



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

## **COURSE STRUCTURE AND SYLLABUS**

**For UG –R20**

**B. TECH - COMPUTER SCIENCE & ENGINEERING**

*(Applicable for batches admitted from 2020-2021)*



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**

**KAKINADA - 533 003, Andhra Pradesh, India**



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**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

**COURSE STRUCTURE**

<b>I Year – I SEMESTER</b>						
<b>S. No</b>	<b>Course Code</b>	<b>Courses</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	HS	Communicative English	3	0	0	3
2	BS	Mathematics - I (Calculus And Differential Equations)	3	0	0	3
3	BS	Applied Physics	3	0	0	3
4	ES	Programming for Problem Solving using C	3	0	0	3
5	ES	Computer Engineering Workshop	1	0	4	3
6	HS	English Communication Skills Laboratory	0	0	3	1.5
7	BS	Applied Physics Lab	0	0	3	1.5
8	ES	Programming for Problem Solving using C Lab	0	0	3	1.5
<b>Total Credits</b>			<b>19.5</b>			

<b>I Year – II SEMESTER</b>						
<b>S. No</b>	<b>Course Code</b>	<b>Courses</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	BS	Mathematics – II (Linear Algebra And Numerical Methods)	3	0	0	3
2	BS	Applied Chemistry	3	0	0	3
3	ES	Computer Organization	3	0	0	3
4	ES	Python Programming	3	0	0	3
5	ES	Data Structures	3	0	0	3
6	BS	Applied Chemistry Lab	0	0	3	1.5
7	ES	Python Programming Lab	0	0	3	1.5
8	ES	Data Structures Lab	0	0	3	1.5
9	MC	Environment Science	2	0	0	0
<b>Total Credits</b>			<b>19.5</b>			



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II Year – I SEMESTER						
S. No	Course Code	Courses	L	T	P	Credits
1	BS	Mathematics III	3	0	0	3
2	CS	Object Oriented Programming through C++	3	0	0	3
3	CS	Operating Systems	3	0	0	3
4	CS	Software Engineering	3	0	0	3
5	CS	Mathematical Foundations of Computer Science	3	0	0	3
6	CS	Object Oriented Programming through C++ Lab	0	0	3	1.5
7	CS	Operating Systems Lab	0	0	3	1.5
8	CS	Software Engineering Lab	0	0	3	1.5
9	SO	<b>Skill oriented Course - I</b> Applications of Python-NumPy <b>OR</b> 2) Web Application Development Using Full Stack -Frontend Development – Module-I	0	0	4	2
10	MC	Constitution of India	2	0	0	0
<b>Total Credits</b>			<b>21.5</b>			

II Year – II SEMESTER						
S. No	Course Code	Courses	L	T	P	Credits
1	BS	Probability and Statistics	3	0	0	3
2	CS	Database Management Systems	3	0	0	3
3	CS	Formal Languages and Automata Theory	3	0	0	3
4	ES	Java Programming	3	0	0	3
5	HS	Managerial Economics and Financial Accountancy	3	0	0	3
6	CS	Database Management Systems Lab	0	0	2	1
7	CS	R Programming Lab	0	1	2	2
8	ES	Java Programming Lab	0	0	3	1.5
9	SO	<b>Skill Oriented Course - II</b> Applications of Python-Pandas <b>OR</b> 2) Web Application Development Using Full Stack -Frontend Development –Module-II	0	0	4	2
<b>Total Credits</b>			<b>21.5</b>			
10	Minor	Operating Systems <sup>§</sup>	3	0	2	3+1
11	Honors	Any course from the Pool, as per the opted track	4	0	0	4

§- Integrated Course



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III B. Tech – I Semester						
S.No	Course Code	Courses	Hours per week			Credits
			L	T	P	
1	PC	Computer Networks	3	0	0	3
2	PC	Design and Analysis of Algorithms	3	0	0	3
3	PC	Data Warehousing and Data Mining	3	0	0	3
4	Open Elective / Job Oriented	<b>Open Elective-I</b> Open Electives offered by other departments/ Optimization in Operations Research (Job oriented course)	3	0	0	3
5	PE	<b>Professional Elective-I</b> Artificial Intelligence Software Project Management Distributed Systems Advanced Unix Programming	3	0	0	3
6	PC	Data Warehousing and Data Mining Lab	0	0	3	1.5
7	PC	Computer Networks Lab	0	0	3	1.5
8	SO	<b>Skill Oriented Course – III</b> 1. Animation course: Animation Design <b>OR</b> 2. Continuous Integration and Continuous Delivery using DevOps	0	0	4	2
9	MC	Employability Skills-I	2	0	0	0
10	PR	<b>Summer Internship 2 Months</b> <b>(Mandatory) after second year (to be</b> <b>evaluated during V semester</b>	0	0	0	1.5
<b>Total credits</b>						<b>21.5</b>
11	Minor	Database Management Systems <sup>§</sup>	3	0	2	3+1
12	Honors	Any course from the Pool, as per the opted track	4	0	0	4

§- Integrated Course



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III B. Tech – II Semester						
S.No	Course Code	Courses	Hours per week			Credits
			L	T	P	
1	PC	Machine Learning	3	0	0	3
2	PC	Compiler Design	3	0	0	3
3	PC	Cryptography and Network Security	3	0	0	3
4	PE	<b>Professional Elective-II</b> 1.Mobile Computing 2.Big Data Analytics 3.Object Oriented Analysis and Design 4.Network Programming	3	0	0	3
5	Open Elective /Job Oriented	<b>Open Elective-II</b> Open Electives offered by other departments/ MEAN Stack Development ( <i>Job Oriented</i> )	3	0	0	3
6	PC	Machine Learning using Python Lab	0	0	3	1.5
7	PC	Compiler Design Lab	0	0	3	1.5
8	PC	Cryptography and Network Security Lab	0	0	3	1.5
9	SO	<b>Skill Oriented Course - IV</b> 1.Big Data:Spark <b>OR</b> 2.MEAN Stack Technologies-Module I (HTML 5, JavaScript, Node.js, Express.js and TypeScript)	0	0	4	2
10	MC	Employability skills-II	2	0	0	0
<b>Total credits</b>						<b>21.5</b>
<b>Industrial/Research Internship(Mandatory) 2 Months during summer vacation</b>						
11	Minor	Data Structures and Algorithms <sup>§</sup>	3	0	2	3+1
12	Honors	Any course from the Pool, as per the opted track	4	0	0	4
<b>Minor course through SWAYAM</b>			-	-	-	<b>2</b>

§- Integrated Course



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IV B. Tech –I Semester						
S.No	Course Code	Course Title	Hoursperweek			Credits
			L	T	P	
1	PE	<b>Professional Elective-III</b> 1.Cloud Computing 2.Neural Networks and Soft Computing 3.Ad-hoc and Sensor Networks 4.Cyber Security & Forensics	3	0	0	3
2	PE	<b>Professional Elective-IV</b> 1. Deep Learning Techniques 2. Social Networks & Semantic Web 3. Computer Vision 4.MOOCs-NPTEL/SWAYAM%	3	0	0	3
3	PE	<b>Professional Elective-V</b> 1.Block-Chain Technologies 2.Wireless Network Security 3.Ethical Hacking 4.MOOCs-NPTEL/SWAYAM%	3	0	0	3
4	Open Elective /Job Oriented	<b>Open Elective-III</b> Open Electives offered by other departments/ API and Microservices (Job Oriented Course)	3	0	0	3
5	Open Elective /Job Oriented	<b>Open Elective-IV</b> Open Electives offered by other departments/ Secure Coding Techniques (Job Oriented Course)	3	0	0	3
6	HS	Universal Human Values 2: Understanding Harmony	3	0	0	3
7	SO	1.PYTHON: Deep Learning <b>OR</b> 2.MEAN Stack Technologies-Module II- Angular JS and MongoDB <b>OR</b> 3.APSSDC offered Courses	0	0	4	2
8	PR	<b>Industrial/Research Internship 2 months (Mandatory) after third year (to be evaluated during VII semester)</b>	0	0	0	3
<b>Total credits</b>						<b>23</b>
11	Minor	Software Engineering <sup>\$</sup> / any other from PART-B (For Minor)	3	0	2	3+1
12	Honors	Any course from the Pool, as per the opted track	4	0	0	4
<b>Minor course through SWAYAM</b>						<b>2</b>

\$- Integrated Course

% - MOOC Course



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IV B. Tech –II Semester						
S.No	Course Code	Course Title	Hours per week			Credits
			L	T	P	C
1	Project	Major Project Work, Seminar Internship	-	-	-	12
<b>Total credits</b>						<b>12</b>

Note:

1. **For integrated courses:** Theory and laboratory exams will be conducted separately, and the student concern will get credits if successfully completes both theory and laboratory. Only external exam will be conducted for Laboratory component. Credit based weightage shall be considered while awarding the grade.
2. **For MOOC courses:** Based on the students interest, student can register and complete a 12 week course one year in advance, by prior information to the concern.



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**SUGGESTED COURSES FOR HONORS PROGRAM**

<b>POOL1- AI &amp; ML</b> <ol style="list-style-type: none"><li>1. Mathematics for Machine Learning</li><li>2. Text Mining and Time Series Analysis</li><li>3. Natural Language Processing</li><li>4. Reinforcement Learning</li></ol>	<b>POOL2- Systems Engineering</b> <ol style="list-style-type: none"><li>1. Internet of Things</li><li>2. Data Communications and Information Coding Theory</li><li>3. Service Oriented Architectures</li><li>4. Design of Secure Protocols</li><li>5. Network Coding</li></ol>
<b>POOL3- Information Security</b> <ol style="list-style-type: none"><li>1. Principles of Cyber Security</li><li>2. Computational Number Theory</li><li>3. Cryptanalysis</li><li>4. Elliptic Curve Cryptography</li><li>5. Introduction to Quantum Computing and Quantum Cryptography</li><li>6. Public Key Infrastructure and Trust Management</li><li>7. Information Security Analysis and Audit</li><li>6. Cloud and IoT Security</li><li>7. Web Security</li><li>8. Block Chain Architecture Design and Use Cases</li></ol>	<b>POOL4 – Data Science</b> <ol style="list-style-type: none"><li>1. Data Visualization</li><li>2. Statistical Foundations for Data Science</li><li>3. Mining Massive Data Sets</li><li>4. Medical Image Data Processing</li></ol>





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#### SUGGESTED COURSES MINOR ENGINEERING IN CSE

##### Note:

1. Any THREE courses need to be studied from PART-A.
2. Any ONE course need to be studied from PART-B.
3. TWO, NPTEL courses of EIGHT week duration covering a total of 4 credits (offered by CSE Department only), Student can register at any time after the completion of II B.Tech. I Sem.
4. Students can pursue suggested MOOC Courses via NPTEL from II B.Tech II Sem and onwards, by prior information to the concern.

##### Eligibility for Minor in CSE:

PART A					
S.No	Subject	L-T-P	Credits	Course available in NPTEL	NPTEL Link
1	Operating Systems	3-0-2	4	Operating Systems	<a href="https://onlinecourses.swayam2.ac.in/cec21_cs20/preview">https://onlinecourses.swayam2.ac.in/cec21_cs20/preview</a>
2	Data Structures and Algorithms	3-0-2	4	Data Structures Programming, Data Structures and Algorithms using Python	<a href="https://onlinecourses.swayam2.ac.in/cec22_cs10/preview">https://onlinecourses.swayam2.ac.in/cec22_cs10/preview</a> <a href="https://onlinecourses.nptel.ac.in/noc22_cs26/preview">https://onlinecourses.nptel.ac.in/noc22_cs26/preview</a>
3	Software Engineering	3-0-2	4	Software Engineering	<a href="https://onlinecourses.swayam2.ac.in/cec21_cs21/preview">https://onlinecourses.swayam2.ac.in/cec21_cs21/preview</a>
4	Computer Networks	3-0-2	4	Computer Networks	<a href="https://onlinecourses.swayam2.ac.in/cec22_cs05/preview">https://onlinecourses.swayam2.ac.in/cec22_cs05/preview</a>
5	Database Management Systems	3-0-2	4	Data Base Management System (noc22-cs51)	<a href="https://onlinecourses.nptel.ac.in/noc22_cs51/preview">https://onlinecourses.nptel.ac.in/noc22_cs51/preview</a>
PART B					
S.No	Subject	L-T-P	Credits	Course available in NPTEL	NPTEL Link
1	Computational Thinking	4-0-0	4	Physics through Computational Thinking	<a href="https://onlinecourses.nptel.ac.in/noc22_ph12/preview">https://onlinecourses.nptel.ac.in/noc22_ph12/preview</a>
2	Object Oriented Programming through JAVA	3-0-2	4		
3	Data Analytics using Python	3-0-2	4	Data Analytics with Python	<a href="https://onlinecourses.nptel.ac.in/noc22_cs8/preview">https://onlinecourses.nptel.ac.in/noc22_cs8/preview</a>
4	Artificial Intelligence	4-0-0	4	Artificial Intelligence: Knowledge Representation And Reasoning	1. <a href="https://onlinecourses.nptel.ac.in/noc22_cs56/preview">https://onlinecourses.nptel.ac.in/noc22_cs56/preview</a> 2. <a href="https://onlinecour">https://onlinecour</a>



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				(noc22-cs02), An Introduction to Artificial Intelligence (noc22-cs56), AI: Constraint Satisfaction (noc22-cs06)	ses.swayam2.ac.i n/cec21_cs08/pre view
<b>5</b>	Unix and Shell Programming	3-0-2	4		
<b>6</b>	Cloud Computing	4-0-0	4	Cloud Computing and Distributed Systems (noc22- cs18), Cloud computing(noc22- cs20)	1. <a href="https://onlinecourses.nptel.ac.in/noc22_cs18/preview">https://onlinecourses.nptel.ac.in/noc22_cs18/preview</a> 2. <a href="https://onlinecourses.nptel.ac.in/noc22_cs20/preview">https://onlinecourses.nptel.ac.in/noc22_cs20/preview</a>



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**Open Electives to be offered by CSE for other Branches:**

<b>Open Elective-I:</b> <ol style="list-style-type: none"><li>1. Data Structures</li><li>2. Object Oriented Programming through JAVA</li><li>3. Data Base Management Systems</li><li>4. Computer Graphics</li><li>5. Advanced UNIX Programming</li><li>6. Computer Organization and Architecture</li><li>7. Operating Systems</li></ol>	<b>Open Elective-II:</b> <ol style="list-style-type: none"><li>1. Python Programming</li><li>2. Web Technologies</li><li>3. Soft Computing</li><li>4. Distributed Computing</li><li>5. AI and ML for Robotics</li><li>6. Computer Networks</li><li>7. Big Data Analytics</li><li>8. Computational Tools</li></ol>
<b>Open Elective-III:</b> <ol style="list-style-type: none"><li>1. AI Tools &amp; Techniques</li><li>2. Image Processing</li><li>3. Information Security</li><li>4. Mobile Application Development</li><li>5. Data Science</li><li>6. Cyber Security</li><li>7. Introduction to Internet of Things</li></ol>	<b>Open Elective-IV:</b> <ol style="list-style-type: none"><li>1. MEAN Stack Technologies</li><li>2. Deep Learning Techniques</li><li>3. Cloud computing with AWS</li><li>4. Block Chain Technologies</li><li>5. Cryptography &amp; Network Security</li><li>6. Introduction to Machine Learning</li><li>7. Machine Learning with Python</li></ol>



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<b>I Year - I Semester</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>COMMUNICATIVE ENGLISH</b>				

**Introduction**

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners’ ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

**Course Objectives:**

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

**Course Outcomes:**

At the end of the module, the learners will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms

**Unit 1:**

**Lesson-1: A Drawer full of happiness** from “**Infotech English**”, Maruthi Publications

**Lesson-2: Deliverance by Premchand** from “**The Individual Society**”, Pearson Publications. (Non-detailed)

**Listening:** Listening to short audio texts and identifying the topic. Listening to prose, prose and conversation.

**Speaking:** Asking and answering general questions on familiar topics such as home, family, work, studies and interests. Self introductions and introducing others.

**Reading:** Skimming text to get the main idea. Scanning to look for specific pieces of information.



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**Reading for Writing:** Paragraph writing (specific topics) using suitable cohesive devices; linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.

**Vocabulary:** Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal reasoning and sequencing of words.

**Grammar:** Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural basic sentence structures; simple question form - wh-questions; word order in sentences.

**Pronunciation:** Vowels, Consonants, Plural markers and their realizations

**Unit 2:**

**Lesson-1: Nehru's letter to his daughter Indira on her birthday** from “**Infotech English**”, Maruthi Publications

**Lesson-2: Bosom Friend** by **Hira Bansode** from “**The Individual Society**”, Pearson Publications.(Non-detailed)

**Listening:** Answering a series of questions about main idea and supporting ideas after listening to audio texts, both in speaking and writing.

**Speaking:** Discussion in pairs/ small groups on specific topics followed by short structured talks. Functional English: Greetings and leave takings. **Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

**Reading for Writing:** Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

**Vocabulary:** Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)

**Grammar:** Use of articles and zero article; prepositions.

**Pronunciation:** Past tense markers, word stress-di-syllabic words

**Unit 3:**

**Lesson-1: Stephen Hawking-Positivity 'Benchmark'** from “**Infotech English**”, Maruthi Publications

**Lesson-2: Shakespeare's Sister** by **Virginia Woolf** from “**The Individual Society**”, Pearson Publications.(Non-detailed)

**Listening:** Listening for global comprehension and summarizing what is listened to, both in speaking and writing.

**Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed. Functional English: Complaining and Apologizing.

**Reading:** Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Critical reading.

**Reading for Writing:** Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. Letter writing-types, format and principles of letter writing. E-mail etiquette, Writing CV's.

