using MapReduce, Extensions to MapReduce, Complexity Theory for MapReduce.

Mining Data Streams: The Stream Data Model, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Counting Ones in a Window, Decaying Windows

**UNIT III**

Frequent Item sets: The Market-Basket Model, Market Baskets and the A-Priori Algorithm, Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream

**UNIT IV**

Clustering: Introduction to Clustering Techniques, Hierarchical Clustering, K-means Algorithms, The CURE Algorithm, Clustering in Non-Euclidean Spaces, and Clustering for Streams and Parallelism.

Dimensionality Reduction: Eigen values and Eigenvectors of Symmetric Matrices, Principal-Component Analysis, Singular-Value Decomposition, CUR Decomposition

**TEXT BOOKS**

- [1] Jure Leskovec , Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2014.
- [2] Jiawei Han, Jian Pei, Hanghang Tong, Data Mining Concepts and Techniques, fourth edition, Elsevier Science, 2022

**REFERENCE BOOKS**

- [1] Christopher Bishop, Pattern Recognition and Machine Learning, Springer-Verlag New York. 2006.
- [2] Kevin Murphy, Machine Learning: A Probabilistic Perspective. MIT Press. 2012
- [3] Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction.. Springer. 2013

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Jure Leskovec, Anand Rajaraman, Jeff Ullman, Mining of Massive Datasets, <http://www.mmids.org/>, Last accessed on 18/06/2024
- [2] CS246, Mining Massive Data Sets, <https://web.stanford.edu/class/cs246/>, Last accessed on 18/06/2024

**20AI&DS7403A**  
**INDUSTRIAL AND MEDICAL IoT**

<b>Course Category:</b>	Program Elective IV	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the basics of Industrial IOT and Medical IOT	K2	1.7.1, 2.7.1, 2.7.2
<b>CO2</b>	Identify the technical and industrial requirement procedures for IIOT applications	K3	1.7.1, 2.7.1, 2.7.2,
<b>CO3</b>	Develop various applications using IIOT architectures	K3	1.7.1, 2.7.1, 2.7.2, 3.6.1, 3.7.1
<b>CO4</b>	Analyze privacy and security measures for industry and medical standard solutions	K4	1.7.1, 2.7.1, 2.7.2, 3.6.1, 3.7.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2											1	1
<b>CO2</b>	3	2											1	1
<b>CO3</b>	3	2	3										3	3
<b>CO4</b>	3	2	2										1	1

**COURSE CONTENT**

**UNIT I:**

**Introduction to Industrial IoT:** Technical requirements, IoT background-History and definition, IoT enabling factors, IoT applications, IoT key technologies, I-IoT, IoT and I-IoT – similarities and differences, Industry environments and scenarios covered by I-IoT.

**UNIT II:**

**Understanding the Industrial Process and Devices Technical requirements:** The industrial process-Automation in the industrial process, Control and measurement systems, Types of industrial processes.

**UNIT III:**

**Industrial Data Flow and Devices :** Technical requirements, The I-IoT data flow in the factory , Measurements and the actuator chain .Sensors , The converters - Digital to analogical , Analog to digital, Actuators, Controllers - Microcontrollers, Embedded microcontrollers , Microcontrollers with external memory, DSP's. Industrial protocols -Automation networks, The fieldbus, Developing Industrial IoT and ArchitectureIntroduction to the I-IoT platform and architectures, OSGi, micro service, containers, and server less computing, The standard IIoT flow.

**UNIT IV:**

**Internet of Medical Things Introduction and system architecture:** Introduction, IoMT Devices-On-Body Devices, InHome Devices, Community Devices, In-Clinic Devices, InHospital Devices ,IoMT System Architecture-Data Collection Layer, Data Management Layer, Medical Server Layer. Internet of Medical Things Security Threats, Security Challenges and Potential Solutions: IoMT Attack Types, Challenges in IoMT Security Schemes, Current Security Plans for IoMT, Potential Solutions for Security Vulnerabilities.

**TEXT BOOKS**

[1] Veneri, Giacomo, and Antonio Capasso- Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1stEd., Packt Publishing Ltd, 2018.

[2] D. Jude Hemanth and J. Anitha George A. Tsihrantzis- Internet of Medical Things Remote Healthcare Systems and Applications, covered by Scopus.

**REFERENCE BOOKS**

- [1] Alasdair Gilchrist- Industry 4.0: The Industrial Internet of Things, 1st Ed., Apress, 2017.
- [2] Reis, Catarina I., and Marisa da Silva Maximiano, eds.- Internet of Things and advanced application in Healthcare, 1st Ed., IGI Global, 2016.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] David Sluiter , university of Colorado, Developing Industrial Internet of Things Specialization, <https://www.coursera.org/specializations/developing-industrial-iot#courses> , Last accessed on 18/06/2024
- [2] M.S. Krishnan, university of Michigan, Industrial Internet of Things (IIoT) <https://www.coursera.org/learn/industrial-internet-of-things>. Last accessed on 18/06/2024
- [3] Ganz Chockalingam. Harinath Garudadri, University of California San Diego, Internet of Things: Sensing and Actuation From Devices <https://www.coursera.org/learn/internet-of-things-sensing-actuation>, Last accessed on 18/06/2024



**20AI&DS7403B**  
**REMOTE SENSING DATA ANALYTICS**

<b>Course Category:</b>	Program Elective IV	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS6301: Big Data Analytics	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understanding basic components of remote Sensing	K2	1.2.1, 1.7.1,2.8.1
<b>CO2</b>	Understand the feature reduction strategies for remote sensing data	K2	1.2.1, 1.7.1,2.8.1
<b>CO3</b>	Understand various supervised classification techniques for remote sensing data	K2	1.2.1, 1.7.1, 2.5.2, 5.5.2
<b>CO4</b>	Understand various un supervised classification techniques for remote sensing data	K2	1.2.1, 1.7.1, 2.5.2, 5.5.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	1											1	
<b>CO2</b>	1	2			2								2	
<b>CO3</b>	1	2			2								1	
<b>CO4</b>	1	2			2								1	

**COURSE CONTENT**

**UNIT I: INTRODUCTION TO REMOTE SENSING:** Definition of Remote Sensing, Data, Remote Sensing Process, Source of Energy, Interaction with Atmosphere, Interaction with Target, Recording of Energy by Sensor, Transmission-Reception and Processing, Interpretation and Analysis

**Types of Remote Sensing and Sensor Characteristics:** Introduction, Types of remote sensing, Characteristics of images, Remote Sensing Satellites, Sensor Resolutions, Unmanned Aerial Vehicle based Remote Sensing

### **UNIT II:**

**Platforms and Sensors:** Orbital movement and Earth coverage. Sun-synchronous and Geosynchronous satellites, Active and passive sensors, PAN, Multi High resolution and Hyper spectral Sensors, Thermal and Microwave sensors, Sensors characteristics.

**Satellites and their Specifications:** LANDSAT, Pleiades, SPOT5/6/7, ENVISAT, WorldView, Quickbird, GeoEye, Sentinel-1/2, ASTER, RADARSAT, IRS, IKONOS, Cartosat etc. Referencing scheme of satellite system (path/row calculation).