**Vocabulary:** Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, sequencing of words

**Grammar:** Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

**Pronunciation:** word stress-poly-syllabic words.



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**Unit 4:**

**Lesson-1: Liking a Tree, Unbowed: Wangari Maathai-biography** from “**Infotech English**”, Maruthi Publications

**Lesson-2: Telephone Conversation-Wole Soyinka** from “**The Individual Society**”, Pearson Publications.(Non-detailed)

**Listening:** Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts.

**Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. Functional English: Permissions, Requesting, Inviting.

**Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicative process or display complicated data.

**Reading for Writing:** Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. Writing SOP, writing for media.

**Vocabulary:** Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.

**Grammar:** Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

**Pronunciation:** Contrastive Stress

**Unit 5:**

**Lesson-1: Stay Hungry-Stay foolish** from “**Infotech English**”, Maruthi Publications

**Lesson-2: Still I Rise by Maya Angelou** from “**The Individual Society**”, Pearson Publications.(Non-detailed)

**Listening:** Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing.

**Speaking:** Formal oral presentations on topics from academic contexts - without the use of PPT slides. Functional English: Suggesting/Opinion giving.

**Reading:** Reading for comprehension. RAP Strategy Intensive reading and Extensive reading techniques.

**Reading for Writing:** Writing academic proposals- writing research articles: format and style.

**Vocabulary:** Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, matching emotions.

**Grammar:** Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

**Pronunciation:** Stress in compound words

**Text Books:**

1. “**Infotech English**”, Maruthi Publications. (Detailed)
2. “**The Individual Society**”, Pearson Publications.(Non-detailed)

**Prescribed text book for Laboratory for Semesters-I & II:**

1. “**Infotech English**”, Maruthi Publications. (with Compact Disc)



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**Reference Books**

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.





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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>MATHEMATICS-I</b> (Calculus And Differential Equations)					

**Course Objectives:**

- To familiarize a variety of well-known sequences and series, with a developing intuition about the behaviour of new ones.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

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

- utilize mean value theorems to real life problems (L3)
- solve the differential equations related to various engineering fields (L3)
- familiarize with functions of several variables which is useful in optimization (L3)
- apply double integration techniques in evaluating areas bounded by region (L3)
- students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional and 3-dimensional coordinate systems(L5 )

**UNIT – I: Sequences, Series and Mean value theorems: (10hrs)**

Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy’s root test – Alternate series– Leibnitz’s rule.

Mean Value Theorems (without proofs): Rolle’s Theorem – Lagrange’s mean value theorem – Cauchy’s mean value theorem – Taylor’s and Maclaurin’s theorems with remainders, Problems and applications on the above theorem.

**UNIT – II: Differential equations of first order and first degree: (10hrs)**

Linear differential equations– Bernoulli’s equations –Exact equations and equations reducible to exact form.

Applications: Newton’s Law of cooling– Law of natural growth and decay– Orthogonal trajectories– Electrical circuits.

**UNIT – III: Linear differential equations of higher order: (10hrs)**

Homogeneous and Non-homogeneous differential equations of higher order with constant coefficients – with non-homogeneous term of the type  $e^{ax}$ ,  $\sin ax$ ,  $\cos ax$ , polynomials in  $x^n$ ,  $e^{ax}V(x)$  and  $x^nV(x)$  – Method of Variation of parameters, Cauchy and Legendre’s linear equations.

Applications: LCR circuit, Simple Harmonic motion.

**UNIT – IV: Partial differentiation: (10hrs)**

Introduction – Homogeneous function – Euler’s theorem– Total derivative– Chain rule– Jacobian – Functional dependence –Taylor’s and MacLaurin’s series expansion of functions of two variables.

Applications: Maxima and Minima of functions of two variables without constraints and Lagrange’s method.





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**UNIT – V: Multiple integrals:**

**(8 hrs)**

Double and Triple integrals – Change of order of integration in double integrals – Change of variables to polar, cylindrical and spherical coordinates.

Applications: Finding Areas and Volumes.

**Text Books:**

1. B. S. Grewal, Higher Engineering Mathematics, 44<sup>th</sup> Edition, Khanna Publishers.
2. B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

**Reference Books:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10<sup>th</sup> Edition, Wiley-India.
2. Joel Hass, Christopher Heil and Maurice D. Weir, Thomas calculus, 14<sup>th</sup> Edition, Pearson.
3. Lawrence Turyrn, Advanced Engineering Mathematics, CRC Press, 2013.
4. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.



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<b>I Year - I Semester</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>APPLIED PHYSICS</b> <b>(For All Circuital Branches like ECE, EEE, CSE etc)</b>				

**Course Objectives:**

1. Bridging the gap between the physics in school at 10+2 level and UG level engineering courses.
2. To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications
3. Understand the mechanism of emission of light, utilization of lasers as coherent light sources for low and high energy applications, study of propagation of light through optical fibers and their implications in optical communications.
4. Enlightenment of the concepts of Quantum Mechanics and to provide fundamentals of deBroglie matter waves, quantum mechanical wave equation and its application, the importance of free electron theory for metals and band theory for crystalline solids. Metals-Semiconductors-Insulators concepts utilization of transport phenomenon of charge carriers in semiconductors.
5. To explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging micro devices.
6. To Understand the physics of Semiconductors and their working mechanism. To give an impetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications.

**Course Outcomes:**

1. Explain the need of coherent sources and the conditions for sustained interference (L2). Identify the applications of interference in engineering (L3). Analyze the differences between interference and diffraction with applications (L4). Illustrate the concept of polarization of light and its applications (L2). Classify ordinary refracted light and extraordinary refracted rays by their states of polarization (L2)
2. Explain various types of emission of radiation (L2). Identify the role of laser in engineering applications (L3). Describe the construction and working principles of various types of lasers (L1). Explain the working principle of optical fibers (L2). Classify optical fibers based on refractive index profile and mode of propagation (L2). Identify the applications of optical fibers in medical, communication and other fields (L2). Apply the fiber optic concepts in various fields (L3).
3. Describe the dual nature of matter (L1). Explain the significance of wave function (L2). Identify the role of Schrodinger's time independent wave equation in studying particle in one-dimensional infinite potential well (L3). Identify the role of classical and quantum free electron theory in the study of electrical conductivity (L3). Classify the energy bands of solids (L2).



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4. Explain the concept of dielectric constant and polarization in dielectric materials (L2). Summarize various types of polarization of dielectrics (L2). Interpret Lorentz field and Claussius-Mosotti relation in dielectrics (L2). Classify the magnetic materials based on susceptibility and their temperature dependence (L2). Explain the applications of dielectric and magnetic materials (L2). Apply the concept of magnetism to magnetic devices (L3)
5. Outline the properties of charge carriers in semiconductors (L2). Identify the type of semiconductor using Hall effect (L2). Identify applications of semiconductors in electronic devices (L2). Classify superconductors based on Meissner's effect (L2). Explain Meissner's effect, BCS theory & Josephson effect in superconductors (L2).

**Unit-I: Wave Optics**

**12hrs**

**Interference:** Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colors in thin films- Newton's Rings- Determination of wavelength and refractive index.

**Diffraction:** Introduction - Fresnel and Fraunhofer diffraction - Fraunhofer diffraction due to single slit, double slit - N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating(Qualitative).

**Polarization:** Introduction-Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

**Unit Outcomes:**

*The students will be able to*

- **Explain** the need of coherent sources and the conditions for sustained interference (L2)
- **Identify** engineering applications of interference (L3)
- **Analyze** the differences between interference and diffraction with applications (L4)
- **Illustrate** the concept of polarization of light and its applications (L2)
- **Classify** ordinary polarized light and extraordinary polarized light (L2)

**Unit-II: Lasers and Fiber optics**

**8hrs**

**Lasers:** Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein's coefficients – Population inversion – Lasing action - Pumping mechanisms – Ruby laser – He-Ne laser - Applications of lasers.

**Fiber optics:** Introduction –Principle of optical fiber- Acceptance Angle - Numerical Aperture - Classification of optical fibers based on refractive index profile and modes – Propagation of electromagnetic wave through optical fibers - Applications.

**Unit Outcomes:**

*The students will be able to*

- **Understand** the basic concepts of LASER light Sources (L2)
- **Apply** the concepts to learn the types of lasers (L3)
- **Identifies** the Engineering applications of lasers (L2)
- **Explain** the working principle of optical fibers (L2)
- **Classify** optical fibers based on refractive index profile and mode of propagation (L2)



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- **Identify** the applications of optical fibers in various fields (L2)

**Unit III: Quantum Mechanics, Free Electron Theory and Band theory** **10hrs**

**Quantum Mechanics:** Dual nature of matter – Heisenberg’s Uncertainty Principle – Significance and properties of wave function – Schrodinger’s time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

**Free Electron Theory:** Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory– Equation for electrical conductivity based on quantum free electron theory- Fermi-Dirac distribution- Density of states (3D) - Fermi energy.

**Band theory of Solids:** Bloch’s Theorem (Qualitative) - Kronig - Penney model (Qualitative)- E vs K diagram - v vs K diagram - effective mass of electron – Classification of crystalline solids– concept of hole.

**Unit Outcomes:**

*The students will be able to*

- **Explain** the concept of dual nature of matter (L2)
- **Understand** the significance of wave function (L2)
- **Interpret** the concepts of classical and quantum free electron theories (L2)
- **Explain** the importance of K-P model
- **Classify** the materials based on band theory (L2)
- **Apply** the concept of effective mass of electron (L3)

**Unit-IV: Dielectric and Magnetic Materials**

**8hrs**

**Dielectric Materials:** Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility and Dielectric constant - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius-Mossotti equation- Piezoelectricity.

**Magnetic Materials:** Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability - Origin of permanent magnetic moment - Classification of magnetic materials: Dia, para, Ferro, antiferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials- Eddy currents- Engineering applications.

**Unit Outcomes:** *The students will be able to*

- **Explain** the concept of dielectric constant and polarization in dielectric materials (L2)
- **Summarize** various types of polarization of dielectrics (L2)
- **Interpret** Lorentz field and Clausius- Mosotti relation in dielectrics(L2)
- **Classify** the magnetic materials based on susceptibility and their temperature dependence (L2)
- **Explain** the applications of dielectric and magnetic materials (L2)
- **Apply** the concept of magnetism to magnetic data storage devices (L3)

**Unit – V: Semiconductors and Superconductors**

**10hrs**

**Semiconductors:** Introduction- Intrinsic semiconductors – Density of charge carriers – Electrical conductivity – Fermi level – extrinsic semiconductors – density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein’s equation- Hall effect – Hall coefficient –Applications of Hall effect.



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**Superconductors:** Introduction – Properties of superconductors – Meissner effect – Type I and Type II superconductors – BCS theory (Qualitative) – Josephson effects (AC and DC) – SQUIDS – High  $T_c$  superconductors – Applications of superconductors.

#### Unit Outcomes:

*The students will be able to*

- **Classify** the energy bands of semiconductors (L2)
- **Interpret** the direct and indirect band gap semiconductors (L2)
- **Identify** the type of semiconductor using Hall effect (L2)
- **Identify** applications of semiconductors in electronic devices (L2)
- **Classify** superconductors based on Meissner's effect (L2)
- **Explain** Meissner's effect, BCS theory & Josephson effect in superconductors (L2)

#### Text books:

1. M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy” A Text book of Engineering Physics”- S.Chand Publications, 11<sup>th</sup> Edition 2019.
2. Engineering Physics” by D.K.Bhattacharya and Poonam Tandon, Oxford press (2015).
3. Applied Physics by P.K.Palanisamy SciTech publications.

#### Reference Books:

1. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley & Sons
2. Engineering Physics by M.R.Srinivasan, New Age international publishers (2009).
3. Shatendra Sharma, Jyotsna Sharma, “Engineering Physics”, Pearson Education, 2018
4. Engineering Physics - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press
5. Semiconductor physics and devices- Basic principle – Donald A, Neamen, Mc Graw Hill
6. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PROGRAMMING FOR PROBLEM SOLVING USING C</b>					

**Course Objectives:**

The objectives of Programming for Problem Solving Using C are

- To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
- To gain knowledge of the operators, selection, control statements and repetition in C
- To learn about the design concepts of arrays, strings, enumerated structure and union types and their usage.
- To assimilate about pointers, dynamic memory allocation and know the significance of Preprocessor.
- To assimilate about File I/O and significance of functions

**Course Outcomes:**

Upon the completion of the course the student will learn

- To write algorithms and to draw flowcharts for solving problems
- To convert flowcharts/algorithms to C Programs, compile and debug programs
- To use different operators, data types and write programs that use two-way/ multi-way selection
- To select the best loop construct for a given problem
- To design and implement programs to analyze the different pointer applications
- To decompose a problem into functions and to develop modular reusable code
- To apply File I/O operations

**UNIT I**

Introduction to Computers: Creating and running Programs, Computer Numbering System, Storing Integers, Storing Real Numbers

Introduction to the C Language: Background, C Programs, Identifiers, Types, Variable, Constants, Input/output, Programming Examples, Scope, Storage Classes and Type Qualifiers.

Structure of a C Program: Expressions Precedence and Associativity, Side Effects, Evaluating Expressions, Type Conversion Statements, Simple Programs, Command Line Arguments.

**UNIT II**

Bitwise Operators: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators.

Selection & Making Decisions: Logical Data and Operators, Two Way Selection, Multiway Selection, More Standard Functions.

Repetition: Concept of Loop, Pretest and Post-test Loops, Initialization and Updating, Event and Counter Controlled Loops, Loops in C, Other Statements Related to Looping, Looping Applications, Programming Examples.

**UNIT III**

Arrays: Concepts, Using Array in C, Array Application, Two Dimensional Arrays, Multidimensional Arrays, Programming Example – Calculate Averages

Strings: String Concepts, C String, String Input / Output Functions, Arrays of Strings, String Manipulation Functions String/ Data Conversion, A Programming Example – Morse Code

Enumerated, Structure, and Union: The Type Definition (Type def), Enumerated Types, Structure, Unions, and Programming Application.



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**UNIT IV**

Pointers: Introduction, Pointers to pointers, Compatibility, L value and R value

Pointer Applications: Arrays, and Pointers, Pointer Arithmetic and Arrays, Memory Allocation

Function, Array of Pointers, Programming Application.

Processor Commands: Processor Commands.

**UNIT V**

Functions: Designing, Structured Programs, Function in C, User Defined Functions, Inter-Function Communication, Standard Functions, Passing Array to Functions, Passing Pointers to Functions, Recursion

Text Input / Output: Files, Streams, Standard Library Input / Output Functions, Formatting Input / Output Functions, Character Input / Output Functions

Binary Input / Output: Text versus Binary Streams, Standard Library, Functions for Files, Converting File Type.

**Text Books:**

- 1) Programming for Problem Solving, Behrouz A. Forouzan, Richard F. Gilberg, CENGAGE.
- 2) The C Programming Language, Brian W. Kernighan, Dennis M. Ritchie, 2e, Pearson.

**Reference Books:**

- 1) Computer Fundamentals and Programming, Sumithabha Das, Mc Graw Hill.
- 2) Programming in C, Ashok N. Kamthane, Amit Kamthane, Pearson.
- 3) Computer Fundamentals and Programming in C, Pradip Dey, Manas Ghosh, OXFORD.





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	<b>1</b>	<b>0</b>	<b>4</b>	<b>3</b>
<b>COMPUTER ENGINEERING WORKSHOP</b>				

**Course Objectives:**

The objective of this course is to

- Explain the internal parts of a computer, peripherals, I/O ports, connecting cables
- Demonstrate basic command line interface commands on Linux
- Teach the usage of Internet for productivity and self paced lifelong learning
- Describe about Compression, Multimedia and Antivirus tools
- Demonstrate Office Tools such as Word processors, Spreadsheets and Presentation tools

**Course Outcomes:**

Students should be able to:

- Assemble and disassemble components of a PC
- Construct a fully functional virtual machine, Summarize various Linux operating system commands,
- Recognize characters & extract text from scanned images, Create audio files and podcasts

**Computer Hardware:**

Experiment 1: Identification of peripherals of a PC, Laptop, Server and Smart Phones: Prepare a report containing the block diagram along with the configuration of each component and its functionality, Input/ Output devices, I/O ports and interfaces, main memory, cache memory and secondary storage technologies, digital storage basics, networking components and speeds.

**Operating Systems:**

Experiment 2: Virtual Machine setup:

- Setting up and configuring a new Virtual Machine
- Setting up and configuring an existing Virtual Machine
- Exporting and packaging an existing Virtual Machine into a portable format

Experiment 2: Operating System installation:

- Installing an Operating System such as Linux on Computer hardware.

Experiment 3: Linux Operating System commands:

- General command syntax
- Basic *help* commands
- Basic File system commands
- Date and Time
- Basic Filters and Text processing
- Basic File compression commands
- Miscellaneous: apt-get, vi editor

**Networking and Internet:**

Experiment 4: Networking Commands:

- ping, ssh, ifconfig, scp, netstat, ipstat, nslookup, traceroute, telnet, host, ftp, arp, wget, route

Experiment 5: Internet Services:

- Web Browser usage and advanced settings like LAN, proxy, content, privacy, security, cookies, extensions/ plugins





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- Antivirus installation, configuring a firewall, blocking pop-ups
- Email creation and usage, Creating a Digital Profile on LinkedIn

**Productivity Tools:**

Experiment 6: Basic HTML tags, Introduction to HTML5 and its tags, Introduction to CSS3 and its properties. Preparation of a simple website/ homepage,

Assignment: Develop your home page using HTML Consisting of your photo, name, address and education details as a table and your skill set as a list.

Features to be covered:- Layouts, Inserting text objects, Editing text objects, Inserting Tables, Working with menu objects, Inserting pages, Hyper linking, Renaming, deleting, modifying pages, etc.,

**Internet of Things (IoT):** IoT fundamentals, applications, protocols, communication models, architecture, IoT devices

**Office Tools:**

Experiment 7: Demonstration and Practice on Text Editors like Notepad++, Sublime Text, Atom, Brackets, Visual code, etc

Experiment 8: Demonstration and practice on Microsoft Word, Power Point, Microsoft Excel

Experiment 10: Demonstration and practice on LaTeX and produce professional pdf documents.

**Text Books:**

- 1) Computer Fundamentals, Anita Goel, Pearson Education, 2017
- 2) PC Hardware Trouble Shooting Made Easy, TMH

**References Books:**

- 1) Essential Computer and IT Fundamentals for Engineering and Science Students, Dr.N.B.Vekateswarlu, S.Chand

**e-Resources:**

- 1) [https://explorersposts.grc.nasa.gov/post631/2006-2007/computer\\_basics/ComputerPorts.doc](https://explorersposts.grc.nasa.gov/post631/2006-2007/computer_basics/ComputerPorts.doc)



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	<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>ENGLISH COMMUNICATION SKILLS LABORATORY</b>				

**UNIT I:**

Vowels, Consonants, Pronunciation, Phonetic Transcription, Common Errors in Pronunciation,

**UNIT II:**

Word stress-di-syllabic words, poly-syllabic words, weak and strong forms, contrastive stress  
(Homographs)

**UNIT III:** Stress in compound words, rhythm, intonation, accent neutralisation.

**UNIT IV:** Listening to short audio texts and identifying the context and specific pieces of information to answer a series of questions in speaking.

**UNIT V:** Newspapers reading; Understanding and identifying key terms and structures useful for writing reports.

**Text Book:**

1. "Infotech English", Maruthi Publications.

**Reference Books:**

1. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
4. English Pronunciation in use- Mark Hewings, Cambridge University Press.
5. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
6. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.



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	<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>APPLIED PHYSICS LAB</b>				

**(For All Circuital Branches like CSE, ECE, EEE etc.)**  
(Any 10 of the following listed experiments)

**List of Applied Physics Experiments**

1. Determination of thickness of thin object by wedge method.
2. Determination of radius of curvature of a given plano convex lens by Newton's rings.
3. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
4. Determination of dispersive power of the prism.
5. Determination of dielectric constant using charging and discharging method.
6. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
7. Determination of numerical aperture and acceptance angle of an optical fiber.
8. Determination of wavelength of Laser light using diffraction grating.
9. Estimation of Planck's constant using photoelectric effect.
10. Determination of the resistivity of semiconductor by four probe method.
11. To determine the energy gap of a semiconductor using p-n junction diode.
12. Magnetic field along the axis of a current carrying circular coil by Stewart & Gee's Method
13. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect .
14. Measurement of resistance of a semiconductor with varying temperature.
15. Resistivity of a Superconductor using four probe method & Meissner effect.

**References:**

1. S. Balasubramanian, M.N. Srinivasan "A Text Book of Practical Physics"- S Chand Publishers, 2017.



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	<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>PROGRAMMING FOR PROBLEM SOLVING USING C LAB</b>				

**Course Objectives:**

- Apply the principles of C language in problem solving.
- To design flowcharts, algorithms and knowing how to debug programs.
- To design & develop of C programs using arrays, strings pointers & functions.
- To review the file operations, preprocessor commands.

**Course Outcomes:**

By the end of the Lab, the student

- Gains Knowledge on various concepts of a C language.
- Able to draw flowcharts and write algorithms.
- Able design and development of C problem solving skills.
- Able to design and develop modular programming skills.
- Able to trace and debug a program

**Exercise 1:**

1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters.
2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches.
3. Write a C program to display multiple variables.

**Exercise 2:**

1. Write a C program to calculate the distance between the two points.
2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

**Exercise 3:**

1. Write a C program to convert a string to a long integer.
2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
3. Write a C program to calculate the factorial of a given number.

**Exercise 4:**

1. Write a program in C to display the n terms of even natural number and their sum.
2. Write a program in C to display the n terms of harmonic series and their sum.  
 $1 + 1/2 + 1/3 + 1/4 + 1/5 \dots 1/n$  terms.
3. Write a C program to check whether a given number is an Armstrong number or not.

**Exercise 5:**

1. Write a program in C to print all unique elements in an array.
2. Write a program in C to separate odd and even integers in separate arrays.
3. Write a program in C to sort elements of array in ascending order.



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**Exercise 6:**

1. Write a program in C for multiplication of two square Matrices.
2. Write a program in C to find transpose of a given matrix.

**Exercise 7:**

1. Write a program in C to search an element in a row wise and column wise sorted matrix.
2. Write a program in C to print individual characters of string in reverse order.

**Exercise 8:**

1. Write a program in C to compare two strings without using string library functions.
2. Write a program in C to copy one string to another string.

**Exercise 9:**

1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
2. Write a program in C to demonstrate how to handle the pointers in the program.

**Exercise 10:**

1. Write a program in C to demonstrate the use of & (address of) and \*(value at address) operator.
2. Write a program in C to add two numbers using pointers.

**Exercise 11:**

1. Write a program in C to add numbers using call by reference.
2. Write a program in C to find the largest element using Dynamic Memory Allocation.

**Exercise 12:**

1. Write a program in C to swap elements using call by reference.
2. Write a program in C to count the number of vowels and consonants in a string using a pointer.

**Exercise 13:**

1. Write a program in C to show how a function returning pointer.
2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc( ) function.

**Exercise 14:**

1. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc( ) function. Understand the difference between the above two programs
2. Write a program in C to convert decimal number to binary number using the function.

**Exercise 15:**

1. Write a program in C to check whether a number is a prime number or not using the function.
2. Write a program in C to get the largest element of an array using the function.

**Exercise 16:**

1. Write a program in C to append multiple lines at the end of a text file.
2. Write a program in C to copy a file in another name.
3. Write a program in C to remove a file from the disk.



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<b>I Year - II Semester</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>MATHEMATICS-II</b> (Linear Algebra And Numerical Methods)				

**Course Objectives:**

- To instruct the concept of Matrices in solving linear algebraic equations
- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

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

- develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)
- solve system of linear algebraic equations using Gauss elimination, Gauss Jordan, Gauss Seidel (L3)
- evaluate the approximate roots of polynomial and transcendental equations by different algorithms (L5)
- apply Newton’s forward & backward interpolation and Lagrange’s formulae for equal and unequal intervals (L3)
- apply numerical integral techniques to different Engineering problems (L3)
- apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations (L3)

**UNIT – I: Solving systems of linear equations, Eigen values and Eigen vectors: (10hrs)**

Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous linear equations – Gauss Elimination method – Eigenvalues and Eigen vectors and properties (article-2.14 in text book-1).

**Unit – II: Cayley–Hamilton theorem and Quadratic forms: (10hrs)**

Cayley-Hamilton theorem (without proof) – Applications – Finding the inverse and power of a matrix by Cayley-Hamilton theorem – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation. Singular values of a matrix, singular value decomposition (text book-3).

**UNIT – III: Iterative methods: (8 hrs)**

Introduction– Bisection method–Secant method – Method of false position– Iteration method – Newton-Raphson method (One variable and simultaneous Equations) – Jacobi and Gauss-Seidel methods for solving system of equations numerically.

**UNIT – IV: Interpolation: (10 hrs)**

Introduction– Errors in polynomial interpolation – Finite differences– Forward differences– Backward differences –Central differences – Relations between operators – Newton’s forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange’s interpolation formula– Newton’s divide difference formula.



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#### **UNIT – V: Numerical differentiation and integration, Solution of ordinary differential equations with initial conditions: (10 hrs)**

Numerical differentiation using interpolating polynomial – Trapezoidal rule– Simpson's  $1/3^{\text{rd}}$  and  $3/8^{\text{th}}$  rule– Solution of initial value problems by Taylor's series– Picard's method of successive approximations– Euler's method –Runge-Kutta method (second and fourth order).

#### **Text Books:**

1. B. S. Grewal, Higher Engineering Mathematics, 44<sup>th</sup> Edition, Khanna Publishers.
2. B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
3. David Poole, Linear Algebra- A modern introduction, 4<sup>th</sup> Edition, Cengage.

#### **Reference Books:**

1. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineering and Science, Tata Mc. Graw Hill Education.
2. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
3. Lawrence Turyn, Advanced Engineering Mathematics, CRC Press.





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<b>APPLIED CHEMISTRY</b>				

**Course Objectives**

- Importance of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- Outline the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
- Explain the preparation of semiconductors and nanomaterials, engineering applications of nanomaterials, superconductors and liquid crystals.
- Recall the increase in demand for power and hence alternative sources of power are studied due to depleting sources of fossil fuels. Advanced instrumental techniques are introduced.
- Outline the basics of computational chemistry and molecular switches

**UNIT I: POLYMER TECHNOLOGY**

**8 hrs**

**Polymerisation:-** Introduction, methods of polymerization (emulsion and suspension), mechanical properties.

**Plastics:** Compounding, fabrication (compression, injection, blown film and extrusion), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste (waste to wealth).

**Elastomers:-** Introduction, preparation, properties and applications (Buna S, thiokol and polyurethanes).

**Composite materials:** Fiber reinforced plastics, conducting polymers, biodegradable polymers, biopolymers, biomedical polymers.

**Course Outcomes:** At the end of this unit, the students will be able to

- Analyze the different types of composite plastic materials and interpret the mechanism of conduction in conducting polymers.

**UNIT II: ELECTROCHEMICAL CELLS AND CORROSION**

**10 hrs**

Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery and zinc air cells), fuel cells (H<sub>2</sub>-O<sub>2</sub>, CH<sub>3</sub>OH-O<sub>2</sub>, phosphoric acid and molten carbonate).

**Corrosion:-** Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, factors influencing rate of corrosion, corrosion control (proper designing and cathodic protection), Protective coatings (surface preparation, cathodic coatings, anodic coatings, electroplating and electroless plating [nickel]), Paints (constituents, functions and special paints).

**Course Outcomes:** At the end of this unit, the students will be able to

- Utilize the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion.





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**UNIT III: MATERIAL CHEMISTRY**

**10 hrs**

Part I : Non-elemental semiconducting materials:- Stoichiometric, controlled valency & chalcogen photo/semiconductors-preparation of semiconductors (distillation, zone refining, Czochralski crystal pulling, epitaxy, diffusion, ion implantation) - Semiconductor devices (p-n junction diode as rectifier, junction transistor).

Insulators & magnetic materials: electrical insulators-ferro and ferri magnetism-Hall effect and its applications.

Part II: Nano materials:- Introduction, sol-gel method, characterization by (Brunauer Emmet Teller [BET]), (scanning electron microscopy [SEM]) and (transmission electron microscopy [TEM]), applications of graphene and fullerenes, carbon nanotubes (types, preparation and applications)

Liquid crystals:- Introduction-types-applications.

Super conductors:-Type –I, Type II-characteristics and applications

**Course Outcomes:** At the end of this unit, the students will be able to

- Synthesize nanomaterials for modern advances of engineering technology.
- Summarize the preparation of semiconductors; analyze the applications of liquid crystals and superconductors.

**UNIT IV: SPECTROSCOPIC TECHNIQUES & NON-CONVENTIONAL ENERGY SOURCES**

**10 hrs**

**Part A: SPECTROSCOPIC TECHNIQUES**

Electromagnetic spectrum-UV (laws of absorption, instrumentation, theory of electronic spectroscopy, Frank-condon principle, chromophores and auxochromes, intensity shifts, applications), FT-IR [instrumentation and differentiation of sp, sp<sup>2</sup>, sp<sup>3</sup> and IR stretching of functional groups (alcohols, carbonyls, amines) applications], magnetic resonance imaging and CT scan (procedure & applications).

**Part B: NON-CONVENTIONAL ENERGY SOURCES**

Design, working, schematic diagram, advantages and disadvantages of photovoltaic cell, hydropower, geothermal power, tidal and wave power, ocean thermal energy conversion.

**Course Outcomes:** At the end of this unit, the students will be able to

- Analyze the principles of different analytical instruments and their applications.
- Design models for energy by different natural sources.

**UNIT V: ADVANCED CONCEPTS/TOPICS IN CHEMISTRY**

**8 hrs**

Computational chemistry: Introduction to computational chemistry, molecular modelling and docking studies

Molecular switches: characteristics of molecular motors and machines, Rotaxanes and Catenanes as artificial molecular machines, prototypes – linear motions in rotaxanes, an acid-base controlled molecular shuttle, a molecular elevator, an autonomous light-powered molecular motor

**Course Outcomes:** At the end of this unit, the students will be able to

- Obtain the knowledge of computational chemistry and molecular machines

**Text Books:**

1. P.C. Jain and M. Jain “Engineering Chemistry”, 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, “Engineering Chemistry”, Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, “A Textbook of Engineering Chemistry”, S.Chand & Co, (2010).
4. Shashi Chawla, “Engineering Chemistry”, Dhanpat Rai Publishing Co. (Latest edition).



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**Reference Books:**

1. K. Sesa Maheshwaramma and Mridula Chugh, “Engineering Chemistry”, Pearson India Edn.
2. O.G. Palana, “Engineering Chemistry”, Tata McGraw Hill Education Private Limited, (2009).
3. CNR Rao and JM Honig (Eds) “Preparation and characterization of materials” Academic press, New York (latest edition)
4. B. S. Murthy, P. Shankar and others, “Textbook of Nanoscience and Nanotechnology”, University press (latest edition)



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<b>COMPUTER ORGANIZATION</b>				

**Course Objectives:**

The purpose of the course is to introduce principles of computer organization and the basic architectural concepts. It provides an in depth understanding of basic organization, design, programming of a simple digital computer, computer arithmetic, instruction set design, microprogrammed control unit, pipelining and vector processing, memory organization and I/O systems.

**Course Outcomes:**

By the end of the course the student will be able to

- Demonstrate and understanding of the design of the functional units of a digital computer system.
- Relate Postulates of Boolean algebra and minimize combinational functions
- Recognize and manipulate representations of numbers stored in digital computers
- Build the logic families and realization of logic gates.
- Design and analyze combinational and sequential circuits
- Recall the internal organization of computers, CPU, memory unit and Input/Outputs and the relations between its main components
- Solve elementary problems by assembly language programming

**UNIT I:**

**Digital Computers and Data Representation:** Introduction ,Numbering Systems, Decimal to Binary Conversion, Binary Coded Decimal Numbers, Weighted Codes, Self-Complementing Codes, Cyclic Codes, Error Detecting Codes, Error Correcting Codes, Hamming Code for Error Correction, Alphanumeric Codes, ASCII Code

**Data Representation:** Data types, Complements, Fixed Point Representation, Floating Point Representation.

**Boolean Algebra and Logical gates:**

Boolean Algebra :Theorems and properties, Boolean functions, canonical and standard forms , minimization of Boolean functions using algebraic identities; Karnaugh map representation and minimization using two and three variable Maps ;Logical gates ,universal gates and Two-level realizations using gates : AND-OR, OR-AND, NAND-NAND and NOR-NOR structures

**UNIT II:**

**Digital logic circuits:** Combinatorial Circuits: Introduction, Combinatorial Circuit Design Procedure, Implementation using universal gates, Multi-bit adder, Multiplexers, Demultiplexers, Decoders

**Sequential Switching Circuits:** Latches and Flip-Flops, Ripple counters using T flip-flops; Synchronous counters: Shift Registers; Ring counters



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**UNIT III:**

**Computer Arithmetic:** Addition and subtraction, multiplication Algorithms, Booth multiplication algorithm, Division Algorithms, Floating – point Arithmetic operations.

**Register Transfer language and microinstructions :** Bus memory transfer, arithmetic and logical micro-operations, shift and rotate micro-operations

**Basic Computer Organization and Design:** Stored program concept, computer Registers, common bus system, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input–Output configuration and program Interrupt.

**UNIT IV:**

**Microprogrammed Control:** Control memory, Address sequencing, microprogram example, design of control unit.

**Central Processing Unit:** General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control: conditional Flags and Branching

**UNIT V:**

**Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

**Input-Output Organization:** Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt Direct memory Access.

**Text Books:**

1. Digital Logic and Computer Design, Moriss Mano, 11<sup>th</sup> Edition, Pearson Education.
2. Computer System Architecture, 3<sup>rd</sup> ed., M. Morris Mano, PHI

**Reference Books:**

1. Digital Logic and Computer Organization, Rajaraman, Radhakrishnan, PHI, 2006
2. Computer Organization, 5<sup>th</sup> ed., Hamacher, Vranesic and Zaky, TMH, 2002
3. Computer Organization & Architecture : Designing for Performance, 7<sup>th</sup> ed., William Stallings, PHI, 2006



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PYTHON PROGRAMMING</b>					

**Course Objectives:**

The Objectives of Python Programming are

- To learn about Python programming language syntax, semantics, and the runtime environment
- To be familiarized with universal computer programming concepts like data types, containers
- To be familiarized with general computer programming concepts like conditional execution, loops & functions
- To be familiarized with general coding techniques and object-oriented programming

**Course Outcomes:**

- Develop essential programming skills in computer programming concepts like data types, containers
- Apply the basics of programming in the Python language
- Solve coding tasks related conditional execution, loops
- Solve coding tasks related to the fundamental notions and techniques used in object-oriented programming

**UNIT I**

Introduction: Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, Operators. Type conversions, Expressions, More about Data Output.

Data Types, and Expression: Strings Assignment, and Comment, Numeric Data Types and Character Sets, Using functions and Modules.

Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables. Repetition Structures: Introduction, while loop, for loop, Calculating a Running Total, Input Validation Loops, Nested Loops.

**UNIT II**

Control Statement: Definite iteration for Loop Formatting Text for output, Selection if and if else Statement Conditional Iteration The While Loop

Strings and Text Files: Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods Text Files.

**UNIT III**

List and Dictionaries: Lists, Defining Simple Functions, Dictionaries

Design with Function: Functions as Abstraction Mechanisms, Problem Solving with Top Down Design, Design with Recursive Functions, Case Study Gathering Information from a File System, Managing a Program's Namespace, Higher Order Function.

Modules: Modules, Standard Modules, Packages.



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**UNIT IV**

File Operations: Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations

Object Oriented Programming: Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance, overlapping and overloading operators, Adding and retrieving dynamic attributes of classes, Programming using OOps support

Design with Classes: Objects and Classes, Data modeling Examples, Case Study An ATM, Structuring Classes with Inheritance and Polymorphism

**UNIT V**

Errors and Exceptions: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions, Redefined Clean-up Actions.

Graphical User Interfaces: The Behavior of Terminal Based Programs and GUI -Based, Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources.

Programming: Introduction to Programming Concepts with Scratch.

**Text Books**

- 1) Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage.
- 2) Python Programming: A Modern Approach, Vamsi Kurama, Pearson.