### **UNIT III:**

**Applications of Remote Sensing:** Introduction, Lanuse Lancover Mapping, Geologic and Soil mapping, Agricultural applications, Forestry applications, water resource applications, urban and regional planning applications, wetland mapping, wildlife ecology

**Digital image analysis:** Introduction, preprocessing of images, image enhancement, contrast manipulation, spatial feature manipulation

**Supervised Classification Techniques:** Gaussian Mixture Models , Minimum Distance Classification: The Case of Limited Training Data, Parallelepiped Classification, Mahalanobis Classification

Non-Parametric Classification: Table Look Up Classification, Non-Parametric Classification from a Geometric Basis, Training a Linear Classifier , Multi-Category Classification with Binary Classifiers, Spatial Context Classification

### **UNIT IV:**

**Clustering and Unsupervised Classification :** How Clustering is Used, Similarity Metrics and Clustering Criteria , k Means Clustering , The k Means Algorithm, Isodata Clustering: Merging and Deleting Clusters , Splitting Elongated Clusters , Choosing the Initial Cluster Centres , Unsupervised

Classification , An Example of Clustering with the k Means Algorithm , Hierarchical Clustering: Agglomerative Hierarchical Clustering, Other Clustering Metrics , Other Clustering Techniques , Cluster Space Classification

### **TEXT BOOKS**

- [1] Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman , Remote Sensing and Image Interpretation, 5<sup>th</sup> Edition, 2015, Wiley publisher [Unit I & II]  
[2] John A. Richards, Remote Sensing Digital Image Analysis, 6th Edition, Springer ,2022[Unit III & IV]

### **REFERENCE BOOKS**

- [1] Borengasser, M., Hungate, W. S., & Watkins, R. (2007). Hyperspectral Remote Sensing: Principles and Applications. CRC Press.  
[2] Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote Sensing and Image Interpretation. John Wiley & Sons  
[3] Thenkabail, P. S., & Lyon, J. G. (2016). Hyperspectral Remote Sensing of Vegetation. CRC Press

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Dr Devis Tuia, Machine Learning for Remote Sensing Data Analysis,<https://www.youtube.com/watch?v=5NHmxYkYoZg>,  
Last accessed on 06/03/2023  
[2] Runmin Dong, Deep learning for remote sensing image analysis: applications, methods and perspectives, IEEE GRSS,  
<https://www.youtube.com/watch?v=oO55mK7mgrM>,  
Last accessed on 06/03/2023

**20AI&DS7403C**  
**CYBER SECURITY AND LAWS**

<b>Course Category:</b>	Program Elective IV	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS5404C: Cryptography and Network Security	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the basics of internet security and securing data	K2	1.7.1, 2.5.3, 3.5.1
<b>CO2</b>	Apply and use the basic and network monitoring tools for the given scenario	K3	1.2.2, 2.8.2, 5.4.1
<b>CO3</b>	Understand the internet regulations and intellectual property	K2	1.6.1, 3.6.1, 4.4.1
<b>CO4</b>	Understand the business laws, cyberthreats, and emerging issues in cyber law	K2	1.7.1, 2.5.1, 3.5.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3	2	1										1	1
<b>CO2</b>	2	1			3								1	1
<b>CO3</b>	1		2	3									1	1
<b>CO4</b>	2	3	1										1	1

## COURSE CONTENT

### UNIT I:

**Understanding the Environment:** The Basics of Internet Security, Basic Internet Concepts, Internet Services, Standards and RFCs.

**Protecting the Perimeter:** Understanding the Perimeter, Firewalls, Network Appliances, Proxy Servers, Demilitarized Zones, Honeypots, Extranets.

**Protecting Data Moving through the Internet:** Securing Data in Motion – Authentication, Encryption, Cryptography - Digital Certificates, Hash Tables, Cookies, CAPTCHAs, Virtual Private Networks.

### UNIT II:

**Tools and Utilities:** Using Basic Tools – IFconfig/Ipconfig, Whois, Nslookup, PING, Traceroute, Telnet, Secure Shell. Monitoring Tools and Software – Nagios, SolarWinds, Microsoft Network Monitor, Wireshark, Snort, Nmap, Nikto, OpenVAS, Metasploit, The Browser Exploitation Framework (BeEF).

**Identifying and Defending Against Vulnerabilities:** Zero Day Vulnerabilities, Software Exploits, Social Engineering Exploits, Network Threats and Attacks, Dictionary Attacks, Denial of Service (DoS) Attacks, Spam, Other Exploits.

### UNIT III:

**Making of Internet Regulations:** Laws, Cyber Lawmaking in America, Challenges to Internet Lawmaking, Cyber Ethics.

**Digital Privacy:** Privacy Protections – Public Disclosure of Private and Embarrassing Facts, False Light, Misappropriation, Intrusion, Other Privacy Laws, Privacy Problems – Outdated Laws, Government Surveillance, Private Surveillance, Comparative Law, The Price of Privacy.

**Intellectual Property:** Copyright – What Can Be Copyrighted, What is Not Protected, How Long Does Copyright Last, How to Copyright Your Work, Who Owns a Copyright, Contributory Infringement, Streaming, Fair Use: An Important Exception, Other Copyright Exceptions, Penalties for Copyright Infringement, Copyright vs. Plagiarism. Other IP Laws – Patent Law, Trademark Law, Trade Secrets, International Intellectual Rights.

**UNIT IV:**

**Online Business and the Law:** Anti-Trust Laws, E-Contracts, Taxes, Advertising, Data Protection, ADA Compliance, Online Reviews, International E-Commerce Laws, Intellectual Property.

**Cyberthreats:** Cybercrime – Criminal Law Explained, Cybercrime Laws – Hacking, Cell Phone Fraud, Wire Fraud, Money Laundering, Cybersex Crimes, Spam, Piracy, Identity Theft, Data Security Laws – Challenges of Fighting Cybercrime, Cyberwarfare.

**Emerging Issues in Cyber Law:** Artificial Intelligence, Cyborgs, Cryptocurrency, Sharing Economy, U.S.–China Tech War, Climate Change, Staying Informed.

**TEXT BOOKS**

[1] Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short. “Cybersecurity Essentials”, John Wiley & Sons, 2018.

[2] Grabowski, Mark, and Eric P. Robinson. Cyber law and ethics: regulation of the connected world. Routledge, 2021.

**REFERENCE BOOKS**

[1] Thomas W. Edgar, David O. Manz. “Research Methods for Cyber Security”. Syngress, 2017.

[2] Alfreda Dudley, James Braman, Giovanni Vincenti. "Investigating Cyber Law and Cyber Ethics: Issues, Impacts and Practices". Information Science Reference (an imprint of IGI Global), 2012

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Cyber Crime & Cyber Law, <https://www.udemy.com/course/cyber-crime-cyber-law-by-dr-pavan-duggal/> last accessed on 18/06/2024

**20AI&DS7403D**  
**REAL TIME DATA ANALYTICS FOR DRONES**

<b>Course Category:</b>	Program Elective IV	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS6301: Big Data Analytics	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the foundations of remote sensing, photogrammetry, drone common sensors, and drone images collection and processing.	2	1.6.1,2.5.1,2.5.2,2.6.3, 2.7.1
<b>CO2</b>	Understand how to arrange a fly and use aerial cinematography techniques.	2	1.6.1,2.5.1,2.5.2,2.6.3, 2.7.1,3.5.1,3.8.2
<b>CO3</b>	Apply augmented reality to applications such as 3D surface modeling.	3	1.6.1,2.5.1,2.5.2,2.6.3, 2.7.1,3.5.1,3.8.2
<b>CO4</b>	Analyze non imagery, atmospheric data for different case studies.	4	1.6.1,2.5.1,2.5.2,2.6.3, 2.7.1,3.5.1,3.8.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2											2	2
<b>CO2</b>	2	2	3										2	2
<b>CO3</b>	2	2	3										2	2
<b>CO4</b>	2	2	3										2	2

**COURSE CONTENT**

## **UNIT I**

### **Introduction to Capturing and Processing Drone Imagery and Data**

Introduction, Drone Terminology, Flying and Safe Operations, Platforms, Fixed-Wing Platforms, Rotary-Wing Platforms, Which Platform to Choose?, Payload, Cameras and Non-imagery Sensors, Drone Applications , Agriculture , Wildlife Surveys, Geomorphology, Historical and Cultural Heritage Preservation , Atmospheric Studies, Other Applications, Ethics and Privacy

### **An Introduction to Drone Remote Sensing and Photogrammetry**

Introduction, Remote Sensing with Drones, A Brief History of Aerial Photography and Photogrammetry , General Considerations for Capturing Images with Drones, Radiometric Errors and Effects, Radiometric Correction, Geometric Errors and Effects Georeferencing and Geometric Correction , Doming and Dishing , Data Products Derived from Drone Images Georeferenced Point Clouds , Digital Elevation Models , Orthophotos and Orthomosaics, Image Enhancement and Classification

### **Choosing a Sensor for UAS Imagery Collection**

Introduction, Passive and Active Sensors, Sensor Characteristics , Geometric Camera Calibration , Radiometry and Radiometric Calibration , Common Passive Sensors Used with Drones