**Reference Books:**

- 1) Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press.
- 2) Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

**e-Resources:**

[https://www.tutorialspoint.com/python3/python\\_tutorial.pdf](https://www.tutorialspoint.com/python3/python_tutorial.pdf)



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>DATA STRUCTURES</b>					

**Course Objectives:**

The objective of the course is to

- Introduce the fundamental concept of data structures and abstract data types
- Emphasize the importance of data structures in developing and implementing efficient algorithms
- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms

**Course Outcomes:**

After completing this course a student will be able to:

- Summarize the properties, interfaces, and behaviors of basic abstract data types
- Discuss the computational efficiency of the principal algorithms for sorting & searching
- Use arrays, records, linked structures, stacks, queues, trees, and Graphs in writing programs
- Demonstrate different methods for traversing trees

**UNIT I**

Data Structures - Definition, Classification of Data Structures, Operations on Data Structures, Abstract Data Type (ADT), Preliminaries of algorithms. Time and Space complexity.

Searching - Linear search, Binary search, Fibonacci search.

Sorting- Insertion sort, Selection sort, Exchange (Bubble sort, quick sort), distribution (radix sort), merging (Merge sort) algorithms.

**UNIT II**

Linked List: Introduction, Single linked list, Representation of Linked list in memory, Operations on Single Linked list-Insertion, Deletion, Search and Traversal ,Reversing Single Linked list, Applications on Single Linked list- Polynomial Expression Representation ,Addition and Multiplication, Sparse Matrix Representation using Linked List, Advantages and Disadvantages of Single Linked list, Double Linked list-Insertion, Deletion, Circular Linked list-Insertion, Deletion.

**UNIT III**

Queues: Introduction to Queues, Representation of Queues-using Arrays and using Linked list, Implementation of Queues-using Arrays and using Linked list, Application of Queues-Circular Queues, Deques, Priority Queues, Multiple Queues.

Stacks: Introduction to Stacks, Array Representation of Stacks, Operations on Stacks, Linked list Representation of Stacks, Operations on Linked Stack, Applications-Reversing list, Factorial Calculation, Infix to Postfix Conversion, Evaluating Postfix Expressions.

**UNIT IV**

Trees: Basic Terminology in Trees, Binary Trees-Properties, Representation of Binary Trees using Arrays and Linked lists. Binary Search Trees- Basic Concepts, BST Operations: Insertion, Deletion, Tree Traversals, Applications-Expression Trees, Heap Sort, Balanced Binary Trees- AVL Trees, Insertion, Deletion and Rotations.





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**UNIT V**

Graphs: Basic Concepts, Representations of Graphs-Adjacency Matrix and using Linked list, Graph Traversals (BFT & DFT), Applications- Minimum Spanning Tree Using Prim's & Kruskal's Algorithm, Dijkstra's shortest path, Transitive closure, Warshall's Algorithm.

**Text Books:**

- 1) Data Structures Using C. 2<sup>nd</sup> Edition. Reema Thareja, Oxford.
- 2) Data Structures and algorithm analysis in C, 2<sup>nd</sup>ed, Mark Allen Weiss.

**Reference Books:**

- 1) Fundamentals of Data Structures in C, 2nd Edition, Horowitz, Sahni, Universities Press.
- 2) Data Structures: A PseudoCode Approach, 2/e, Richard F. Gilberg, Behrouz A. Forouzan, Cengage.
- 3) Data Structures with C, Seymour Lipschutz TMH

**e-Resources:**

- 1) <http://algs4.cs.princeton.edu/home/>
- 2) [https://faculty.washington.edu/jstraub/dsa/Master\\_2\\_7a.pdf](https://faculty.washington.edu/jstraub/dsa/Master_2_7a.pdf)





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		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>APPLIED CHEMISTRY LAB</b>					

Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, volumetric titrations, quantitative analysis

1. Determination of HCl using standard  $\text{Na}_2\text{CO}_3$  solution.
2. Determination of alkalinity of a sample containing  $\text{Na}_2\text{CO}_3$  and NaOH.
3. Determination of  $\text{Mn}^{+2}$  using standard oxalic acid solution.
4. Determination of ferrous iron using standard  $\text{K}_2\text{Cr}_2\text{O}_7$  solution.
5. Determination of  $\text{Cu}^{+2}$  using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of  $\text{Fe}^{+3}$  by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of iso-electric point of amino acids using pH-metry method/conductometric method.
10. Determination of the concentration of strong acid vs strong base (by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Determination of  $\text{Mg}^{+2}$  present in an antacid.
13. Determination of  $\text{CaCO}_3$  present in an egg shell.
14. Estimation of Vitamin C.
15. Determination of phosphoric content in soft drinks.
16. Adsorption of acetic acid by charcoal.
17. Preparation of nylon-6, 6 and Bakelite (demonstration only).

Of the above experiments at-least 10 assessment experiments should be completed in a semester.

**Outcomes:** The students entering into the professional course have practically very little exposure to lab classes. The experiments introduce volumetric analysis; redox titrations with different indicators; EDTA titrations; then they are exposed to a few instrumental methods of chemical analysis. Thus at the end of the lab course, the student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills.

**Reference Books**

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.



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		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>PYTHON PROGRAMMING LAB</b>					

**Course Objectives:**

*The Objectives of Python Programming are*

- *To learn about Python programming language syntax, semantics, and the runtime environment*
- *To be familiarized with universal computer programming concepts like data types, containers*
- *To be familiarized with general computer programming concepts like conditional execution, loops & functions*
- *To be familiarized with general coding techniques and object-oriented programming*

**Course Outcomes:**

- Develop essential programming skills in computer programming concepts like data types, containers
- Apply the basics of programming in the Python language
- Solve coding tasks related conditional execution, loops
- Solve coding tasks related to the fundamental notions and techniques used in object-oriented programming

**List of Experiments:**

- 1) Write a program that asks the user for a weight in kilograms and converts it to pounds. There are 2.2 pounds in a kilogram.
- 2) Write a program that asks the user to enter three numbers (use three separate input statements). Create variables called total and average that hold the sum and average of the three numbers and print out the values of total and average.
- 3) Write a program that uses a *for* loop to print the numbers 8, 11, 14, 17, 20, . . . , 83, 86, 89.
- 4) Write a program that asks the user for their name and how many times to print it. The program should print out the user’s name the specified number of times.
- 5) Use a *for* loop to print a triangle like the one below. Allow the user to specify how high the triangle should be.
 

```
*
**
***
****
```
- 6) Generate a random number between 1 and 10. Ask the user to guess the number and print a message based on whether they get it right or not.
- 7) Write a program that asks the user for two numbers and prints *Close* if the numbers are within .001 of each other and *Not close* otherwise.
- 8) Write a program that asks the user to enter a word and prints out whether that word contains any vowels.
- 9) Write a program that asks the user to enter two strings of the same length. The program should then check to see if the strings are of the same length. If they are not, the program should print an appropriate message and exit. If they are of the same



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- length, the program should alternate the characters of the two strings. For example, if the user enters *abcde* and *ABCDE* the program should print out *AaBbCcDdEe*.
- 10) Write a program that asks the user for a large integer and inserts commas into it according to the standard American convention for commas in large numbers. For instance, if the user enters 1000000, the output should be 1,000,000.
  - 11) In algebraic expressions, the symbol for multiplication is often left out, as in  $3x+4y$  or  $3(x+5)$ . Computers prefer those expressions to include the multiplication symbol, like  $3*x+4*y$  or  $3*(x+5)$ . Write a program that asks the user for an algebraic expression and then inserts multiplication symbols where appropriate.
  - 12) Write a program that generates a list of 20 random numbers between 1 and 100.
    - (a) Print the list.
    - (b) Print the average of the elements in the list.
    - (c) Print the largest and smallest values in the list.
    - (d) Print the second largest and second smallest entries in the list
    - (e) Print how many even numbers are in the list.
  - 13) Write a program that asks the user for an integer and creates a list that consists of the factors of that integer.
  - 14) Write a program that generates 100 random integers that are either 0 or 1. Then find the longest run of zeros, the largest number of zeros in a row. For instance, the longest run of zeros in  $[1,0,1,1,0,0,0,0,1,0,0]$  is 4.
  - 15) Write a program that removes any repeated items from a list so that each item appears at most once. For instance, the list  $[1,1,2,3,4,3,0,0]$  would become  $[1,2,3,4,0]$ .
  - 16) Write a program that asks the user to enter a length in feet. The program should then give the user the option to convert from feet into inches, yards, miles, millimeters, centimeters, meters, or kilometers. Say if the user enters a 1, then the program converts to inches, if they enter a 2, then the program converts to yards, etc. While this can be done with if statements, it is much shorter with lists and it is also easier to add new conversions if you use lists.
  - 17) Write a function called *sum\_digits* that is given an integer num and returns the sum of the digits of num.
  - 18) Write a function called *first\_diff* that is given two strings and returns the first location in which the strings differ. If the strings are identical, it should return -1.
  - 19) Write a function called *number\_of\_factors* that takes an integer and returns how many factors the number has.
  - 20) Write a function called *is\_sorted* that is given a list and returns True if the list is sorted and False otherwise.
  - 21) Write a function called *root* that is given a number x and an integer n and returns  $x^{1/n}$ . In the function definition, set the default value of n to 2.
  - 22) Write a function called *primes* that is given a number n and returns a list of the first n primes. Let the default value of n be 100.
  - 23) Write a function called *merge* that takes two already sorted lists of possibly different lengths, and merges them into a single sorted list.
    - (a) Do this using the sort method.
    - (b) Do this without using the sort method.
  - 24) Write a program that asks the user for a word and finds all the smaller words that can be made from the letters of that word. The number of occurrences of a letter in a smaller word can't exceed the number of occurrences of the letter in the user's word.
  - 25) Write a program that reads a file consisting of email addresses, each on its own line. Your program should print out a string consisting of those email addresses separated by semicolons.



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- 26) Write a program that reads a list of temperatures from a file called *temps.txt*, converts those temperatures to Fahrenheit, and writes the results to a file called *ftemps.txt*.
- 27) Write a class called *Product*. The class should have fields called *name*, *amount*, and *price*, holding the product's name, the number of items of that product in stock, and the regular price of the product. There should be a method *get\_price* that receives the number of items to be bought and returns a the cost of buying that many items, where the regular price is charged for orders of less than 10 items, a 10% discount is applied for orders of between 10 and 99 items, and a 20% discount is applied for orders of 100 or more items. There should also be a method called *make\_purchase* that receives the number of items to be bought and decreases amount by that much.
- 28) Write a class called *Time* whose only field is a time in seconds. It should have a method called *convert\_to\_minutes* that returns a string of minutes and seconds formatted as in the following example: if seconds is 230, the method should return '5:50'. It should also have a method called *convert\_to\_hours* that returns a string of hours, minutes, and seconds formatted analogously to the previous method.
- 29) Write a class called *Converter*. The user will pass a length and a unit when declaring an object from the class—for example, *c = Converter(9,'inches')*. The possible units are inches, feet, yards, miles, kilometers, meters, centimeters, and millimeters. For each of these units there should be a method that returns the length converted into those units. For example, using the *Converter* object created above, the user could call *c.feet()* and should get 0.75 as the result.
- 30) Write a Python class to implement *pow(x, n)*.
- 31) Write a Python class to reverse a string word by word.
- 32) Write a program that opens a file dialog that allows you to select a text file. The program then displays the contents of the file in a textbox.
- 33) Write a program to demonstrate *Try/except/else*.
- 34) Write a program to demonstrate *try/finally* and *with/as*.



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	<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>DATA STRUCTURES LAB</b>				

**Course Objectives:**

The objective of this lab is to

- Demonstrate the different data structures implementation.

**Course Outcomes:**

By the end of this lab the student is able to

- Use basic data structures such as arrays and linked list.
- Programs to demonstrate fundamental algorithmic problems including Tree Traversals, Graph traversals, and shortest paths.
- Use various searching and sorting algorithms.

**List of Experiments:**

**Exercise -1 (Searching)**

- Write C program that use both recursive and non recursive functions to perform Linear search for a Key value in a given list.
- Write C program that use both recursive and non recursive functions to perform Binary search for a Key value in a given list.

**Exercise -2 (Sorting-I)**

- Write C program that implement Bubble sort, to sort a given list of integers in ascending order
- Write C program that implement Quick sort, to sort a given list of integers in ascending order
- Write C program that implement Insertion sort, to sort a given list of integers in ascending order

**Exercise -3(Sorting-II)**

- Write C program that implement radix sort, to sort a given list of integers in ascending order
- Write C program that implement merge sort, to sort a given list of integers in ascending order

**Exercise -4(Singly Linked List)**

- Write a C program that uses functions to create a singly linked list
- Write a C program that uses functions to perform insertion operation on a singly linked list
- Write a C program that uses functions to perform deletion operation on a singly linked list
- Write a C program to reverse elements of a single linked list.

**Exercise -5(Queue)**

- Write C program that implement Queue (its operations) using arrays.
- Write C program that implement Queue (its operations) using linked lists



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**Exercise -6(Stack)**

- a) Write C program that implement stack (its operations) using arrays
- b) Write C program that implement stack (its operations) using Linked list
- c) Write a C program that uses Stack operations to evaluate postfix expression

**Exercise -7(Binary Tree)**

- d) Write a recursive C program for traversing a binary tree in preorder, inorder and postorder.

**Exercise -8(Binary Search Tree)**

- a) Write a C program to Create a BST
- b) Write a C program to insert a node into a BST.
- c) Write a C program to delete a node from a BST.





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	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>ENVIRONMENT SCIENCE</b>				

**Course Objectives:**

The objectives of the course are to impart:

- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

**UNIT I**

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information technology in environment and human health.

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 Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

**UNIT II**

Natural Resources: Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

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

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

**UNIT III**

Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.



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**UNIT IV**

Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being.

Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

**UNIT V**

Social Issues and the Environment: Urban problems related to energy -Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental 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.

Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics.

The student should Visit an Industry / Ecosystem and submit a report individually on any **issues related to Environmental Studies course and make a power point presentation.**

**Text Books:**

- 1) Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
- 2) Environmental Studies, R. Rajagopalan, 2<sup>nd</sup> Edition, 2011, Oxford University Press.
- 3) Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

**Reference Books:**

- 1) Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
- 2) A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
- 3) Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
- 4) Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014





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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>MATHEMATICS - III</b>					

**Course Objectives:**

- To familiarize the techniques in partial differential equations
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

**Course Outcomes:**

At the end of the course, the student will be able to

- Interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- Estimate the work done against a field, circulation and flux using vector calculus (L5)
- Apply the Laplace transform for solving differential equations (L3)
- Find or compute the Fourier series of periodic signals (L3)
- Know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)
- Identify solution methods for partial differential equations that model physical processes (L3)

**UNIT I: Vector calculus:** (10 hrs)

Vector Differentiation: Gradient – Directional derivative – Divergence – Curl – Scalar Potential.

Vector Integration: Line integral – Work done – Area – Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof).

**UNIT II: Laplace Transforms:** (10 hrs)

Laplace transforms of standard functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function – Dirac’s delta function – Inverse Laplace transforms – Convolution theorem (without proof).

Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

**UNIT III: Fourier series and Fourier Transforms:** (10 hrs)

Fourier Series: Introduction – Periodic functions – Fourier series of periodic function – Dirichlet’s conditions – Even and odd functions – Change of interval – Half-range sine and cosine series.

Fourier Transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Sine and cosine transforms – Properties – inverse transforms – Finite Fourier transforms.

**UNIT IV: PDE of first order:** (8 hrs)

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.



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**UNIT V: Second order PDE and Applications:** (10 hrs)

Second order PDE: Solutions of linear partial differential equations with constant coefficients

– RHS term of the type  $e^{ax+by}$ ,  $\sin(ax + by)$ ,  $\cos(ax + by)$ ,  $x^m y^n$  .

Applications of PDE: Method of separation of Variables – Solution of One dimensional Wave, Heat and two-dimensional Laplace equation.

**Text Books:**

- 1) B. S. Grewal, Higher Engineering Mathematics, 43<sup>rd</sup> Edition, Khanna Publishers.
- 2) B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

**Reference Books:**

- 1) Erwin Kreyszig, Advanced Engineering Mathematics, 10<sup>th</sup> Edition, Wiley-India.
- 2) Dean. G. Duffy, Advanced Engineering Mathematics with MATLAB, 3<sup>rd</sup> Edition, CRC Press.
- 3) Peter O' Neil, Advanced Engineering Mathematics, Cengage.
- 4) Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>OBJECT ORIENTED PROGRAMMING THROUGH C++</b>				

**Course Objectives:**

- Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects
- Understand dynamic memory management techniques using pointers, constructors, destructors
- Describe the concept of function overloading, operator overloading, virtual functions and polymorphism
- Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming
- Demonstrate the use of various OOPs concepts with the help of programs

**Course Outcomes:**

By the end of the course, the student

- Classify object oriented programming and procedural programming
- Apply C++ features such as composition of objects, operator overloads, dynamic memory allocation, inheritance and polymorphism, file I/O, exception handling
- Build C++ classes using appropriate encapsulation and design principles
- Apply object oriented or non-object oriented techniques to solve bigger computing problems

**UNIT I**

Introduction to C++: Difference between C and C++, Evolution of C++, The Object Oriented Technology, Disadvantage of Conventional Programming, Key Concepts of Object Oriented Programming, Advantage of OOP, Object Oriented Language.

**UNIT II**

Classes and Objects & Constructors and Destructor: Classes in C++, Declaring Objects, Access Specifiers and their Scope, Defining Member Function, Overloading Member Function, Nested class, Constructors and Destructors, Introduction, Constructors and Destructor, Characteristics of Constructor and Destructor, Application with Constructor, Constructor with Arguments parameterized Constructor, Destructors, Anonymous Objects.

**UNIT III**

Operator Overloading and Type Conversion & Inheritance: The Keyword Operator, Overloading Unary Operator, Operator Return Type, Overloading Assignment Operator (=), Rules for Overloading Operators, Inheritance, Reusability, Types of Inheritance, Virtual Base Classes- Object as a Class Member, Abstract Classes, Advantages of Inheritance, Disadvantages of Inheritance.