### **Mission Planning for Capturing UAS Imagery**

Introduction, Defining Product Specifications and Accuracy Requirements, Researching Operational Site Restrictions , Selecting an Imaging Sensor and Computing Image Geometry - The Digital Sensor (Camera) , Geometry of Vertical Imagery, Planning Aerial Imagery Collection, Estimating Costs and Developing a Delivery Schedule, Solution to Design a Flight Plan and Layout

## **UNIT II**

### **Structure from Motion (SfM) Workflow for Processing Drone Imagery**

Introduction, Image Processing with Structure from Motion (SfM) - Georeferencing , Multi-View Stereo, Data Products, SfM Considerations , Image Capture Camera Calibration, Image Characteristics - Multispectral and Hyperspectral Imaging Data , Software, Applications

### **Aerial Cinematography with UAS**

Introduction, Quantitative Mapping versus Qualitative Videos, Geographic



Communication with Aerial Cinematography, Abstracted Views and Phantom Rides , Communicating through UAS Aerial Cinematography , Planning and Executing a Successful UAS Aerial Cinematography Mission - Selecting a Platform and Accessories , Techniques for Capturing Great Videos, Example Applications for UAS Aerial Cinematography

### **Planning Unoccupied Aircraft Systems (UAS) Missions**

Introduction, Learning Objectives, Hardware and Software Requirements , Overview of Mission Planner - Downloading and Installing Mission Planner , Navigating Mission Planner

Mission Planning in a Familiar Landscape Case study - Exploring the Area of Interest , Defining the Boundaries of the Area of Interest, Creating the UAS Mission

Mission Planning for the Unfamiliar Landscape Case study - Exploring the Area of Interest , Defining a UAS Mission within an Area of Interest ,Creating the UAS Mission

### **Aligning and Stitching Drone-Captured Images**

Learning Objectives, Hardware and Software Requirements, Introduction, Workflow for Stitching Drone-Captured Images, General Considerations for High-Quality Image Stitching, Counting Wildlife from Drone-Captured Imagery Using Visual and Semi Automated Techniques Case Study

## **UNIT III**

### **Terrain and Surface Modeling of Vegetation Height Using Simple Linear Regression**

Introduction, Hardware and Software Requirements, Datasets

Case Study - Developing a Digital Elevation Model (DEM), Building the SfM Point Cloud, Classifying Ground Points for the SfM Point Cloud, Creating a DEM Using Classified Ground Points, Mapping Vegetation Height Using 3D Data, Importing SfM Points into a GIS and Calculating Their Height above Ground, Associating PLOT ID with SfM Points and Calculating Height Metrics, Performing Simple Linear Regression and Applying Height Estimate Models to the Entire Study Area

### **Assessing the Accuracy of Digital Surface Models of an Earthen Dam Derived from SfM Techniques**

Introduction, Hardware and Software Requirements, Study Area and Data

## Collection

Case Studies- Part 1: Evaluating 3D Model Accuracy Using Only the Geotagged Images, Evaluate the Accuracy of a 3D Model Derived from Flight 1 , Evaluate the Accuracy of a 3D Model Derived from Flight 2 and Flight 3 Part 2: Evaluating the Impact of GCP Density and Distribution on DSM Accuracy, Evaluate the Vertical Accuracy of the DSM Generated Using Flights 2 and 3 with a Variable Number of GCPs

## **Estimating Forage Mass from Unmanned Aircraft Systems in Rangelands H**

Introduction, Hardware and Software Requirements, Study Area

Case Study- Part 1: Processing UAS Imagery into a DSM and Orthomosaic, Part 2: Linear Regression: Volumes and Forage Mass, Part 3: Forage Mass Estimation

## **Applications of UAS-Derived Terrain Data for Hydrology and Flood Hazard Modeling**

Introduction, Hardware and Software Requirements, Study Area

Case Study - Part 1: Getting to Know the Terrain and Hydrology of the Study Area, Visualize and Examine Digital Elevation Models of the Study Area, Analyze Terrain with Neighborhood Functions , Investigate the Hydrology of the Study Area, Modeling Flood Hazard with Drone Data, Load UAS Terrain Data into HEC-RAS Model Flow Area Setup, Modeling Unsteady Flow, Visualizing the Modeling Results

## **UNIT IV**

### **Comparing UAS and Terrestrial Laser Scanning Methods for Change Detection in Coastal Landscapes**

Objectives and Key Concepts ,Introduction, Coastal Foredune Systems ,Using UAS SfM-MVS and TLS Datasets for Terrain Mapping, Geomorphic Change Detection (GCD), Case study

### **Digital Preservation of Historical Heritage Using 3D Models and Augmented Reality**

Introduction, Hardware and Software Requirements, Datasets, Considerations when Capturing Drone Imagery for Digital Preservation, Regulations and Sensitivities, Representation of Area of Interest, Time of Data Acquisition , Camera Angle, Historical Context: The Old Athens Cemetery, Case study

### **Detecting Scales of Drone-Based Atmospheric Measurements Using Semivariograms**

Introduction, Hardware and Software Requirements, Datasets ,Traditional Atmospheric Measurement Technologies, Using Drones to Collect Atmospheric Measurements, Spatial Statistics and Geostatistics, Spatial Dependence and the Semivariogram, Data and Code, Computing a Sample Variogram and Fitting a Model, Analyzing Scale Changes in Different Atmospheric Situations Assessing the Greenhouse Gas Carbon Dioxide in the Atmospheric Boundary Layer

### **TEXT BOOKS**

[1] Amy E. Frazier and Kunwar K. Singh Fundamentals of Capturing and Processing Drone Imagery and Data CRC Press, 2021

### **REFERENCE BOOKS**

[1] Aaron Asadi Drones The Complete Manual. The essential handbook for drone enthusiasts Imagine Publishing Limited 2016

[2] Make Magazine DIY Drone and Quadcopter Projects: A Collection of Drone-Based Essays, Tutorials and Projects Maker Media, Inc 2016

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Drone Data Analytics, <https://aeromegh.com/blog/drone-data-analytics/> last accessed on 18/06/2024

[2] DroneCamp 2022 ep20: Drone Data Analysis with QGIS w/ Marc Mayes [https://www.youtube.com/watch?v=\\_B4wEU3S9xk](https://www.youtube.com/watch?v=_B4wEU3S9xk), <https://aeromegh.com/blog/drone-data-analytics/> last accessed on 18/06/2024

**20AI&DS7403E**  
**GPU ARCHITECTURE AND PROGRAMMING**

<b>Course Category:</b>	Program Elective IV	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS5404D: MicroProcessor and Microcontrollers	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand GPU computing architecture	K2	1.6.1,2.5.1,2.5.2,2.6.3, 2.7.1
<b>CO2</b>	Apply CUDA concepts for solving real world applications	K3	1.6.1,2.5.1,2.5.2,2.6.3, 2.7.1,3.5.1,3.8.2
<b>CO3</b>	Apply the concepts to identify parallel programming patterns to solve problems	K3	1.6.1,2.5.1,2.5.2,2.6.3, 2.7.1,3.5.1,3.8.2
<b>CO4</b>	Develop efficient algorithms in GPUs for common application kernels, such as matrix multiplication	K5	1.2.2, 2.8.2, 3.5.1,3.8.2 5.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2											1	1
<b>CO2</b>	2	2	2										1	1
<b>CO3</b>	2	2	2										1	1
<b>CO4</b>	2	2	2		2								1	1

**COURSE CONTENT**

## **UNIT I GPU ARCHITECTURE**

Evolution of GPU architectures – Understanding Parallelism with GPU – Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

## **UNIT II CUDA PROGRAMMING**

Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

## **UNIT III PROGRAMMING ISSUES**

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors, Developing for Future GPUs

## **UNIT IV OPENCL BASICS**

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.

## **TEXT BOOKS**

1. Shane Cook, CUDA Programming: —A Developer’s Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, —Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.

## **REFERENCE BOOKS**

1. Nicholas Wilt, —CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison – Wesley, 2013.
2. Jason Sanders, Edward Kandrot, —CUDA by Example: An Introduction to

General Purpose GPU Programming, Addison – Wesley, 2010.

3. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors – A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] <https://www.nvidia.com/en-us/research/> Last accessed on 18/06/2024

[2] <http://www.openCL.org>, Last accessed on 18/06/2024

[3] Soumyajit Dey , GPU Architectures and Programming, IIT Kharagpur  
[https://onlinecourses.nptel.ac.in/noc20\\_cs41/preview](https://onlinecourses.nptel.ac.in/noc20_cs41/preview), Last accessed on 18/06/2024

[4] GPU Architecture & CUDA Programming  
[https://www.cs.cmu.edu/afs/cs/academic/class/15418s18/www/lectures/06\\_gpuar ch.pdf](https://www.cs.cmu.edu/afs/cs/academic/class/15418s18/www/lectures/06_gpuar ch.pdf), Last accessed on 18/06/2024

[5] Swarnendu Biswas, CS 610: GPU Architectures and CUDA Programming, IIT Kanpur, <https://www.cse.iitk.ac.in/users/swarnendu/courses/autumn2020-cs610/gpu-cuda.pdf>, Last accessed on 18/06/2024

**20AI&DS7403F**  
**TIME SERIES ANALYSIS AND TEXT MINING**

<b>Course Category:</b>	Program Elective IV	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20BS3101E – Discrete Mathematics for Data Science 20BS4101 – Numerical Methods for Data Analysis	<b>Continuous Evaluation:</b> <b>Semester end Evaluation:</b> <b>Total Marks:</b>	30 70 100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Apply univariate stationary processes on time-series data.	K3	1.2.1, 1.7.1, 2.5.2, 2.6.3, 2.8.1, 2.8.4, 3.6.1
<b>CO2</b>	Understand autoregressive and stationary algorithm approaches to perform time series analysis.	K2	1.2.1, 1.7.1, 2.5.2, 2.6.3, 2.8.1, 2.8.4
<b>CO3</b>	Apply text extraction, multilingual document clustering and novelty mining on textual data.	K3	1.2.1, 1.7.1, 2.5.2, 2.6.3, 2.8.1, 2.8.4, 3.6.1
<b>CO4</b>	Understand events and trends in text streams, semantics embedding and different K-mean clustering techniques.	K2	1.2.1, 1.7.1, 2.5.2, 2.6.3, 2.8.1, 2.8.4

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2	1										1	1
<b>CO2</b>	2	2											2	2
<b>CO3</b>	2	2	1										2	2
<b>CO4</b>	2	2											2	2

## COURSE CONTENT

### UNIT – I

**Introduction:** Graphical Representations of Time Series, Ergodicity and Stationarity, World Decomposition.

**Univariate Stationary Processes:** Autoregressive Processes: First Order and second order Autoregressive Processes, Moving Average Processes: First Order and Higher order Moving Average Processes, Mixed Processes: ARMA (1,1), ARMA (p, q) processes, Forecasting: Forecasts with Minimal Mean Squared Errors and ARMA (p, q) Processes.

### UNIT – II

**Vector Autoregressive Processes:** Representation of the System, Granger Causality, Impulse Response Analysis, Variance Decomposition

**Nonstationary Processes:** Forms of Nonstationary, Trend elimination, Unit Root Tests: Dickey-Fuller Tests, Decomposition of Time Series.

**Autoregressive Conditional Heteroskedasticity:** ARCH Models, Generalized ARCH Models

### UNIT - III

**Text Extraction:** Rapid automatic keyword extraction, benchmark evaluation, stoplist generation, evaluation on news articles: MPQA Corpus, keyword extraction.

**Multilingual Document Clustering:** Multilingual LSA, Tucker 1 method, PARAFAC2 method, Latent morpho-semantic analysis (LMSA).

**Novelty Mining:** Adaptive threshold setting, Gaussian-based adaptive threshold setting.

### UNIT – IV

**Text streams:** Introduction, feature extraction and data reduction, event detection, trend detection, Event and trend descriptions, semantic vector space model, latent semantic analysis, probabilistic latent semantic analysis.

**Clustering:** Classical k-means clustering, Constrained k-means with Bregman divergences, constrained spherical k-means clustering

## TEXTBOOKS

- [1] Kirchgessner, G., Wolters, J., & Hassler, U. (2012). Introduction to modern time series analysis. Springer Science & Business Media.
- [2] Berry, M. W., & Kogan, J. (Eds.). (2010). Text mining: applications and



theory. John Wiley & Sons.

## REFERENCE BOOKS

- [1] Hamilton, J. D. (2020). Time series analysis. Princeton university press.
- [2] Madsen, H. (2007). Time series analysis. CRC Press.
- [3] Do Prado, H. A., & Ferneda, E. (Eds.). (2007). Emerging Technologies of Text Mining: Techniques and Applications: Techniques and Applications. IGI Global.

## E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] Tangirala, A. (2017, January 16). Applied Time-Series Analysis. NPTEL. Retrieved March 15, 2023, from <https://archive.nptel.ac.in/courses/103/106/103106123/>
- [2] Mikusheva. (2009, September 9). Lecture Notes | Time Series Analysis | Economics | MIT OpenCourseWare. MIT OpenCourseWare. Retrieved March 15, 2023, from <https://ocw.mit.edu/courses/14-384-time-series-analysis-fall-2013/pages/lecture-notes/>
- [3] Dixit, G. (2019, May 22). Business Analytics & Text Mining Modeling Using Python. NPTEL. Retrieved March 15, 2023, from <https://archive.nptel.ac.in/courses/110/107/110107129/>

**20AI&DS7403H**  
**AGILE PROJECT MANAGEMENT**

<b>Course Category:</b>	Program Elective IV	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS6303: Software Engineering	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the purpose of planning.	K2	1.2.1, 1.7.1, 2.5.2, 2.6.3, 2.8.1, 2.8.4
<b>CO2</b>	Understand the Scrum development process and agile development principles	K2	1.2.1, 1.7.1, 2.5.2, 2.6.3, 2.8.1, 2.8.4
<b>CO3</b>	Apply estimation techniques in agile projects.	K3	1.2.2, 2.8.2, 3.5.1,3.8.2 5.4.1
<b>CO4</b>	Analyze user stories for estimating an agile project.	K4	1.2.2, 2.8.2, 3.5.1,3.8.2 5.4.1

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2												1
<b>CO2</b>	2	1												1
<b>CO3</b>	3	2	2		2									1
<b>CO4</b>	1	3	2		2								1	2

**COURSE CONTENT****UNIT I**

**Purpose of planning:** What Makes a Good Plan, What Makes Planning Agile, Why Planning Fails, Planning Is By Activity Rather Than Feature, Multitasking

Causes Further Delays, Features Are Not Developed By Priority, Estimates Become Commitments.

## UNIT II

**An Agile Approach:** An Agile Approach To Projects, An Agile Approach to Planning

**Estimating Size:** Estimating Size with Story points, Story Points Are Relative, Velocity, Estimating in ideal days, Ideal Time and Software Development, Ideal Days As A Measure of Size, One Estimate, not Many.

## UNIT III

**Techniques for Estimating:** Estimates Are Shared, The Estimation Scale, Deriving An Estimate, Planning Poker, Re-Estimating, Swim Stats Website, When Not To Re-Estimate, When To Re-Estimate, Re-Estimating Partially Completed Stories, The Purpose of Re-Estimating.

## UNIT IV

**Estimating User Stories:** Story Points, Estimate as a Team ,Estimating Triangulate Using Story Points , What If We Pair Program, Planning a Release, Planning an Iteration.

## TEXTBOOKS

- [1] Mike Cohn-Agile Estimating and Planning, Prentice Hall, 2005. UNIT 1, 2, 3  
 [2]Mike Cohn-User Stories Applied: For Agile Software Development, Addison-Wesley Professional, 2004 . UNIT -4

## REFERENCE BOOKS

- [1] Jim Highsmith- Agile Project Management: Creating Innovative Products, Second Edition, Addison-Wesley Professional,2009  
 [2] David Morris-Agile Project Management in Easy Steps, 3rd Edition, In Easy Steps Limited, 2022.

## E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] Essential Scrum: A Practical Guide to the Most Popular Agile Process, <http://www.utdallas.edu/library/resources/ebooks/ebooks.php>, Last accessed on 18/06/2024  
 [2] PMP in Depth, 2nd Edition, <http://www.utdallas.edu/library/resources/ebooks/ebooks.php>, Last accessed on 18/06/2024

[3] Philip Tan, Sara Verrilli, and and Andrew Grant, Agile Project Management, <https://ocw.mit.edu/courses/cms-611j-creating-video-games-fall-2014/resources/lecture-6-agile-project-management/> Last accessed on 18/06/2024

**20AI&DS7404A**  
**COMPUTER VISION**

<b>Course Category:</b>	Program Elective V	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	Digital image processing fundamentals	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the concepts and techniques in computer vision and image processing.	K2	1.2.1, 1.7.1,2.8.1
<b>CO2</b>	Apply computer vision and image processing algorithms to solve real world problems	K3	1.2.1, 1.7.1,2.8.1,5.5.2
<b>CO3</b>	Apply segmentation techniques to the images and perform Pattern analysis.	K3	1.2.1, 1.7.1, 2.5.2, 5.5.2
<b>CO4</b>	Develop applications using computer vision techniques.	K6	1.2.1, 1.7.1, 2.5.2, 5.5.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	1	2											1	2
<b>CO2</b>	1	2			2								1	2
<b>CO3</b>	1	2			2								1	2
<b>CO4</b>	1	2			2								1	2

**COURSE CONTENT**

**UNIT I: IMAGE PROCESSING FOUNDATIONS**

Image processing techniques - classical filtering operations - thresholding techniques - edge detection techniques - corner and interest point detection - mathematical morphology - texture.

**UNIT II: IMAGE FORMATION AND PROCESSING**

Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine and Projective. Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing

**UNIT III:****FEATURE EXTRACTION**

Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

**IMAGE SEGMENTATION**

Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

**UNIT IV: PATTERN ANALYSIS**

**Clustering:** K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

**APPLICATIONS**

Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras  
In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

**TEXTBOOKS**

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

[2] Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson

Education, 2003.

[3] R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992

### REFERENCE BOOKS

[1] Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.

[2] K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

[3] R. Szeliski, — Computer Vision: Algorithms and Applications, Springer 2011.

### E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Jayanta Mukhopadhyay , Computer Vision, IIT Kharagpur, [https://onlinecourses.nptel.ac.in/noc19\\_cs58/preview](https://onlinecourses.nptel.ac.in/noc19_cs58/preview), Last accessed on 18/06/2024

[2] Visualization and perception lab,IITM, [http://www.cse.iitm.ac.in/~vplab/computer\\_vision.html](http://www.cse.iitm.ac.in/~vplab/computer_vision.html), Last accessed on 18/06/2024

**20AI&DS7404B**  
**SENTIMENT ANALYSIS AND OPINION MINING**

<b>Course Category:</b>	Program Elective V	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS5302: Machine Learning	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand different approaches to document sentiments and classifications	K2	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.8.1
<b>CO2</b>	Apply different opinion techniques to real time problems	K3	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3,5,5,2
<b>CO3</b>	Analyze the opinion results on different services	K4	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3,5,5,2
<b>CO4</b>	Apply different opinion spam detection methods	K3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.6.4, 2.8.4,5,5,2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	3											2	
<b>CO2</b>	2	2			2								2	
<b>CO3</b>	2	2			2								2	
<b>CO4</b>	2	3			2								1	

**COURSE CONTENT****UNIT I**

**Sentiment Analysis:** A Fascinating Problem, Sentiment Analysis Applications, Sentiment Analysis Research, Different Levels of Analysis, Sentiment Lexicon



and Its Issues, Natural Language Processing Issues, Opinion Spam Detection.

**The Problem of Sentiment Analysis:** Problem Definitions, Opinion Definition, Sentiment Analysis Tasks, Opinion Summarization, Different Types of Opinions, Regular and Comparative Opinions, Explicit and Implicit Opinions.

**Document Sentiment Classification:** Sentiment Classification Using Supervised Learning, Sentiment Classification Using Unsupervised Learning, Sentiment Rating Prediction Cross-Domain, Sentiment Classification Cross-Language Sentiment Classification.

## UNIT II

**Sentence Subjectivity and Sentiment Classification:** Sentiment Analysis and Opinion Mining, Subjectivity Classification. Subjectivity Classification, Sentence Sentiment Classification, Dealing with Conditional Sentences, Dealing with Sarcastic Sentences, Cross-language Subjectivity and Sentiment Classification, Using Discourse Information for Sentiment Classification.

**Aspect-based Sentiment Analysis:** Aspect Sentiment Classification, Basic Rules of Opinions and Compositional Semantics **Aspect Extraction** Finding Frequent Nouns and Noun Phrases Using Opinion and Target Relations Using Supervised Learning Using Topic Models Mapping Implicit Aspects Identifying Resource Usage Aspect Simutaneous Opinion Lexicon Expansion and Aspect Extraction Grouping Aspects into Categories Entity, Opinion Holder and Time Extraction Co-reference Resolution and Word Sense Disambiguation

## UNIT III

**Sentiment Lexicon Generation:** Dictionary-based Approach, Corpus-based Approach, Desirable and Undesirable Facts Opinion Summarization, Aspect-based Opinion Summarization, Improvements to Aspect-based Opinion Summarization, Contrastive View Summarization Traditional Summarization. **Analysis of Comparative Opinions** Problem Definitions Identify Comparative Sentences Identifying Preferred Entities.

**Opinion Search and Retrieval:** Web Search vs. Opinion Search, Existing Opinion Retrieval Techniques

## UNIT IV

**Opinion Spam Detection:** Types of Spam and Spamming, Harmful Fake Reviews, Individual and Group Spamming Types of Data Features and Detection, Supervised Spam Detection.

**Unsupervised Spam Detection:** Spam Detection based on Atypical Behaviors,

Spam Detection Using Review Graph Group Spam Detection.

**Quality of Reviews:** Quality as Regression Problem Other Methods.

## **TEXTBOOKS**

[1] Sentiment Analysis and Opinion Mining April 22, 2012 Bing Liu

## **REFERENCE BOOKS**

[1] Sentiment Analysis in Social Networks By Federico Pozzi, Elisabetta Fersini, Enza Messina, Bing Liu · 2016

[2] Sentiment Analysis for Social Media, Antonio Moreno, Carlos A. Iglesias, MDPI 2020

[3] New Opportunities for Sentiment Analysis and Information Processing, Aakansha Sharaff, G. R. Sinha, Surbhi Bhatia, IGI Global, 2021

[4] Sentiment Analysis and Knowledge Discovery in Contemporary Business, Dharmendra Singh Rajput, Ramjeevan Singh Thakur, S. Muzamil Basha, IGI Global, 2018

## **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Ferrara Alfio, Text Mining and Sentiment Analysis, <https://www.unimi.it/en/education/degree-programme-courses/2024/text-mining-and-sentiment-analysis>, last accessed on 18/06/2024

[2] ChengXiang Zhai, Text Mining and Analytics, <https://www.coursera.org/learn/text-mining>, last accessed on 18/06/2024

**20AI&DS7404C**  
**DIGITAL FORENSICS**

<b>Course Category:</b>	Program Elective V	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS4304: Computer Networks 20AI&DS5404C : Cryptography & Network Security	<b>Continuous Evaluation:</b> <b>Semester end Evaluation:</b> <b>Total Marks:</b>	30 70 100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the concepts of cyber forensics related Issues.	K2	1.7.1, 2.6.4
<b>CO2</b>	Analyse the process of various forensic systems.	K4	1.7.1, 3.6.2
<b>CO3</b>	Analyze Evidence capture mechanism and Recovery steps	K4	1.7.1, 3.6.2
<b>CO4</b>	Analyze electronic communications evidences.	K4	2.6.3

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	3													
<b>CO2</b>	2		2											2
<b>CO3</b>	2		2											
<b>CO4</b>		2												2

**COURSE CONTENT****UNIT I:**

Forensic Terminology and Investigations: Introduction, Traditional problems in investigation, Forensic science and disk structure. Forensic Laboratory:

Developing computer Forensic Science capabilities, Minimum Housing requirements, Hardware and Software requirements, Popular Software.