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**UNIT IV**

Pointers & Binding Polymorphisms and Virtual Functions: Pointer, Features of Pointers, Pointer Declaration, Pointer to Class, Pointer Object, The this Pointer, Pointer to Derived Classes and Base Class, Binding Polymorphisms and Virtual Functions, Introduction, Binding in C++, Virtual Functions, Rules for Virtual Function, Virtual Destructor.

**UNIT V**

Generic Programming with Templates & Exception Handling: Definition of class Templates, Normal Function Templates, Over Loading of Template Function, Bubble Sort Using Function Templates, Difference between Templates and Macros, Linked Lists with Templates, Exception Handling, Principles of Exception Handling, The Keywords try throw and catch, Multiple Catch Statements, Specifying Exceptions.

Overview of Standard Template Library, STL Programming Model, Containers, Sequence Containers, Associative Containers, Algorithms, Iterators, Vectors, Lists, Maps.

**Text Books:**

- 1) A First Book of C++, Gary Bronson, Cengage Learning.
- 2) The Complete Reference C++, Herbert Schildt, TMH.

**Reference Books:**

- 1) Object Oriented Programming C++, Joyce Farrell, Cengage.
- 2) C++ Programming: from problem analysis to program design, DS Malik, Cengage Learning
- 3) Programming in C++, Ashok N Kamthane, Pearson 2<sup>nd</sup> Edition

**e- Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105151/>
- 2) <https://github.com/topics/object-oriented-programming>



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>OPERATING SYSTEMS</b>				

**Course Objectives:**

The objectives of this course is to

- Introduce to the internal operation of modern operating systems
- Define, explain, processes and threads, mutual exclusion, CPU scheduling, deadlock, memory management, and file systems
- Understand File Systems in Operating System like UNIX/Linux and Windows
- Understand Input Output Management and use of Device Driver and Secondary Storage (Disk) Mechanism
- Analyze Security and Protection Mechanism in Operating System

**Course Outcomes:**

After learning, the course the students should be able to:

- Describe various generations of Operating System and functions of Operating System
- Describe the concept of program, process and thread and analyze various CPU Scheduling Algorithms and compare their performance
- Solve Inter Process Communication problems using Mathematical Equations by various methods
- Compare various Memory Management Schemes especially paging and Segmentation in Operating System and apply various Page Replacement Techniques
- Outline File Systems in Operating System like UNIX/Linux and Windows

**UNIT I**

Operating Systems Overview: Operating system functions, Operating system structure, Operating systems operations, Computing environments, Open-Source Operating Systems.  
 System Structures: Operating System Services, User and Operating-System Interface, systems calls, Types of System Calls, system programs, operating system structure, operating system debugging, System Boot.

**UNIT II**

Process Concept: Process scheduling, Operations on processes, Inter-process communication, Communication in client server systems.  
 Multithreaded Programming: Multithreading models, Thread libraries, Threading issues.  
 Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling.  
 Inter-process Communication: Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Barriers, Classical IPC Problems - Dining philosophers problem, Readers and writers problem.



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**UNIT III**

Memory-Management Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation.

Virtual Memory Management: Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation.

**UNIT IV**

Deadlocks: Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection and recovery, Deadlock avoidance, Deadlock prevention.

File Systems: Files, Directories, File system implementation, management and optimization.

Secondary-Storage Structure: Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.

**UNIT V**

System Protection: Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights.

System Security: Introduction, Program threats, System and network threats, Cryptography for security, User authentication, Implementing security defenses, Firewalling to protect systems and networks, Computer security classification.

Case Studies: Linux, Microsoft Windows.

**Text Books:**

- 1) Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2013.
- 2) Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education, 2008. (for Interprocess Communication and File systems.)

**Reference Books:**

- 1) Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw-Hill, 2012.
- 2) Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009
- 3) Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004.

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105214/>



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>SOFTWARE ENGINEERING</b>					

**Course Objectives:**

This course is designed to:

- Give exposure to phases of Software Development, common process models including Waterfall, and the Unified Process, and hands-on experience with elements of the agile process
- Give exposure to a variety of Software Engineering practices such as requirements analysis and specification, code analysis, code debugging, testing, traceability, and version control
- Give exposure to Software Design techniques

**Course Outcomes:**

Students taking this subject will gain software engineering skills in the following areas:

- Ability to transform an Object-Oriented Design into high quality, executable code
- Skills to design, implement, and execute test cases at the Unit and Integration level
- Compare conventional and agile software methods

**UNIT I**

The Nature of Software, The Unique Nature of WebApps, Software Engineering, The Software Process, Software Engineering Practice, Software Myths. A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models, Process Technology.

**UNIT II**

Agility, Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Other Agile Process Models, A Tool Set for the Agile Process, Software Engineering Knowledge, Core Principles, Principles That Guide Each Framework Activity, Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements.

**UNIT III**

Requirements Analysis, Scenario-Based Modeling, UML Models That Supplement the Use Case, Data Modeling Concepts, Class-Based Modeling, Requirements Modeling Strategies, Flow-Oriented Modeling, Creating a Behavioral Model, Patterns for Requirements Modelling, Requirements Modeling for WebApps.

**UNIT IV**

Design within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model, Software Architecture, Architectural Genres, Architectural Styles,





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Assessing Alternative Architectural Designs, Architectural Mapping Using Data Flow, Components, Designing Class-Based Components, Conducting Component-Level Design, Component-Level Design for WebApps, Designing Traditional Components, Component-Based Development.

**UNIT V**

The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, WebApp Interface Design, Design Evaluation, Elements of Software Quality Assurance, SQA Tasks, Goals & Metrics, Statistical SQA, Software Reliability, A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object-Oriented Software, Test Strategies for WebApps, Validation Testing, System Testing, The Art of Debugging, Software Testing Fundamentals, Internal and External Views of Testing, White-Box Testing, Basis Path Testing.

**Text Books:**

- 1) Software Engineering a practitioner's approach, Roger S. Pressman, Seventh Edition, McGraw Hill Higher Education.
- 2) Software Engineering, Ian Sommerville, Ninth Edition, Pearson.

**Reference Books:**

- 1) Software Engineering, A Precise Approach, PankajJalote, Wiley India, 2010.
- 2) Software Engineering, Ugrasen Suman, Cengage.

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105182/>



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE</b>				

**Course Objectives:**

This course is designed to:

- To introduce the students to the topics and techniques of discrete methods and combinatorial reasoning
- To introduce a wide variety of applications. The algorithmic approach to the solution of problems is fundamental in discrete mathematics, and this approach reinforces the close ties between this discipline and the area of computer science

**Course Outcomes:**

At the end of the course student will be able to

- Demonstrate skills in solving mathematical problems
- Comprehend mathematical principles and logic
- Demonstrate knowledge of mathematical modeling and proficiency in using mathematical software
- Manipulate and analyze data numerically and/or graphically using appropriate Software
- Communicate effectively mathematical ideas/results verbally or in writing

**UNIT I**

Mathematical Logic: Propositional Calculus: Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, Indirect Method of Proof, Predicate Calculus: Predicates, Predicative Logic, Statement Functions, Variables and Quantifiers, Free and Bound Variables, Inference Theory for Predicate Calculus.

**UNIT II**

Set Theory: Sets: Operations on Sets, Principle of Inclusion-Exclusion, Relations: Properties, Operations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering, Hasse Diagrams, Functions: Bijective, Composition, Inverse, Permutation, and Recursive Functions, Lattice and its Properties, Algebraic Structures: Algebraic Systems, Properties, Semi Groups and Monoids, Group, Subgroup and Abelian Group, Homomorphism, Isomorphism.

**UNIT III**

Combinatorics: Basis of Counting, Permutations, Permutations with Repetitions, Circular and Restricted Permutations, Combinations, Restricted Combinations, Binomial and Multinomial Coefficients and Theorems, Number Theory: Properties of Integers, Division Theorem,



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Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic, Fermat's and Euler's Theorems

**UNIT IV**

Recurrence Relations: Generating Functions, Function of Sequences, Partial Fractions, Calculating Coefficient of Generating Functions, Recurrence Relations, Formulation as Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots, Solving Inhomogeneous Recurrence Relations

**UNIT V**

Graph Theory: Basic Concepts, Graph Theory and its Applications, Sub graphs, Graph Representations: Adjacency and Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs, Multigraphs, Bipartite and Planar Graphs, Euler's Theorem, Graph Colouring and Covering, Chromatic Number, Spanning Trees, Prim's and Kruskal's Algorithms, BFS and DFS Spanning Trees.

**Text Books:**

- 1) Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay and P. Manohar, Tata McGraw Hill.
- 2) Elements of Discrete Mathematics-A Computer Oriented Approach, C. L. Liu and D. P. Mohapatra, 3<sup>rd</sup> Edition, Tata McGraw Hill.

**Reference Books:**

- 1) Discrete Mathematics for Computer Scientists and Mathematicians, J. L. Mott, A. Kandel and T. P. Baker, 2<sup>nd</sup> Edition, Prentice Hall of India.
- 2) Discrete Mathematical Structures, Bernard Kolman, Robert C. Busby and Sharon Cutler Ross, PHI.
- 3) Discrete Mathematics and its Applications with Combinatorics and Graph Theory, K. H. Rosen, 7<sup>th</sup> Edition, Tata McGraw Hill.

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/106/106106094/>



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		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>OBJECT ORIENTED PROGRAMMING THROUGH C++ LAB</b>					

**Course Objectives:**

The objective of this lab is to

- Demonstrate procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects.
- Understand dynamic memory management techniques using pointers, constructors, destructors, etc
- Demonstrate the concept of function overloading, operator overloading, virtual functions and polymorphism, inheritance.

**Course Outcomes:**

By the end of this lab the student is able to

- Apply the various OOPs concepts with the help of programs.

**Exercise -1 (Classes Objects)**

Create a Distance class with:

- feet and inches as data members
  - member function to input distance
  - member function to output distance
  - member function to add two distance objects
1. Write a main function to create objects of DISTANCE class. Input two distances and output the sum.
  2. Write a C++ Program to illustrate the use of Constructors and Destructors (use the above program.)
  3. Write a program for illustrating function overloading in adding the distance between objects (use the above problem)

**Exercise – 2 (Access)**

Write a program for illustrating Access Specifiers public, private, protected

1. Write a program implementing Friend Function
2. Write a program to illustrate this pointer
3. Write a Program to illustrate pointer to a class



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**Exercise -3 (Operator Overloading)**

1. Write a program to Overload Unary, and Binary Operators as Member Function, and Non Member Function.
  1. Unary operator as member function
  2. Binary operator as non member function
2. Write a c ++ program to implement the overloading assignment = operator

**Exercise -4 (Inheritance)**

1. Write C++ Programs and incorporating various forms of Inheritance
  - i) Single Inheritance
  - ii) Hierarchical Inheritance
  - iii) Multiple Inheritances
  - iv) Multi-level inheritance
  - v) Hybrid inheritance
2. Also illustrate the order of execution of constructors and destructors in inheritance

**Exercise -5(Templates, Exception Handling)**

1. a)Write a C++ Program to illustrate template class
2. b)Write a Program to illustrate member function templates
3. c) Write a Program for Exception Handling Divide by zero
4. d)Write a Program to rethrow an Exception

**Exercise -6**

1. Write a C++ program illustrating user defined string processing functions using pointers (string length, string copy, string concatenation)
2. Write a C++ program illustrating Virtual classes & virtual functions.
3. Write C++ program that implement Bubble sort, to sort a given list of integers in ascending order



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		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>OPERATING SYSTEM LAB</b>					

**Course Objectives:**

- To understand the design aspects of operating system
- To study the process management concepts & Techniques
- To study the storage management concepts
- To familiarize students with the Linux environment
- To learn the fundamentals of shell scripting/programming

**Course Outcomes:**

- To use Unix utilities and perform basic shell control of the utilities
  - To use the Unix file system and file access control
  - To use of an operating system to develop software
  - Students will be able to use Linux environment efficiently
  - Solve problems using bash for shell scripting
- 1) a) Study of Unix/Linux general purpose utility command list: man,who,cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown.  
 b) Study of vi editor  
 c) Study of Bash shell, Bourne shell and C shell in Unix/Linux operating system  
 d) Study of Unix/Linux file system (tree structure)  
 e) Study of .bashrc, /etc/bashrc and Environment variables.
  - 2) Write a C program that makes a copy of a file using standard I/O, and system calls
  - 3) Write a C program to emulate the UNIX ls -l command.
  - 4) Write a C program that illustrates how to execute two commands concurrently with a command pipe. Ex: - ls -l | sort
  - 5) Simulate the following CPU scheduling algorithms:  
 (a) Round Robin (b) SJF (c) FCFS (d) Priority
  - 6) Multiprogramming-Memory management-Implementation of fork (), wait (), exec() and exit (), System calls
  - 7) Simulate the following:  
 a) Multiprogramming with a fixed number of tasks (MFT)  
 b) Multiprogramming with a variable number of tasks (MVT)
  - 8) Simulate Bankers Algorithm for Dead Lock Avoidance
  - 9) Simulate Bankers Algorithm for Dead Lock Prevention.



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- 10) Simulate the following page replacement algorithms:  
a) FIFO b) LRU c) LFU
- 11) Simulate the following File allocation strategies  
(a) Sequenced (b) Indexed (c) Linked
- 12) Write a C program that illustrates two processes communicating using shared memory
- 13) Write a C program to simulate producer and consumer problem using semaphores
- 14) Write C program to create a thread using pthreads library and let it run its function.
- 15) Write a C program to illustrate concurrent execution of threads using pthreads library.





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		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>SOFTWARE ENGINEERING LAB</b>					

**Course Objectives:**

The objective of this lab is to acquire the generic software development skill through various stages of software life cycle and also to ensure the quality of software through software development with various protocol based environment

**Course Outcomes:**

- By the end of this lab the student is able to elicit, analyze and specify software requirements through a productive working relationship with various stakeholders of the project
- prepare SRS document, design document, test cases and software configuration management and risk management related document.
- develop function oriented and object oriented software design using tools like rational rose.
- use modern engineering tools necessary for software project management, estimations, time management and software reuse
- generate test cases for software testing

1) Perform the following, for the following experiments:

- i. Do the Requirement Analysis and Prepare SRS
- ii. Draw E-R diagrams, DFD, CFD and structured charts for the project.

1) Course Registration System

2) Students Marks Analyzing System

3) Online Ticket Reservation System

4) Stock Maintenance

5) Consider any application, using COCOMO model, estimate the effort.

6) Consider any application, Calculate effort using FP oriented estimation model.

7) Draw the UML Diagrams for the problem 1,2, 3, 4.

8) Design the test cases for e-Commerce application (Flipcart, Amazon)

9) Design the test cases for a Mobile Application (Consider any example from Appstore)

10) Design and Implement ATM system through UML Diagrams.



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<b>II Year - I Semester</b>	<b>Skill Oriented Course- I</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>APPLICATIONS OF PYTHON-NumPy</b>					

**Course Objectives:**

The objective of this lab is to acquire programming skills in Python package NumPy and perform mathematical and statistical operations.

**Course Outcomes:**

By the end of this lab the student is able to

- Explain how data is collected, managed and stored for processing
- Understand the workings of various numerical techniques, different descriptive measures of Statistics, correlation and regression to solve the engineering problems
- Understand how to apply some linear algebra operations to n-dimensional arrays
- Use NumPy perform common data wrangling and computational tasks in Python.

Perform the following:

- 1) NumPy Installation using different scientific python distributions( Anaconda, Python(x,y), WinPython, Pyzo)
- 2) NumPy Basics (np.array, np.arange, np.linspace, np.zeros, np.ones, np.random.random, np.empty)
- 3) Arrays ( array.shape, len(array), array.ndim, array.dtype, array.astype(type), type(array))
- 4) Array Manipulation (np.append, np.insert, np.resize, np.delete, np.concatenate, np.vstack, np.hstack)
- 5) Mathematical Operations( np.add, np.subtract, np.divide, np.multiply, np.sqrt, np.sin, np.cos, np.log, np.dot, np.roots) , Statistical Operations( np.mean, np.median, np.std, array.corrcoef( ) )
- 6) NumPy data types
- 7) NumPy ndarray
- 8) NumPy String Operations
- 9) NumPy Financial functions
- 10) NumPy Functional Programming



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<b>II Year - I Semester</b>	<b>Skill Oriented Course- I</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>WEB APPLICATION DEVELOPMENT USING FULL STACK</b> Frontend Development – Module -I					

**Course Objectives:**

The objective of this lab is to provide understanding about the core concepts of frontend programming for web application

**Course Outcomes:**

By the end of this lab the student is able to

- Analyze a web page and identify its elements and attributes.
- Demonstrate the important HTML tags for designing static pages and separate design from content using Cascading Style sheet
- Implement MVC and responsive design to scale well across PC, tablet and Mobile Phone
- Create web pages using HTML and Cascading Style Sheets.