### **UNIT II:**

Search and Seize Computer Related Evidence: Identifying Digital Evidence, Collecting the Evidence in Private-Sector Incident Scenes, Processing law Enforcement Crime Scenes, Preparing for a Search, Securing a Computer Incident or Crime Scene, Sizing Digital evidence at the Scene, Storing Digital evidence, obtaining a Digital Hash.

### **UNIT III:**

Computer Forensics Analysis and Validation: Determining What Data to Collect and Analyse, Validating Forensic Data, Addressing Data-Hiding Techniques, Performing Remote Acquisition, Current Forensic Tool: Evaluating Computer Forensics Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software

### **UNIT IV:**

E-mail Investigations & Report Writing: Exploring the Role of E-mail in Investigations, Exploring the Role of Client and Server in E-mail, Investigating E-mail Crimes and Violations, Using Specialized E-mail Forensics Tools, Report Writing

### **TEXT BOOKS**

[1] John R. Vacca, Firewall Media, “Computer Forensics: Computer Crime Investigation”, Charles River Media, 2015.

[2] Nelson, Phillips Enfinger, Steuart , “Computer Forensics and Investigations”, CENGAGE , 2005.

### **REFERENCE BOOKS**

[1] Keith J. Jones, Richard Bejtlich, Curtis W. Rose, Addison , Real Digital Forensics, Wesley Pearson Education, 2006

[2] Tony Sammes and Brian Jenkinson, “Forensic Compiling”, Springer, 2007

[3] Christopher L.T. Brown, “ Computer Evidence Collection & Preservation”, Firewall Media, 2005.

[4] Chuck Eastom, “Certified Cyber Forensics Professional Certification: McGraw Hill, July 2017

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] Digital & Cyber Forensics

<https://drive.google.com/file/d/1FDO0tDbwSsWQiNbC2jQL4XXi->

[DUvz5kP/view](https://drive.google.com/file/d/1FDO0tDbwSsWQiNbC2jQL4XXi-DUvz5kP/view), Last accessed on 18/06/2024

[2] Joshua I James, Hallim University, Introduction to digital forensics

<https://www.youtube.com/watch?v=giv0DQDSsjQ>, Last accessed on 18/06/2024

**20AI&DS7404D**  
**WEB AND DATABASE SECURITY**

<b>Course Category:</b>	Program Elective V	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the vulnerabilities in the web applications..	K2	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.8.1
<b>CO2</b>	Understand the various types of threats and mitigation measures of web applications	K2	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3
<b>CO3</b>	Apply various administration policies for users.	K3	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3,5,5,2
<b>CO4</b>	Analyze various database security models	K4	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.6.4, 2.8.4,5,5,2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2												1
<b>CO2</b>	2	2												1
<b>CO3</b>	2	2			2									1
<b>CO4</b>	2	2			2									1

**COURSE CONTENT****UNIT- I****Overview of Web Applications**

Introduction history of web applications interface ad structure benefits and

drawbacks of web applications, Web application Vs Cloud application.

### **Web Application Security Fundamentals**

Security Fundamentals: Input Validation - Attack Surface Reduction Rules of Thumb- Classifying and Prioritizing Threads

### **Browser Security Principles**

Origin Policy - Exceptions to the Same-Origin Policy - Cross-Site Scripting and Cross-Site Request Forgery - Reflected XSS - HTML Injection

## **Unit – II**

### **Web Application Vulnerabilities**

Understanding vulnerabilities in traditional client server application and web applications, client state manipulation, cookie based attacks, SQL injection, cross domain attack (XSS/XSRF/XSSI) http header injection. SSL vulnerabilities and testing - Proper encryption use in web application - Session vulnerabilities and testing - Cross-site request forgery

### **Web Application Mitigations**

Http request , http response, rendering and events , html image tags, image tag security, issue, java script on error , Javascript timing , port scanning , remote scripting , running remotecode, frame and iframe , browser sandbox, policy goals, same origin policy, library import, domain relaxation

## **UNIT- III**

### **Introduction to Database Security:**

Introduction to Databases Security Problems in Databases Security Controls Conclusions

### **Security Models 1**

Introduction Access Matrix Model Take-Grant Model Acten Model PN Model Hartson and Hsiao's Model Fernandez's Model Bussolati and Martella's Model for Distributed databases

## **UNIT- IV**

**Security Models 2** - Bell and LaPadula's Model Biba's Model Dion's Model Sea View Model Jajodia and Sandhu's Model The Lattice Model for the Flow Control conclusion

### **Security Mechanisms**

Introduction User Identification/Authentication Memory Protection Resource

Protection Control Flow Mechanisms Isolation Security Functionalities in Some Operating Systems Trusted Computer System Evaluation Criteria

### **TEXT BOOKS**

- [1] Sullivan, Bryan, and Vincent Liu. Web Application Security, A Beginner's Guide. McGraw Hill Professional, 2011.
- [2] Stuttard, Dafydd, and Marcus Pinto. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws. John Wiley Sons, 2011
- [3] Database Security and Auditing, Hassan A. Afyouni, India Edition, CENGAGE Learning, 2009.
- [4] Database Security, Castano, Second edition, Pearson Education.

### **REFERENCE BOOKS**

- [1] Database security by alfred basta, melissa zgola, CENGAGE learning, 2012

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Dr. Maurice Dawson J, Database Security, <https://www.youtube.com/watch?v=eigUZoKUuug>, Last accessed on 18/06/2024
- [2] Philippe De Ryck, University of Leuven Web Security Fundamentals, <https://www.edx.org/learn/computer-security/ku-leuven-web-security-fundamentals>, Last accessed on 18/06/2024



**20AI&DS7404E**  
**CYBER PHYSICAL SYSTEMS**

<b>Course Category:</b>	Program Elective V	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	Computer Networks 20CS4304	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Apply Embedded system concepts to solve real word problems.	<b>K3</b>	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4
<b>CO2</b>	Develop solution to automated systems to make life easier.	<b>K5</b>	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4, 3.7.1.5.5.2
<b>CO3</b>	Apply concepts of embedded systems and microcontroller to enhance existing systems.	<b>K3</b>	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4
<b>CO4</b>	Analyze concepts, logics towards solving a unknown problem in research and industry.	<b>K4</b>	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2	3												1
<b>CO2</b>	2	2	2		2									1
<b>CO3</b>	2	2												1
<b>CO4</b>	2	2												1

**COURSE CONTENT**

**UNIT I:**

Introduction: Cyber-Physical System, Key Features of CPS, Application Domains of CPS, Basic principles of design and validation of CPS, Challenges in CPS.

**UNIT II:**

CPS Platform components: CPS HW platforms, Processors, Sensors and Actuators, CPS Network - Wireless, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks, Synchronous Model and Asynchronous Model

**UNIT III:**

Synchronous and Asynchronous Model: Reactive Components, Components Properties,

Components Composing, Synchronous Designs and Circuits, Asynchronous Processes and operations, Design Primitives in Asynchronous Process, Coordination Protocols in Asynchronous Process, Leader Election, Reliable Transmission.

**UNIT IV:**

Security of Cyber-Physical Systems: Introduction to CPS Securities, Basic Techniques in CPS Securities, Cyber Security Requirements, Attack Model and Countermeasures, Advanced Techniques in CPS Securities.

CPS Application: Health care and Medical Cyber-Physical Systems, Smart grid and Energy Cyber-Physical Systems, WSN based Cyber-Physical Systems, Smart Cities.

**TEXT BOOKS**

1. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.
2. R. Alur, "Principles of Cyber-Physical Systems," MIT Press, 2015.

**REFERENCE BOOKS**

- [1] Raj Rajkumar, Dionisio de Niz and Mark Klein, "Cyber-Physical Systems", Addison-Wesley, 2017

## **E-RESOURCES AND OTHER DIGITAL MATERIAL**

[1] André Platzer, "Lecture Notes on Foundations of Cyber-Physical Systems", Carnegie Mellon University, available

@<https://www.cs.cmu.edu/~aplatzer/course/fcps14/fcps14.pdf>, accessed on 2nd May 2023.

[2] Dr. Sayan Mitra, "Modeling and verification of Cyber-Physical Systems", IIT GUwahati, available @ <https://www.iitg.ac.in/pbhaduri/GIAN-CPS/>, accessed on 2nd May 2023.

**20AI&DS7404F**  
**MOBILE COMMERCE**

<b>Course Category:</b>	Program Elective V	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand about the infrastructure required for building an M-commerce application	K2	5.2.1, 5.3.1, 6.1.1, 7.2.1
<b>CO2</b>	Analyze the M-Commerce Technologies.	K4	5.2.1, 5.3.1, 6.1.1, 7.2.1
<b>CO3</b>	Understand the secure Electronic transactions	K2	5.2.1, 5.3.1, 6.1.1, 8.1.1
<b>CO4</b>	Understand the secure Electronic transactions	K2	5.2.1, 5.3.1, 6.1.1, 7.2.1, 8.1.1, 10.3.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>					2	1	1							
<b>CO2</b>					2	1	1							
<b>CO3</b>					1	2		2						1
<b>CO4</b>					2	2	2	2		2				2

**COURSE CONTENT**

**UNIT I**  
**ELECTRONIC COMMERCE**

Traditional commerce and E-commerce – The Dimensions of E-Commerce – E-

Commerce Business Models – E-Commerce information System Function Model

**MOBILE COMMERCE** Introduction – Infrastructure of M- Commerce – Types Of Mobile Commerce Services – Technologies Of Wireless Business – Benefits And Limitations, Support, Mobile Marketing & Advertisement, Non-Internet Applications In M- Commerce – Wireless/Wired Commerce Comparisons.

## **UNIT II**

### **M COMMERCE: TECHNOLOGY**

Mobile Clients: Types – Device limitations – Device location technology

Mobile Client Software: Mobile Device Operating System – Micro Browsers – Mobile Device Communication protocols: WAP, Client Side – Server side – WAP, i-Mode – Page Description languages – application Software

**WIRELESS COMMUNICATION TECHNOLOGY:** Wireless widearea network Technology: Cellular Systems – 2G(CDMA, TDMA, GSM)– 2.5G(GPRS, EDGE) – 3G(UMTS, CDMA-2000) – 4G – Wireless LAN (Wi-fi) – WMAN (wi-max) – WPAN(Bluetooth).

## **UNIT III**

**APPROACHES TO SAFE ELECTRONIC COMMERCE:** Secure transport Protocols, Secure Transactions, Secure Electronic Payment Protocol (SEPP), Secure Electronic Transaction (SET)

**ELECTRONIC CASH AND ELECTRONIC PAYMENT SCHEMES:** Introduction, Internet Monetary Payment & Security Requirements. Payment andPurchase Order Process, On-line Electronic cash.

**MASTER CARD/VISA SECURE ELECTRONIC TRANSACTION:** Introduction, Business Requirements, Concepts, payment Processing.

## **UNIT IV**

**ADVERTISING ON INTERNET:** Issues and Technologies. Introduction, advertising on the Web, Marketing, Electronic Publishing Issues, Approaches and Technologies: EP and web based EP

### **M-COMMERCE ISSUES**

Technology Issues – Mobile Client Issues – Communication infrastructure Issues – other technology Issues – Application issues – Global m-Commerce issues

**TEXT BOOKS**

[1] Norman Sadeh, “M-Commerce Technologies, Services and Business Models”Wiley publications, 2002.

**REFERENCE BOOKS**

- [1] Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth Chang, “E-Commercefundamentals and applications”, John Wiley.
- [2] Paul May, “Mobile Commerce: Opportunities, Applications, and Technologiesof Wireless Business” Cambridge University Press March 2001.

**E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] PROF. MAMATA JENAMAN E-Business  
<https://nptel.ac.in/courses/110105083> last accessed on 28-02-2023.
- [2] Lecture Series on Internet Technologies by Prof.I.Sengupta, Department ofComputer Science & Engineering, IIT Kharagpur  
<https://www.youtube.com/watch?v=xKJjyn8DaAw> Last accessed on 04-03-2022

**20AI&DS7404G**  
**REINFORCEMENT LEARNING**

<b>Course Category:</b>	Program Elective V	<b>Credits:</b>	3
<b>Course Type:</b>	Theory	<b>Lecture -Tutorial-Practice:</b>	3 - 0 - 0
<b>Prerequisites:</b>	20AI&DS5302: Machine Learning	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand the basics of reinforcement learning. Its elements and limitations.	2	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4
<b>CO2</b>	Understand the finite Markov decision process.	2	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4
<b>CO3</b>	Understand value functions as a general-purpose tool for optimal decision making	2	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4
<b>CO4</b>	Analyze dynamic programming concepts as an efficient solution approach to real world problems	4	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4, 5.5.2

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	1												1
<b>CO2</b>	2	2												1
<b>CO3</b>	2	2												1
<b>CO4</b>	2	2			2									2

**COURSE CONTENT**

**UNIT - I**

**Introduction to RL:** The Reinforcement Learning Problem, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe

**Multi-arm Bandits :** An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandits

**UNIT - II**

**Finite Markov Decision Processes:** The Agent–Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation

Dynamic Programming: Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming,

**UNIT - III**

**Monte Carlo Methods:** Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated

**Temporal-Difference Learning:** TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-Policy TD Control, Q-Learning: Off-Policy TD Control

**UNIT - IV**

Policy Based Reinforcement Learning: Policy Gradient and Actor-Critic Methods—REINFORCE Algorithm and Stochastic Policy Search, Vanilla Policy Gradient(VPG), Asynchronous Advantage Actor-Critic (A3C), Generalized Advantage Estimation (GAE), Advantage Actor-Critic(A2C), Deep Deterministic Policy Gradient (DDPG), Twin-Delayed DDPG (TD3), Soft Actor-Critic (SAC), proximal policy optimization (PPO).

**TEXT BOOKS**

[1] Richard S. Sutton and Andrew G. Barto; Reinforcement Learning: An Introduction; 2nd Edition, MIT Press,2020.

**REFERENCE BOOKS**



1. Keng, Wah Loon, Graesser, Laura, Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Addison Wesley Data & Analytics Series, 2020.
2. Miguel Morales, Grokking Deep Reinforcement Learning, Manning Publications, 2020

## **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Balaraman Ravindran , Reinforcement Learning, IIT Madras, [https://onlinecourses.nptel.ac.in/noc20\\_cs74/preview](https://onlinecourses.nptel.ac.in/noc20_cs74/preview) last accessed on 18/06/2024
- [2] CS234: Reinforcement Learning Spring 2024, <https://web.stanford.edu/class/cs234/> last accessed on 18/06/2024
- [3] Alexander Amini , MIT 6.S191 (2023): Deep Reinforcement Learning , <https://www.youtube.com/watch?v=AhyznRSDjw8>, last accessed on 18/06/2024

**20AI&DS7607****CORPORATE READINESS SKILLS**

<b>Course Category:</b>	Advanced Skill Course	<b>Credits:</b>	2
<b>Course Type:</b>	Lab	<b>Lecture -Tutorial-Practice:</b>	1-0-2
<b>Prerequisites:</b>	-	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

**COURSE OUTCOMES****BTL****POI**

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

<b>CO1</b>	Understand required Life long Skills & Job skills and make them Industry ready	K2	
<b>CO2</b>	Develop interpersonal skills, like conflict resolution, teamwork, and respect for diversity	K5	
<b>CO3</b>	Develop skills to face interviews confidently	K5	
<b>CO4</b>	Analyze various career paths and to choose one path	K4	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
<b>CO1</b>	2	2	2	2	2				2		2	2	2	2
<b>CO2</b>	2	2	2	2	2				2		2	2	2	2
<b>CO3</b>	2	2	2	2	2				2		2	2	2	2
<b>CO4</b>	2	2	2	2	2				2		2	2	2	2

**COURSE CONTENT****Personal Qualities and Abilities**

1. Demonstrate creativity and innovation.
2. Demonstrate critical thinking and problem-solving.
3. Demonstrate initiative and self-direction.