Perform experiments related to the following concepts:

**A) HTML**

- 1) Introduction to HTML
- 2) Browsers and HTML
- 3) Editor's Offline and Online
- 4) Tags, Attribute and Elements
- 5) Doctype Element
- 6) Comments
- 7) Headings, Paragraphs, and Formatting Text
- 8) Lists and Links
- 9) Images and Tables

**B) CSS**

- 1) Introduction CSS
- 2) Applying CSS to HTML
- 3) Selectors, Properties and Values
- 4) CSS Colors and Backgrounds
- 5) CSS Box Model
- 6) CSS Margins, Padding, and Borders
- 7) CSS Text and Font Properties
- 8) CSS General Topics



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		<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>CONSTITUTION OF INDIA</b>					

**Course Objectives:**

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
- To understand the central and state relation financial and administrative

**Course Outcomes:**

At the end of the course, the student will be able to have a clear knowledge on the following:

- Understand historical background of the constitution making and its importance for building a democratic India.
- Understand the functioning of three wings of the government ie., executive, legislative and judiciary.
- Understand the value of the fundamental rights and duties for becoming good citizen of India.
- Analyze the decentralization of power between central, state and local self-government.
- Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.
  1. Know the sources, features and principles of Indian Constitution.
  2. Learn about Union Government, State government and its administration.
  3. Get acquainted with Local administration and Pachayati Raj.
  4. Be aware of basic concepts and developments of Human Rights.
  5. Gain knowledge on roles and functioning of Election Commission

**UNIT I**

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Learning outcomes: After completion of this unit student will

- Understand the concept of Indian constitution
- Apply the knowledge on directive principle of state policy
- Analyze the History, features of Indian constitution
- Evaluate Preamble Fundamental Rights and Duties



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**UNIT II**

Union Government and its Administration Structure of the Indian Union: Federalism, Centre-State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions;

Learning outcomes: After completion of this unit student will

- Understand the structure of Indian government
- Differentiate between the state and central government
- Explain the role of President and Prime Minister
- Know the Structure of supreme court and High court

**UNIT III**

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

Learning outcomes: After completion of this unit student will

- Understand the structure of state government
- Analyze the role Governor and Chief Minister
- Explain the role of state Secretariat
- Differentiate between structure and functions of state secretariat

**UNIT IV**

A. Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation  
Pachayati Raj: Functions PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

Learning outcomes:-After completion of this unit student will

- Understand the local Administration
- Compare and contrast district administration role and importance
- Analyze the role of Mayor and elected representatives of Municipalities
- Evaluate Zilla Panchayat block level organisation

**UNIT V**

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC and women

Learning outcomes: After completion of this unit student will

- Know the role of Election Commission apply knowledge
- Contrast and compare the role of Chief Election commissioner and Commissionerate
- Analyze role of state election commission
- Evaluate various commissions of viz SC/ST/OBC and women



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**References:**

- 1) Durga Das Basu, Introduction to the Constitution of India, Prentice Hall of India Pvt. Ltd.
- 2) SubashKashyap, Indian Constitution, National Book Trust
- 3) J.A. Siwach, Dynamics of Indian Government & Politics
- 4) D.C. Gupta, Indian Government and Politics
- 5) H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
- 6) J.C. Johari, Indian Government and Politics Hans
- 7) J. Raj Indian Government and Politics
- 8) M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
- 9) Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

**e-Resources:**

- 1) [nptel.ac.in/courses/109104074/8](http://nptel.ac.in/courses/109104074/8)
- 2) [nptel.ac.in/courses/109104045/](http://nptel.ac.in/courses/109104045/)
- 3) [nptel.ac.in/courses/101104065/](http://nptel.ac.in/courses/101104065/)
- 4) [www.hss.iitb.ac.in/en/lecture-details](http://www.hss.iitb.ac.in/en/lecture-details)
- 5) [www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution](http://www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution)



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PROBABILITY AND STATISTICS</b>				

**Course Objectives:**

- To familiarize the students with the foundations of probability and statistical methods
- To impart probability concepts and statistical methods in various applications Engineering

**Course Outcomes:**

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

- Classify the concepts of data science and its importance (L4) or (L2)
- Interpret the association of characteristics and through correlation and regression tools (L4)
- Make use of the concepts of probability and their applications (L3)
- Apply discrete and continuous probability distributions (L3)
- Design the components of a classical hypothesis test (L6)
- Infer the statistical inferential methods based on small and large sampling tests (L4)

**UNIT I**

Descriptive statistics and methods for data science: Data science – Statistics Introduction – Population vs Sample – Collection of data – primary and secondary data – Type of variable: dependent and independent Categorical and Continuous variables – Data visualization – Measures of Central tendency – Measures of Variability (spread or variance) – Skewness Kurtosis.

**UNIT II**

Correlation and Curve fitting: Correlation – correlation coefficient – rank correlation – regression coefficients and properties – regression lines – Method of least squares – Straight line – parabola – Exponential – Power curves.

**UNIT III**

Probability and Distributions: Probability – Conditional probability and Baye’s theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

**UNIT IV**

Sampling Theory: Introduction – Population and samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Introduction to t,  $\chi^2$  and F-distributions – Point and Interval estimations – Maximum error of estimate.





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**UNIT V**

Tests of Hypothesis: Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions.

**Text Books:**

- 1) Miller and Freund's, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
- 2) S. C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

**Reference Books:**

- 1) Shron L. Myers, Keying Ye, Ronald E Walpole, Probability and Statistics Engineers and the Scientists, 8<sup>th</sup> Edition, Pearson 2007.
- 2) Jay I. Devore, Probability and Statistics for Engineering and the Sciences, 8<sup>th</sup> Edition, Cengage.
- 3) Sheldon M. Ross, Introduction to probability and statistics Engineers and the Scientists, 4<sup>th</sup> Edition, Academic Foundation, 2011.
- 4) Johannes Ledolter and Robert V. Hogg, Applied statistics for Engineers and Physical Scientists, 3<sup>rd</sup> Edition, Pearson, 2010.



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>DATABASE MANAGEMENT SYSTEMS</b>					

**Course Objectives:**

- To introduce about database management systems
- To give a good formal foundation on the relational model of data and usage of Relational Algebra
- To introduce the concepts of basic SQL as a universal Database language
- To demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- To provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques

**Course Outcomes:**

By the end of the course, the student will be able to

- Describe a relational database and object-oriented database
- Create, maintain and manipulate a relational database using SQL
- Describe ER model and normalization for database design
- Examine issues in data storage and query processing and can formulate appropriate solutions
- Outline the role and issues in management of data such as efficiency, privacy, security, ethical responsibility, and strategic advantage

**UNIT I**

Introduction: Database system, Characteristics (Database Vs File System), Database Users(Actors on Scene, Workers behind the scene), Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

**UNIT II**

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).

**UNIT III**

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams. SQL: Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable and non-updatable), relational set operations.



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**UNIT IV**

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency(1NF, 2NF and 3 NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF), Fifth Normal Form (5NF).

**UNIT V**

Transaction Concept: Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

Indexing Techniques: B+ Trees: Search, Insert, Delete algorithms, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes , Index data Structures, Hash Based Indexing: Tree base Indexing ,Comparison of File Organizations, Indexes and Performance Tuning

**Text Books:**

- 1) Database Management Systems, 3/e, Raghurama Krishnan, Johannes Gehrke, TMH
- 2) Database System Concepts,5/e, Silberschatz, Korth, TMH

**Reference Books:**

- 1) Introduction to Database Systems, 8/e C J Date, PEA.
- 2) Database Management System, 6/e Ramez Elmasri, Shamkant B. Navathe, PEA
- 3) Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105175/>
- 2) <https://www.geeksforgeeks.org/introduction-to-nosql/>



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>FORMAL LANGUAGES AND AUTOMATA THEORY</b>				

**Course Objectives:**

- To learn fundamentals of Regular and Context Free Grammars and Languages
- To understand the relation between Regular Language and Finite Automata and machines
- To learn how to design Automata's and machines as Acceptors, Verifiers and Translators
- To understand the relation between Contexts free Languages, PDA and TM
- To learn how to design PDA as acceptor and TM as Calculators

**Course Outcomes:**

By the end of the course students can

- Classify machines by their power to recognize languages.
- Summarize language classes & grammars relationship among them with the help of Chomsky hierarchy
- Employ finite state machines to solve problems in computing
- Illustrate deterministic and non-deterministic machines
- Quote the hierarchy of problems arising in the computer science

**UNIT I**

Finite Automata: Need of Automata theory, Central Concepts of Automata Theory, Automation, Finite Automata, Transition Systems, Acceptance of a String, DFA, Design of DFAs, NFA, Design of NFA, Equivalence of DFA and NFA, Conversion of NFA into DFA, Finite Automata with  $\epsilon$ -Transitions, Minimization of Finite Automata, Finite Automata with output-Mealy and Moore Machines, Applications and Limitation of Finite Automata.

**UNIT II**

Regular Expressions, Regular Sets, Identity Rules, Equivalence of two RE, Manipulations of REs, Finite Automata and Regular Expressions, Inter Conversion, Equivalence between FA and RE, Pumping Lemma of Regular Sets, Closure Properties of Regular Sets, Grammars, Classification of Grammars, Chomsky Hierarchy Theorem, Right and Left Linear Regular Grammars, Equivalence between RG and FA, Inter Conversion.

**UNIT III**

Formal Languages, Context Free Grammar, Leftmost and Rightmost Derivations, Parse Trees, Ambiguous Grammars, Simplification of Context Free Grammars-Elimination of Useless Symbols,  $\epsilon$ -Productions and Unit Productions, Normal Forms-Chomsky Normal Form and Greibach Normal Form, Pumping Lemma, Closure Properties, Applications of Context Free Grammars.



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**UNIT IV**

Pushdown Automata, Definition, Model, Graphical Notation, Instantaneous Description, Language Acceptance of Pushdown Automata, Design of Pushdown Automata, Deterministic and Non – Deterministic Pushdown Automata, Equivalence of Pushdown Automata and Context Free Grammars, Conversion, Two Stack Pushdown Automata, Application of Pushdown Automata.

**UNIT V**

Turning Machine: Definition, Model, Representation of TMs-Instantaneous Descriptions, Transition Tables and Transition Diagrams, Language of a TM, Design of TMs, Types of TMs, Church's Thesis, Universal and Restricted TM, Decidable and Un-decidable Problems, Halting Problem of TMs, Post's Correspondence Problem, Modified PCP, Classes of P and NP, NP-Hard and NP-Complete Problems.

**Text Books:**

- 1) Introduction to Automata Theory, Languages and Computation, J. E. Hopcroft, R. Motwani and J. D. Ullman, 3<sup>rd</sup> Edition, Pearson, 2008
- 2) Theory of Computer Science-Automata, Languages and Computation, K. L. P. Mishra and N. Chandrasekharan, 3<sup>rd</sup> Edition, PHI, 2007

**Reference Books:**

- 1) Elements of Theory of Computation, Lewis H.P. & Papadimitiou C.H., Pearson /PHI
- 2) Theory of Computation, V. Kulkarni, Oxford University Press, 2013
- 3) Theory of Automata, Languages and Computation, Rajendra Kumar, McGraw Hill, 2014

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/104/106104028/>



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>JAVA PROGRAMMING</b>					

**Course Objectives:**

The learning objectives of this course are:

- To identify Java language components and how they work together in applications
- To learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- To learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- To understand how to design applications with threads in Java
- To understand how to use Java APIs for program development

**Course Outcomes:**

By the end of the course, the student will be

- Able to realize the concept of Object Oriented Programming & Java Programming Constructs
- Able to describe the basic concepts of Java such as operators, classes, objects, inheritance, packages, Enumeration and various keywords
- Apply the concept of exception handling and Input/ Output operations
- Able to design the applications of Java & Java applet
- Able to Analyze & Design the concept of Event Handling and Abstract Window Toolkit

**UNIT I**

Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators: Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator ( = ), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.



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Control Statements: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?., Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

**UNIT II**

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

**UNIT III**

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

**UNIT IV**

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions, try-with-resources, Catching Subclass Exception, Custom Exceptions, Nested try and catch Blocks, Rethrowing Exception, Throws Clause.





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**UNIT V**

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Methods for Comparison of Strings, Methods for Modifying Strings, Methods for Searching Strings, Data Conversion and Miscellaneous Methods, Class String Buffer, Class String Builder.

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread- Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.

Java Database Connectivity: Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, ResultSet Interface, Creating JDBC Application, JDBC Batch Processing, JDBC Transaction Management

**Text Books:**

- 1) JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
- 2) The complete Reference Java, 8th edition, Herbert Schildt, TMH.

**References Books:**

- 1) Introduction to java programming, 7th edition by Y Daniel Liang, Pearson
- 2) Murach's Java Programming, Joel Murach

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105191/>
- 2) [https://www.w3schools.com/java/java\\_data\\_types.asp](https://www.w3schools.com/java/java_data_types.asp)



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTANCY</b>					

**Course Objectives:**

- The Learning objectives of this paper are to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting
- To familiarize about the Production function, Input Output relationship, Cost-Output relationship and Cost-Volume-Profit Analysis
- To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles
- To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation
- Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals

**Course Outcomes:**

- The Learner is equipped with the knowledge of estimating the Demand and demand elasticities for a product
- The knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs
- The pupil is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units
- The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis
- The Learner can able to evaluate various investment project proposals with the help of capital budgeting techniques for decision making

**UNIT I**

Introduction to Managerial Economics and demand Analysis: Definition of Managerial Economics – Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

**UNIT II**

Theories of Production and Cost Analyses: Theories of Production function- Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit analysis-Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.



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**UNIT III**

Introduction to Markets, Theories of the Firm & Pricing Policies: Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing, Business Cycles : Meaning and Features – Phases of a Business Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

**UNIT IV**

Introduction to Accounting & Financing Analysis: Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

**UNIT V**

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods (pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

**Text Books:**

- 1) A R Aryasri, Managerial Economics and Financial Analysis, The McGraw – Hill companies.

**Reference Books:**

- 1) Varshney R.L, K.L Maheswari, Managerial Economics, S. Chand & Company Ltd.
- 2) JL Pappas and EF Brigham, Managerial Economics, Holt, R & W; New edition edition
- 3) N.P Srinivasn and M. SakthivelMurugan, Accounting for Management, S. Chand & Company Ltd.
- 4) Maheswari S.N, An Introduction to Accountancy, Vikas Publishing House Pvt Ltd
- 5) I.M Pandey, Financial Management , Vikas Publishing House Pvt Ltd
- 6) V. Maheswari, Managerial Economics, S. Chand & Company Ltd.



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		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>DATABASE MANAGEMENT SYSTEMS LAB</b>					

**Course Objectives:**

This Course will enable students to

- Populate and query a database using SQL DDL/DML Commands
- Declare and enforce integrity constraints on a database
- Writing Queries using advanced concepts of SQL
- Programming PL/SQL including procedures, functions, cursors and triggers

**Course Outcomes:**

At the end of the course the student will be able to:

- Utilize SQL to execute queries for creating database and performing data manipulation operations
- Examine integrity constraints to build efficient databases
- Apply Queries using Advanced Concepts of SQL
- Build PL/SQL programs including stored procedures, functions, cursors and triggers

**List of Exercises:**

1. Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
2. Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET, Constraints. Example:- Select the roll number and name of the student who secured fourth rank in the class.
3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
4. Queries using Conversion functions (to\_char, to\_number and to\_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next\_day, add\_months, last\_day, months\_between, least, greatest, trunc, round, to\_char, to\_date)
5.
  - i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)
  - ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.
6. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.
7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE-APPLICATION ERROR.



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8. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
9. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
10. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers
12. Create a table and perform the search operation on table using indexing and non-indexing techniques.

**Text Books/Suggested Reading:**

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



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<b>II Year – II Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>
<b>R PROGRAMMING LAB</b>					

**COURSE OBJECTIVES:**

- To learn statistical programming, computation, graphics, and modeling,
- To learn Writing functions and use R in an efficient way,
- To learn about basic types of statistical models

**COURSE OUTCOMES:**

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

- Access online resources for R and import new function packages into the R workspace
  - Import, review, manipulate and summarize data-sets in R
  - Explore data-sets to create testable hypotheses and identify appropriate statistical tests
  - Perform appropriate statistical tests using R
  - Create and edit visualizations with R
- 1) Write a R program to take input from the user (name and age) and display the values. Also print the version of R installation.
  - 2) Write a R program to get the details of the objects in memory.
  - 3) Write a R program to create a sequence of numbers from 20 to 50 and find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91.
  - 4) Write a R program to create a simple bar plot of five subjects marks.
  - 5) Write a R program to get the unique elements of a given string and unique numbers of vector.
  - 6) Write a R program to create three vectors a,b,c with 3 integers. Combine the three vectors to become a 3x3 matrix where each column represents a vector. Print the content of the matrix.
  - 7) Write a R program to create a 5 x 4 matrix , 3 x 3 matrix with labels and fill the matrix by rows and 2 x 2 matrix with labels and fill the matrix by columns.
  - 8) Write a R program to combine three arrays so that the first row of the first array is followed by the first row of the second array and then first row of the third array.
  - 9) Write a R program to create a two-dimensional 5x3 array of sequence of even integers greater than 50.
  - 10) Write a R program to create an array using four given columns, three given rows, and two given tables and display the content of the array.
  - 11) Write a R program to create an empty data frame.
  - 12) Write a R program to create a data frame from four given vectors.
  - 13) Write a R program to create a data frame using two given vectors and display the duplicated elements and unique rows of the said data frame.
  - 14) Write a R program to save the information of a data frame in a file and display the information of the file.



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- 15) Write a R program to create a matrix from a list of given vectors.
- 16) Write a R program to concatenate two given matrices of same column but different rows.
- 17) Write a R program to find row and column index of maximum and minimum value in a given matrix.
- 18) Write a R program to append value to a given empty vector.
- 19) Write a R program to multiply two vectors of integers type and length 3.
- 20) Write a R program to find Sum, Mean and Product of a Vector, ignore element like NA or NaN.
- 21) Write a R program to list containing a vector, a matrix and a list and give names to the elements in the list.
- 22) Write a R program to create a list containing a vector, a matrix and a list and give names to the elements in the list. Access the first and second element of the list.
- 23) Write a R program to create a list containing a vector, a matrix and a list and remove the second element.
- 24) Write a R program to select second element of a given nested list.
- 25) Write a R program to merge two given lists into one list.
- 26) Write a R program to create a list named s containing sequence of 15 capital letters, starting from 'E'.
- 27) Write a R program to assign new names "a", "b" and "c" to the elements of a given list.
- 28) Write a R program to find the levels of factor of a given vector.
- 29) Write a R program to create an ordered factor from data consisting of the names of months.
- 30) Write a R program to concatenate two given factor in a single factor.





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<b>II Year – II Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>JAVA PROGRAMMING LAB</b>					

**Course Objectives:**

The aim of this lab is to

- Practice programming in the Java
- Gain knowledge of object-oriented paradigm in the Java programming language
- Learn use of Java in a variety of technologies and on different platforms

**Course Outcomes:**

By the end of the course student will be able to write java program for

- Evaluate default value of all primitive data type, Operations, Expressions, Control-flow, Strings
- Determine Class, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrating simple inheritance, multi-level inheritance, Exception handling mechanism
- Construct Threads, Event Handling, implement packages, developing applets

**Exercise - 1 (Basics)**

- Write a JAVA program to display default value of all primitive data type of JAVA
- Write a java program that display the roots of a quadratic equation  $ax^2+bx=0$ . Calculate the discriminate D and basing on value of D, describe the nature of root.
- Five Bikers Compete in a race such that they drive at a constant speed which may or may not be the same as the other. To qualify the race, the speed of a racer must be more than the average speed of all 5 racers. Take as input the speed of each racer and print back the speed of qualifying racers.

**Exercise - 2 (Operations, Expressions, Control-flow, Strings)**

- Write a JAVA program to search for an element in a given list of elements using binary search mechanism.
- Write a JAVA program to sort for an element in a given list of elements using bubble sort
- Write a JAVA program to sort for an element in a given list of elements using merge sort.
- Write a JAVA program using StringBuffer to delete, remove character.



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**Exercise - 3 (Class, Objects)**

- Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.
- Write a JAVA program to implement constructor.

**Exercise - 4 (Methods)**

- Write a JAVA program to implement constructor overloading.
- Write a JAVA program implement method overloading.

**Exercise - 5 (Inheritance)**

- Write a JAVA program to implement Single Inheritance
- Write a JAVA program to implement multi level Inheritance
- Write a java program for abstract class to find areas of different shapes

**Exercise - 6 (Inheritance - Continued)**

- Write a JAVA program give example for “super” keyword.
- Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?

**Exercise - 7 (Exception)**

- Write a JAVA program that describes exception handling mechanism
- Write a JAVA program Illustrating Multiple catch clauses

**Exercise – 8 (Runtime Polymorphism)**

- Write a JAVA program that implements Runtime polymorphism
- Write a Case study on run time polymorphism, inheritance that implements in above problem

**Exercise – 9 (User defined Exception)**

- Write a JAVA program for creation of Illustrating throw
- Write a JAVA program for creation of Illustrating finally
- Write a JAVA program for creation of Java Built-in Exceptions
- d) Write a JAVA program for creation of User Defined Exception

**Exercise – 10 (Threads)**

- Write a JAVA program that creates threads by extending Thread class .First thread display “Good Morning “every 1 sec, the second thread displays “Hello “every 2 seconds and the third display “Welcome” every 3 seconds ,(Repeat the same by implementing Runnable)



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b) Write a program illustrating **isAlive** and **join ()**

c) Write a Program illustrating Daemon Threads.

**Exercise - 11** (Threads continuity)

a) Write a JAVA program Producer Consumer Problem

b) Write a case study on thread Synchronization after solving the above producer consumer problem

**Exercise – 12** (Packages)

a) Write a JAVA program illustrate class path

b) Write a case study on including in class path in your os environment of your package.

c) Write a JAVA program that import and use the defined your package in the previous Problem

**Exercise - 13** (Applet)

a) Write a JAVA program to paint like paint brush in applet.

b) Write a JAVA program to display analog clock using Applet.

c) Write a JAVA program to create different shapes and fill colors using Applet.

**Exercise - 14** (Event Handling)

a) Write a JAVA program that display the x and y position of the cursor movement using Mouse.

b) Write a JAVA program that identifies key-up key-down event user entering text in a Applet.



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<b>II Year - II Semester</b>	<b>Skill Oriented Course- II</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>APPLICATIONS OF PYTHON-Pandas</b>					

**Course Objectives:**

The objective of this lab is to understand the fundamentals of the Pandas library in Python and how it is used to handle data and also develop basic skills in data analysis and visualization

**Course Outcomes:**

By the end of this lab the student is able to

- Use Pandas to create and manipulate data structures like Series and DataFrames.
- Work with arrays, queries, and dataframes
- Query DataFrame structures for cleaning and processing and manipulating files
- Understand best practices for creating basic charts

Perform the following:

- 1) Pandas Installation
- 2) Creating DataFrames

**Exercises:**

A) Pandas DataSeries:

- 1) Write a Pandas program to create and display a one-dimensional array-like object containing an array of data using Pandas module.
- 2) Write a Pandas program to convert a Panda module Series to Python list and it's type.
- 3) Write a Pandas program to add, subtract, multiple and divide two Pandas Series.
- 4) Write a Pandas program to convert a NumPy array to a Pandas series.

Sample Series:  
 NumPy array:  
 [10 20 30 40 50]  
 Converted Pandas series:  
 0 10  
 1 20  
 2 30  
 3 40  
 4 50  
 dtype: int64

B) Pandas DataFrames:



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Consider Sample Python dictionary data and list labels:

```
exam_data = {'name': ['Anastasia', 'Dima', 'Katherine', 'James', 'Emily', 'Michael',  
'Matthew', 'Laura', 'Kevin', 'Jonas'],  
'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19],  
'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1],  
'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes']}  
labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j']
```

- 1) Write a Pandas program to create and display a DataFrame from a specified dictionary data which has the index labels.
- 2) Write a Pandas program to change the name 'James' to 'Suresh' in name column of the DataFrame.
- 3) Write a Pandas program to insert a new column in existing DataFrame.
- 4) Write a Pandas program to get list from DataFrame column headers.
- 5) Write a Pandas program to get list from DataFrame column headers.

C) Pandas Index:

- 1) Write a Pandas program to display the default index and set a column as an Index in a given dataframe.
- 2) Write a Pandas program to create an index labels by using 64-bit integers, using floating-point numbers in a given dataframe.

D) Pandas String and Regular Expressions:

- 1) Write a Pandas program to convert all the string values to upper, lower cases in a given pandas series. Also find the length of the string values.
- 2) Write a Pandas program to remove whitespaces, left sided whitespaces and right sided whitespaces of the string values of a given pandas series.
- 3) Write a Pandas program to count of occurrence of a specified substring in a DataFrame column.
- 4) Write a Pandas program to swap the cases of a specified character column in a given DataFrame.

E) Pandas Joining and merging DataFrame:

- 1) Write a Pandas program to join the two given dataframes along rows and assign all data.
- 2) Write a Pandas program to append a list of dictioneries or series to a existing DataFrame and display the combined data.
- 3) Write a Pandas program to join the two dataframes with matching records from both sides where available.

F) Pandas Time Series:

- 1) Write a Pandas program to create  
a) Datetime object for Jan 15 2012.



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- b) Specific date and time of 9:20 pm.
  - c) Local date and time.
  - d) A date without time.
  - e) Current date.
  - f) Time from a datetime.
  - g) Current local time.
- 2) Write a Pandas program to create a date from a given year, month, day and another date from a given string formats.
  - 3) Write a Pandas program to create a time-series with two index labels and random values. Also print the type of the index.

**G) Pandas Grouping Aggregate:**

Consider dataset:

	school	class	name	date_Of_Birth	age	height	weight	address
S1	s001	V	Alberto Franco	15/05/2002	12	173	35	street1
S2	s002	V	Gino Mcneill	17/05/2002	12	192	32	street2
S3	s003	VI	Ryan Parkes	16/02/1999	13	186	33	street3
S4	s001	VI	Eesha Hinton	25/09/1998	13	167	30	street1
S5	s002	V	Gino Mcneill	11/05/2002	14	151	31	street2
S6	s004	VI	David Parkes	15/09/1997	12	159	32	street4

- 1) Write a Pandas program to split the following dataframe into groups based on school code. Also check the type of GroupBy object.
- 2) Write a Pandas program to split the following dataframe by school code and get mean, min, and max value of age for each school.

**H) Pandas Styling:**

- 1) Create a dataframe of ten rows, four columns with random values. Write a Pandas program to highlight the negative numbers red and positive numbers black.
- 2) Create a dataframe of ten rows, four columns with random values. Write a Pandas program to highlight the maximum value in each column.
- 3) Create a dataframe of ten rows, four columns with random values. Write a Pandas program to highlight dataframe's specific columns.



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I) Excel:

- 1) Write a Pandas program to import excel data into a Pandas dataframe.
- 2) Write a Pandas program to find the sum, mean, max, min value of a column of file.

J) Plotting:

- 1) Write a Pandas program to create a horizontal stacked bar plot of opening, closing stock prices of any stock dataset between two specific dates.
- 2) Write a Pandas program to create a histograms plot of opening, closing, high, low stock prices of stock dataset between two specific dates.
- 3) Write a Pandas program to create a stacked histograms plot of opening, closing, high, low stock prices of stock dataset between two specific dates with more bins.

K) Pandas SQL Query:

- 1) Write a Pandas program to display all the records of a student file.
- 2) Write a Pandas program to select distinct department id from employees file.





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<b>II Year - II Semester</b>	<b>Skill Oriented Course- II</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>WEB APPLICATION DEVELOPMENT USING FULL STACK</b> Frontend Development – Module -II					

**Course Objectives:**

The objective of this lab is to build strong foundation of JavaScript which will help developer to apply JavaScript concepts for responsive web frontend development

**Course Outcomes:**

By the end of this lab the student is able to

- develop of the major Web application tier- Client side development
- participate in the active development of cross-browser applications through JavaScript
- Develop JavaScript applications that transition between states

Perform experiments related to the following concepts:

- 1) Introduction to JavaScript
- 2) Applying JavaScript (internal and external)
- 3) Understanding JS Syntax
- 4) Introduction to Document and Window Object
- 5) Variables and Operators
- 6) Data Types and Num Type Conversion
- 7) Math and String Manipulation
- 8) Objects and Arrays
- 9) Date and Time
- 10) Conditional Statements
- 11) Switch Case
- 12) Looping in JS
- 13) Functions



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<b>III Year – I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>COMPUTER NETWORKS</b>					

**Course Objectives:**

- To provide insight about networks, topologies, and the key concepts.
- To gain comprehensive knowledge about the layered communication architectures (OSI and TCP/IP) and its functionalities.
- To understand the principles, key protocols, design issues, and significance of each layers in ISO and TCP/IP.
- To know the basic concepts of network services and various network applications.

**Course Outcomes:**

By the end of the course, the student will be able to

- Demonstrate different network models for networking links OSI, TCP/IP, B-ISDN, N-BISDN and get knowledge about various communication techniques, methods and protocol standards.
- Discuss different transmission media and different switching networks.
- Analyze data link layer services, functions and protocols like HDLC and PPP.
- Compare and Classify medium access control protocols like ALOHA, CSMA, CSMA/CD, CSMA/CA, Polling, Token passing, FDMA, TDMA, CDMA protocols
- Determine application layer services and client server protocols working with the client server paradigms like WWW, HTTP, FTP, e-mail and SNMP etc.

**UNIT I:**

**Introduction:** Network Types, LAN, MAN, WAN, Network Topologies Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, OSI Vs TCP/IP, Lack of OSI models success, Internet History.

**Physical Layer** –Introduction to Guided Media- Twisted-pair cable, Coaxial cable and Fiber optic cable and unguided media: Wireless-Radio waves, microwaves, infrared.

**UNIT II:**

**Data link layer:** Design issues, **Framing:** fixed size framing, variable size framing, flow control, error control, error detection and correction codes, CRC, Checksum: idea, one’s complement internet checksum, services provided to Network Layer, **Elementary Data Link Layer protocols:** simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel.

**Sliding window protocol:** One bit, Go back N, Selective repeat-Stop and wait protocol, Data link layer in HDLC: configuration and transfer modes, frames, control field, point to point protocol (PPP): framing transition phase, multiplexing, multi link PPP.

**UNIT – III:**

**Media Access Control: Random Access:** ALOHA, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance, **Controlled Access:** Reservation, Polling, Token Passing, **Channelization:** frequency division multiple Access(FDMA), time division multiple access(TDMA), code division multiple access(CDMA).

**Wired LANs:** Ethernet, Ethernet Protocol, Standard Ethernet, Fast Ethernet(100 Mbps), Gigabit Ethernet, 10 Gigabit Ethernet.



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**UNIT – IV:**

**The Network Layer Design Issues** – Store and Forward Packet Switching-Services Provided to the Transport layer- Implementation of Connectionless Service-Implementation of Connection Oriented Service- Comparison of Virtual Circuit and Datagram Networks, Routing Algorithms-The Optimality principle-Shortest path, Flooding, Distance vector, Link state, Hierarchical, Congestion Control algorithms-General principles of congestion control, Congestion prevention policies, Approaches to Congestion Control-Traffic Aware Routing- Admission Control-Traffic Throttling-Load Shedding. Traffic Control Algorithm-Leaky bucket & Token bucket.

**Internet Working:** How networks differ- How networks can be connected- Tunnelling, internetwork routing-, Fragmentation, network layer in the internet – IP protocols-IP Version 4 protocol-IPV4 Header Format, IP addresses, Class full Addressing, CIDR, NAT-, Subnets-IP Version 6-The main IPV6 header, Transition from IPV4 to IPV6, Comparison of IPV4 & IPV6- Internet control protocols- ICMP-ARP-DHCP

**UNIT –V:**

**The Transport Layer:** Transport layer protocols: Introduction-services- port number-User data gram protocol-User datagram-UDP services-UDP applications-Transmission control protocol: TCP services-TCP features- Segment- A TCP connection- windows in TCP- flow control-Error control, Congestion control in TCP.

**Application Layer** — World Wide Web: HTTP, Electronic mail-Architecture- web based mail- email security- TELENET-local versus remote Logging-Domain Name System: Name Space, DNS in Internet ,- Resolution-Caching- Resource Records- DNS messages- Registrars-security of DNS Name Servers, SNMP.

**Text Books:**

1. Computer Networks — Andrew S Tanenbaum, Fifth Edition. Pearson Education/PHI
2. Data Communications and Networks – Behrouz A. Forouzan, Fifth Edition TMH.

**References Books:**

1. Data Communications and Networks- Achut S Godbole, Atul Kahate
2. Computer Networks, Mayank Dave, CENGAGE



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<b>III Year – I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>DESIGN AND ANALYSIS OF ALGORITHMS</b>					

**Course Objectives:**

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

- Ability to understand, analyze and denote time complexities of algorithms
- To introduce the different algorithmic approaches for problem solving through numerous example problems
- Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyze them.
- To provide some theoretical grounding in terms of finding the lower bounds of algorithms and the NP-completeness

**Course Outcomes:** After the completion of the course, student will be able to

- Analyze the performance of a given algorithm, denote its time complexity using the asymptotic notation for recursive and non-recursive algorithms
- List and describe various algorithmic approaches and Solve problems using divide and conquer & greedy Method
- Synthesize efficient algorithms dynamic programming approaches to solve in common engineering design situations.
- Organize important algorithmic design paradigms and methods of analysis: backtracking, branch and bound algorithmic approaches
- Demonstrate NP- Completeness theory ,lower bound theory and String Matching

**UNIT I:**

**Introduction:** Algorithm Definition, Algorithm Specification, performance Analysis, Performance measurement, asymptotic notation, Randomized Algorithms.

**UNIT II:**

**Divide and Conquer:** General Method, Defective chessboard, Binary Search, finding the maximum and minimum, Merge sort, Quick sort.

**The Greedy Method:** The general Method, knapsack problem, minimum-cost spanning Trees, Optimal Merge Patterns, Single Source Shortest Paths.

**UNIT III:**

**Dynamic Programming:** The general method, multistage graphs, All pairs-shortest paths, optimal Binary search trees, 0/1 knapsack, The traveling salesperson problem.

**UNIT IV:**

**Backtracking:** The General Method, The 8-Queens problem, sum of subsets, Graph coloring, Hamiltonian cycles, knapsack problem.

**UNIT V:**

**NP-Hard and NP-Complete problems:** Basic concepts, non-deterministic algorithms, NP - Hard and NP-Complete classes, Cook's theorem.



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**Text Books:**

1. Ellis Horowitz, SartajSahni, Sanguthevar Rajasekaran, “Fundamentals of Computer Algorithms”, 2<sup>nd</sup> Edition, Universities Press.
2. Introduction to Algorithms Thomas H. Cormen, PHI Learning
3. Harsh Bhasin, “Algorithms Design & Analysis”, Oxford University Press.

**Reference Books:**

1. Horowitz E. Sahani S: “Fundamentals of Computer Algorithms”, 2<sup>nd</sup> Edition, Galgotia Publications, 2008.
2. S. Sridhar, “Design and Analysis of Algorithms”, Oxford University Press.



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>DATA WAREHOUSING AND DATA MINING</b>					

**Course Objectives:**

The main objective of the course is to

- Introduce basic concepts and techniques of data warehousing and data mining
- Examine the types of the data to be mined and apply pre-processing methods on raw data
- Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.

**Course Outcomes:**

By the end of the course student will be able to

- Illustrate the importance of Data Warehousing, Data Mining and its functionalities and Design schema for real time data warehousing applications.
- Demonstrate on various Data Preprocessing Techniques viz. data cleaning, data integration, data transformation and data reduction and Process raw data to make it suitable for various data mining algorithms.
- Choose appropriate classification technique to perform classification, model building and evaluation.
- Make use of association rule mining techniques viz. Apriori and FP Growth algorithms and analyze on frequent itemsets generation.
- Identify and apply various clustering algorithm (with open source tools), interpret, evaluate and report the result.

**UNIT I:**

**Data Warehousing and Online Analytical Processing:** Data Warehouse: Basic concepts, Data Warehouse Modelling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Introduction: Why and What is data mining, What kinds of data need to be mined and patterns can be mined, Which technologies are used, Which kinds of applications are targeted.

**UNIT II:**

**Data Pre-processing:** An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

**UNIT III:**

**Classification:** Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Visual Mining for Decision Tree Induction.

**UNIT IV:**

**Association Analysis:** Problem Definition, Frequent Item set Generation, Rule Generation: Confident Based Pruning, Rule Generation in Apriori Algorithm, Compact Representation of frequent item sets, FP-Growth Algorithm.

**UNIT V:**

**Cluster Analysis:** Overview, Basics and Importance of Cluster Analysis, Clustering techniques, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bi-secting K Means,



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**Text Books:**

1. Data Mining concepts and Techniques, 3/e, Jiawei Han, Michel Kamber, Elsevier,2011.
2. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson,2012.