4. Demonstrate integrity.
5. Demonstrate work ethic.

### **Interpersonal Skills**

1. Demonstrate conflict-resolution skills.
2. Demonstrate listening and speaking skills.
3. Demonstrate respect for diversity.
4. Demonstrate customer service skills.
5. Collaborate with team members.

### **Professional Competencies**

1. Demonstrate big-picture thinking.
2. Demonstrate career and life-management skills.
3. Demonstrate continuous learning and adaptability.
4. Manage time and resources.
5. Demonstrate information-literacy skills.
6. Demonstrate an understanding of information security.
7. Maintain working knowledge of current information-technology (IT) systems.
8. Demonstrate proficiency with technologies, tools, and machines common to a specific occupation.
9. Apply mathematical skills to job-specific tasks.
10. Demonstrate professionalism.
11. Demonstrate reading and writing skills.
12. Demonstrate workplace safety.

### **TEXT BOOKS**

- [1] Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill, 5th Edition
- [2] Dr. Agarwal.R.S, Quantitative Aptitude for Competitive Examinations, S. Chand and Company Limited, 2018 Edition
- [3] Edgar Thrope, Test of Reasoning for Competitive Examinations, Tata McGraw Hill, 6th Edition

### **REFERENCE BOOKS**

- [1] Bhatnagar R P, English for Competitive Examinations, Trinity Press, 2016

### **E-RESOURCES AND OTHER DIGITAL MATERIAL**

- [1] Soft Skills for Job Readiness. <https://www.careermetis.com/10-soft-skills-job-readiness/> last accessed on 18/06/2024
- [2] Skills to Demonstrate Career Readiness. <https://www.capella.edu/blogs/cublog/how-todemonstrate-7-career-readiness-competencies/> last accessed on 18/06/2024
- [3] Career readiness & employability skills. <https://www.pearson.com/us/higher->

education/whychoose-pearson/career-readiness-employability.html, last accessed on 18/06/2024

[4]Developing a Personal Brand In and Out of the Classroom.  
<https://todayslearner.cengage.com/developing-a-personal-brand-in-and-out-of-theclassroom/> last accessed on 18/06/2024

**20AI&DS7551**  
**MINI PROJECT - II**

<b>Course Category:</b>	Project	<b>Credits:</b>	1.5
<b>Course Type:</b>	Internship/Project	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 3
<b>Prerequisites:</b>	20AI&DS6554: Mini Project I	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Formulate Domain Analysis, Elaboration through Modeling and Implementation through state of the art technology available.	K2	
<b>CO2</b>	Develop generic and modular programs that includes Handling exceptional cases in providing reliable solutions	K4	
<b>CO3</b>	Testing and verification of programs for different scenarios	K3	
<b>CO4</b>	Conclude findings through oral presentations	K3	
<b>CO5</b>	Prepare proper documentation consisting of Software Requirements Specification (SRS), Modeling Techniques, Development Strategies, Implementation and Testing Strategies, use any Design Methodologies such as SSAD, OOAD and UML	K3	
<b>CO6</b>	Builds the spirit of team work in design process.	K4	
<b>CO7</b>	Become proficient in the programming languages	K4	

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

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

<b>CO1</b>	<b>1</b>	<b>2</b>	<b>2</b>				<b>1</b>					<b>3</b>	<b>2</b>	<b>2</b>
<b>CO2</b>	<b>1</b>	<b>2</b>	<b>2</b>		<b>1</b>		<b>1</b>					<b>3</b>	<b>2</b>	<b>2</b>
<b>CO3</b>				<b>2</b>	<b>2</b>						<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO4</b>						<b>1</b>			<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>
<b>CO5</b>					<b>2</b>			<b>2</b>	<b>2</b>		<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO6</b>								<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO7</b>		<b>2</b>	<b>2</b>		<b>2</b>						<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>

## **COURSE CONTENT**

**Mini Project II could be done by a group of students; involves working under a faculty member and carry out detailed feasibility study, literature survey and prepare a detailed project report during VII semesters**

**20AI&DS7552**  
**Industrial / Research Internship**

<b>Course Category:</b>	Project	<b>Credits:</b>	1.5
<b>Course Type:</b>	Internship/Project	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 3
<b>Prerequisites:</b>	20AI&DS6554: Mini Project I	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>	<b>BTL</b>	<b>POI</b>
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**Upon successful completion of the course, the student will be able to:**

<b>CO1</b>	Formulate Domain Analysis, Elaboration through Modeling and Implementation through state of the art technology available.	K2	
<b>CO2</b>	Develop generic and modular programs that includes Handling exceptional cases in providing reliable solutions	K4	
<b>CO3</b>	Testing and verification of programs for different scenarios	K3	
<b>CO4</b>	Conclude findings through oral presentations	K3	
<b>CO5</b>	Prepare proper documentation consisting of Software Requirements Specification (SRS), Modeling Techniques, Development Strategies, Implementation and Testing Strategies, use any Design Methodologies such as SSAD, OOAD and UML	K3	
<b>CO6</b>	Builds the spirit of team work in design process.	K4	
<b>CO7</b>	Become proficient in the programming languages	K4	

**Contribution of Course Outcomes towards achievement of Program**

**Outcomes (1 – Low, 2 - Medium, 3 – High)**

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

CO1	1	2	2				1					3	2	2
CO2	1	2	2		1		1					3	2	2
CO3				2	2						2	2	2	2
CO4						1			2	2	2	3	2	2
CO5					2			2	2		2	2	2	2
CO6								2	2	2	2	2	2	2
CO7		2	2		2						2	2	2	2

## COURSE CONTENT

**Note: Industrial/Research Internship six weeks (Mandatory) during summer vacation. The student should undergo internship and parallely he/she should work on a project with well-defined objectives. A student shall also be permitted to submit project report on the work carried out during the internship. At the end of the VII semester the candidate shall submit an internship completion certificate and a project report.**



# **Semester VIII**

**20AI&DS8551**  
**MAJOR PROJECT**

<b>Course Category:</b>	Project	<b>Credits:</b>	12
<b>Course Type:</b>	Internship/Project	<b>Lecture -Tutorial-Practice:</b>	0 - 0 - 24
<b>Prerequisites:</b>	20AI&DS7551 Mini Project II	<b>Continuous Evaluation:</b>	30
		<b>Semester end Evaluation:</b>	70
		<b>Total Marks:</b>	100

<b>COURSE OUTCOMES</b>		<b>BTL</b>	<b>POI</b>
<b>Upon successful completion of the course, the student will be able to:</b>			
<b>CO1</b>	Formulate a real world problem and develop its requirements	K2	
<b>CO2</b>	Develop and design solution for a set of requirements	K4	
<b>CO3</b>	Test and validate the conformance of the developed prototype against the original requirements of the problem	K3	
<b>CO4</b>	Work as a responsible member and possibly a leader of a team in developing software solutions	K3	
<b>CO5</b>	Express technical and behavioral ideas and thought in oral settings	K3	
<b>CO6</b>	Participate in and possibly moderate, discussions that lead to making decisions	K4	
<b>CO7</b>	Express technical ideas, strategies and methodologies in written form	K4	
<b>CO8</b>	Prepare and conduct oral presentations		
<b>CO9</b>	Self learn new tools, algorithms, and/or techniques that contribute to the software solution of the project		
<b>CO10</b>	Generate alternative solutions, compare them and select the optimum one		

**Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)**

	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
CO1	1	2	2				1					3	2	2
CO2	1	2	2		1	2	1	2	2			3	2	2
CO3	1	2	2	1	2	2	1	2	2		2	2	2	2
CO4						1			3	2	2	3	2	2
CO5					2			2	2		2	2	2	2
CO6								2	2	2	2	2	2	2
CO7		2	2		2						2	2	2	2
CO8					2			2	3		2	2	2	2
CO9					2	2	2	2		2	2	2	2	2
CO10				2	2						2	2	2	2

**COURSE CONTENT**

The student should undergo internship and simultaneously he/she should work on a project with welldefined objectives. At the end of the semester the student should submit an internship completion certificate and a project report.