**Reference Books:**

1. Data Mining Techniques and Applications: An Introduction, Hongbo Du, Cengage Learning.
2. Data Mining: VikramPudi and P. Radha Krishna, Oxford Publisher.
3. Data Mining and Analysis - Fundamental Concepts and Algorithms; Mohammed J. Zaki, Wagner Meira, Jr, Oxford
4. Data Warehousing Data Mining & OLAP, Alex Berson, Stephen Smith, TMH.  
[http://onlinecourses.nptel.ac.in/noc18\\_cs14/preview](http://onlinecourses.nptel.ac.in/noc18_cs14/preview)
5. (NPTEL course by Prof.Pabitra Mitra)  
[http://onlinecourses.nptel.ac.in/noc17\\_mg24/preview](http://onlinecourses.nptel.ac.in/noc17_mg24/preview)
6. (NPTEL course by Dr. Nandan Sudarshanam& Dr. Balaraman Ravindran)  
[http://www.saedsayad.com/data\\_mining\\_map.htm](http://www.saedsayad.com/data_mining_map.htm)





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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>OPTIMIZATION IN OPERATIONS RESEARCH</b> <b>(Job Oriented Course)</b>				

**Course Objectives:**

- To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
- To state single variable and multi variable optimization problems, without and with constraints.
- To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
- To state transportation and assignment problem as a linear programming problem to determine Simplex method.
- To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.

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

- State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
- Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
- Apply and Solve transportation and assignment problem by using Linear programming Simplex method.
- Apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions
- Formulate and apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.

**UNIT I:**

**Introduction and Classical Optimization Techniques:** Statement of an Optimization problem, design vector, design constraints, constraint surface, objective function, objective function surfaces, classification of Optimization problems.

**Classical Optimization Techniques:** Single variable Optimization, multi variable Optimization without constraints, necessary and sufficient conditions for minimum/maximum, multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers, multivariable Optimization with inequality constraints, Kuhn – Tucker conditions

**UNIT II: Linear Programming :** Standard form of a linear programming problem, geometry of linear programming problems, definitions and theorems, solution of a system of linear simultaneous equations, pivotal reduction of a general system of equations, motivation to the simplex method, simplex algorithm, Duality in Linear Programming, Dual Simplex method.

**UNIT III: Transportation Problem:** Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel’s approximation method, testing for optimality of balanced transportation problems, Special cases in transportation problem.

**UNIT IV: Nonlinear Programming:** Unconstrained cases, One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method, Univariate method, Powell’s method and steepest descent method.

Constrained cases– Characteristics of a constrained problem, Classification, Basic approach of Penalty



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Function method; Basic approaches of Interior and Exterior penalty function methods, Introduction to convex Programming Problem.

**UNIT V: Dynamic Programming:** Dynamic programming multistage decision processes, types, concept of sub optimization and the principle of optimality, computational procedure in dynamic programming, examples illustrating the calculus method of solution, examples illustrating the tabular method of solution.

**Text Books:**

1. “Engineering optimization: Theory and practice”, S. S.Rao, New Age International (P) Limited, 3<sup>rd</sup> edition, 1998.
2. “Introductory Operations Research”, H.S. Kasene & K.D. Kumar, Springer (India), Pvt. LTd.

**Reference Books:**

1. “Optimization Methods in Operations Research and systems Analysis”, by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Operations Research, Dr. S.D.Sharma, Kedarnath, Ramnath & Co



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>ARTIFICIAL INTELLIGENCE (Professional Elective –I)</b>					

**Course Objectives:** The student will be able to

- Know the methodology of Problem solving
- Implement basic AI algorithms
- Design and carry out an empirical evolution of different algorithms on a problem formalization

**Course Outcomes (COs):** At the end of the course, student will be able to

- Understand the fundamental concepts in Artificial Intelligence
- Analyze the applications of search strategies and problem reductions
- Apply the mathematical logic concepts.
- Develop the Knowledge representations in Artificial Intelligence.
- Explain the Fuzzy logic systems.

**UNIT I:**

**Introduction to artificial intelligence:** Introduction ,history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI.

**UNIT II:**

**Problem solving: state-space search and control strategies:** Introduction, general problem solving, characteristics of problem

**Search Strategies:** exhaustive searches, heuristic search techniques, iterative-deepening A\*, constraint satisfaction

**UNIT III:**

**Logic concepts:** Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, predicate logic

**UNIT IV:**

**Knowledge representation:** Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR

**Advanced knowledge representation techniques:** Introduction, conceptual dependency theory, script structure.

**UNIT V:**

**Expert system and applications:** Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems blackboard systems truth maintenance systems, application of expert systems, list of shells and tools.

**Text Books:**

1. Artificial Intelligence, Saroj Kaushik, CENGAGE Learning,
2. Artificial intelligence, A modern Approach , 2<sup>nd</sup> ed, Stuart Russel, Peter Norvig, PEA
3. Artificial Intelligence, Rich, Kevin Knight, Shiv Shankar B Nair, 3<sup>rd</sup> ed, TMH
4. Introduction to Artificial Intelligence, Patterson, PHI



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**Reference Books:**

1. Artificial intelligence, structures and Strategies for Complex problem solving, -George F Luger, 5<sup>th</sup> ed, PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer
3. Artificial Intelligence, A new Synthesis, Nils J Nilsson, Elsevier



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>SOFTWARE PROJECT MANAGEMENT</b> <b>(Professional Elective –I)</b>				

**Course Objectives:**

At the end of the course, the student shall be able to:

- To describe and determine the purpose and importance of project management from the perspectives of planning, tracking and completion of project
- To compare and differentiate organization structures and project structures
- To implement a project to manage project schedule, expenses and resources with the application of suitable project management tools

**Course outcomes:**

Upon the completion of the course students will be able to:-

- Apply the process to be followed in the software development life-cycle models
- Apply the concepts of project management & planning
- Implement the project plans through managing people, communications and change
- Conduct activities necessary to successfully complete and close the Software projects
- Implement communication, modeling, and construction & deployment practices in software development

**UNIT-I:**

**Conventional Software Management:** The waterfall model, conventional software Management performance.

**Evolution of Software Economics:** Software Economics, pragmatic software cost estimation.

**Improving Software Economics:** Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections.

**The old way and the new:** The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.

**UNIT-II:**

**Life cycle phases:** Engineering and production stages, inception, Elaboration, construction, transition phases.

**Artifacts of the process:** The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts.

**UNIT- III:**

**Model based software architectures:** A Management perspective and technical perspective.

**Work Flows of the process:** Software process workflows, Iteration workflows.

**Checkpoints of the process:** Major mile stones, Minor Milestones, Periodic status assessments.

**Iterative Process Planning:** Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning.

**UNIT- IV:**

**Project Organizations and Responsibilities:** Line-of-Business Organizations, Project Organizations, evolution of Organizations.

**Process Automation:** Automation Building blocks, The Project Environment.

**Project Control and Process instrumentation:** The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation.



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**UNIT-V:**

Agile Methodology, ADAPTING to Scrum, Patterns for Adopting Scrum, Iterating towards Agility.

**Fundamentals of DevOps:** Architecture, Deployments, Orchestration, Need, Instance of applications, DevOps delivery pipeline, DevOps eco system. DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes

**Text Books:**

1. Software Project Management, Walker Royce, PEA, 2005.
2. Succeeding with Agile: Software Development Using Scrum, Mike Cohn, Addison Wesley.
3. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, Gene Kim , John Willis , Patrick Debois , Jez Humb,1st Edition, O'Reilly publications, 2016.

**Reference Books:**

1. Software Project Management, Bob Hughes,3/e, Mike Cotterell, TMH
2. Software Project Management, Joel Henry, PEA
3. Software Project Management in practice, Pankaj Jalote, PEA, 2005,
4. Effective Software Project Management, Robert K.Wysocki, Wiley,2006
5. Project Management in IT, Kathy Schwalbe, Cengage



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>DISTRIBUTED SYSTEMS (Professional Elective –I)</b>				

**Course Objectives:**

- To understand the foundations of distributed systems.
- To learn issues related to clock Synchronization and the need for global state in distributed systems
- To learn distributed mutual exclusion and deadlock detection algorithms
- To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems
- To learn the characteristics of peer-to-peer and distributed shared memory systems

**Course Outcomes:**

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

- Elucidate the foundations and issues of distributed systems
- Illustrate the various synchronization issues and global state for distributed systems
- Illustrate the Mutual Exclusion and Deadlock detection algorithms in distributed systems
- Describe the agreement protocols and fault tolerance mechanisms in distributed systems
- Describe the features of peer-to-peer and distributed shared memory systems

**UNIT I:**

Distributed Systems: Definition, Relation to computer system components, Motivation, Relation to parallel systems, Message-passing systems versus shared memory systems, Primitives for distributed communication, Synchronous versus asynchronous executions, Design issues and challenges.

A model of distributed computations: A distributed program, A model of distributed executions, Models of communication networks, Global state, Cuts, Past and future cones of an event, Models of process communications.

Logical Time: A framework for a system of logical clocks, Scalar time, Vector time, Physical clock synchronization: NTP.

**UNIT II:**

Message Ordering & Snapshots: Message ordering and group communication: Message ordering paradigms, Asynchronous execution with synchronous communication, Synchronous program order on an asynchronous system, Group communication, Causal order (CO), Total order. Global state and snapshot recording algorithms: Introduction, System model and definitions, Snapshot algorithms for FIFO channels.

**UNIT III:**

Distributed Mutex & Deadlock: Distributed mutual exclusion algorithms: Introduction, Preliminaries, Lamport's algorithm, Ricart-Agrawala algorithm, Maekawa's algorithm, Suzuki-Kasami's broadcast algorithm. Deadlock detection in distributed systems: Introduction, System model, Preliminaries, Models of deadlocks, Knapp's classification, Algorithms for the single resource model, the AND model and the OR model.

**UNIT IV:**

Recovery & Consensus: Check pointing and rollback recovery: Introduction, Background and definitions, Issues in failure recovery, Checkpoint-based recovery, Log-based rollback recovery, Coordinated check pointing algorithm, Algorithm for asynchronous check pointing and recovery. Consensus and agreement algorithms: Problem definition, Overview of results, Agreement in a failure, free system, Agreement in synchronous systems with failures.





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**UNIT V:**

Peer-to-peer computing and overlay graphs: Introduction, Data indexing and overlays, Chord –Content addressable networks, Tapestry.

Distributed shared memory: Abstraction and advantages, Memory consistency models, Sharedmemory Mutual Exclusion.

**Text Books:**

1. Distributed Systems Concepts and Design, George Coulouris, Jean Dollimore and Tim Kindberg, Fifth Edition, Pearson Education, 2012.
2. Distributed computing: Principles, algorithms, and systems, Ajay Kshemkalyani and Mukesh Singhal, Cambridge University Press, 2011.

**Reference Books:**

1. Distributed Operating Systems: Concepts and Design, Pradeep K Sinha, Prentice Hall of India, 2007.
2. Advanced concepts in operating systems. Mukesh Singhal and Niranjana G. Shivaratri, McGraw-Hill, 1994.
3. Distributed Systems: Principles and Paradigms, Tanenbaum A.S., Van Steen M., Pearson Education, 2007.

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/106/106106168/>



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>ADVANCED UNIX PROGRAMMING</b> <b>(Professional Elective –I)</b>					

**Course Objectives:**

Understating the shell commands, shell programming, system calls of files and processes, signals, inter-process communication concepts and programming, TCP and UDP.

**Course Outcomes:** After finishing this course student will be able to:

- Gain good knowledge on Unix commands and awareness of shell programming
- Know about different system calls for files and directories
- Ability to know the working of processes and signals
- Application of client server program for IPC
- Knowledge about socket programming

**UNIT-I:**

Introduction, Architecture of unix, Responsibilities of shell, unix file system, vi editor. **Unix commands:** Some Basic Commands, file utilities, process utilities, text processing utilities, network utilities, disk utilities, backup utilities , Security by file permissions.

**UNIT-II:**

**Shell Programming:** shell variables, The Export command, The Profile File a Script Run During starting, The First Shell Script, The read command, Positional Parameters, The \$? Variable , Knowing the exit Status- More about the Set Command, The Exit command, Branching Control Structures, Loop Control Structures, The Continue and Break Statement- The Expr Command, Performing Integer Arithmetic- Real Arithmetic in Shell Programs- The here Document(<<), The Sleep Command, Debugging Scripts, The Script command, The Eval command, The Exec Command, Sample programs. **Files** - Introduction, file descriptors, open, creat, read, write, close, lseek, dup2, file status information-stat family, file and record locking- fcntl function, file permissions - chmod, fchmod, file ownership-chown, lchown, links-soft and hard links-symlink, link, unlink.

**UNIT-III:**

**Directories**-Creating, removing and changing Directories-mkdir, rmdir, chdir, obtaining current working directory-getcwd, Directory contents, Scanning Directories-opendir, readdir, closedir, rewinddir functions. **Process Control:** process identifiers, fork function, vfork function, exit function, wait and waitpid functions, exec functions, user identification. **Signals:** signal handling using signal function, kill and raise, alarm, pause, abort and sleep functions.

**UNIT-IV:**

**IPC:** introduction, pipes, FIFO's, client –server examples for pipes and FIFO's **message queues:** message queue structure in kernel, system calls of message queue, client-server example for message queue. **Semaphores:** definition, system calls of semaphores, semaphores structure in kernel, file locking using semaphores

**UNIT-V:**

**Shared memory**-system calls of shared memory, semaphore structure in kernel, client server example. **Sockets:** Introduction, overview, elementary socket system calls, TCP Echo program, UDP Echo program



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**Text Books:**

1. Unix the ultimate guide, 3<sup>rd</sup> edition, Sumitabha Das, TMH.
2. Advanced programming in the Unix environment by W. Richard Stevens.
3. Unix network programming by W. Richard Stevens.

**Reference Books:**

1. Introduction to Unix and shell programming, Venkateshmurthy
2. Unix and shell programming by B.M. Harwani, OXFORD university press.



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		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>DATA WAREHOUSING AND DATA MINING LAB</b>					

**Course Objectives:** The main objective of the course is to

- Inculcate Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment
- Design a data warehouse or data mart to present information needed by management in a form that is usable
- Emphasize hands-on experience working with all real data sets.
- Test real data sets using popular data mining tools such as WEKA, Python Libraries
- Develop ability to design various algorithms based on data mining tools.

**Course Outcomes:** By the end of the course student will be able to

- Design a data mart or data warehouse for any organization
- Extract knowledge using data mining techniques and enlist various algorithms used in information analysis of Data Mining Techniques
- Demonstrate the working of algorithms for data mining tasks such as association rule mining, classification for realistic data
- Implement and Analyze on knowledge flow application on data sets and Apply the suitable visualization techniques to output analytical results

**Software Requirements:** WEKA Tool/Python/R-Tool/Rapid Tool/Oracle Data mining

**List of Experiments:**

1. Creation of a Data Warehouse.
  - Build Data Warehouse/Data Mart (using open source tools like Pentaho Data Integration Tool, Pentaho Business Analytics; or other data warehouse tools like Microsoft-SSIS, Informatica, Business Objects,etc.,)
  - Design multi-dimensional data models namely Star, Snowflake and Fact Constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, manufacturing, Automobiles, sales etc).
  - Write ETL scripts and implement using data warehouse tools.
  - Perform Various OLAP operations such slice, dice, roll up, drill up and pivot
2. Explore machine learning tool “WEKA”
  - Explore WEKA Data Mining/Machine Learning Toolkit.
  - Downloading and/or installation of WEKA data mining toolkit.
  - Understand the features of WEKA toolkit such as Explorer, Knowledge Flow interface, Experimenter, command-line interface.
  - Navigate the options available in the WEKA (ex. Select attributes panel, Preprocess panel, Classify panel, Cluster panel, Associate panel and Visualize panel)
  - Study the arff file format Explore the available data sets in WEKA. Load a data set (ex. Weather dataset, Iris dataset, etc.)
  - Load each dataset and observe the following:
    1. List the attribute names and they types
    2. Number of records in each dataset
    3. Identify the class attribute (if any)
    4. Plot Histogram
    5. Determine the number of records for each class.
    6. Visualize the data in various dimensions



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3. Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets
  - Explore various options available in Weka for preprocessing data and apply Unsupervised filters like Discretization, Resample filter, etc. on each dataset
  - Load weather, nominal, Iris, Glass datasets into Weka and run Apriori Algorithm with different support and confidence values.
  - Study the rules generated. Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm. Study the rules generated.
  - Derive interesting insights and observe the effect of discretization in the rule generation process.
4. Demonstrate performing classification on data sets
  - Load each dataset into Weka and run 1d3, J48 classification algorithm. Study the classifier output. Compute entropy values, Kappa statistic.
  - Extract if-then rules from the decision tree generated by the classifier, Observe the confusion matrix.
  - Load each dataset into Weka and perform Naïve-bayes classification and k-Nearest Neighbour classification. Interpret the results obtained.
  - Plot RoC Curves
  - Compare classification results of ID3, J48, Naïve-Bayes and k-NN classifiers for each dataset, and deduce which classifier is performing best and poor for each dataset and justify.
5. Demonstrate performing clustering of data sets
  - Load each dataset into Weka and run simple k-means clustering algorithm with different values of k (number of desired clusters).
  - Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights.
  - Explore other clustering techniques available in Weka.
  - Explore visualization features of Weka to visualize the clusters. Derive interesting insights and explain.
6. Demonstrate knowledge flow application on data sets
  - Develop a knowledge flow layout for finding strong association rules by using Apriori, FP Growth algorithms
  - Set up the knowledge flow to load an ARFF (batch mode) and perform a cross validation using J48 algorithm
  - Demonstrate plotting multiple ROC curves in the same plot window by using j48 and Random forest tree
7. Demonstrate ZeroR technique on Iris dataset (by using necessary preprocessing technique(s)) and share your observations
8. Write a java program to prepare a simulated data set with unique instances.
9. Write a Python program to generate frequent item sets / association rules using Apriori algorithm
10. Write a program to calculate chi-square value using Python. Report your observation.
11. Write a program of Naive Bayesian classification using Python programming language.
12. Implement a Java program to perform Apriori algorithm
13. Write a program to cluster your choice of data using simple k-means algorithm using JDK
14. Write a program of cluster analysis using simple k-means algorithm Python programming language.
15. Write a program to compute/display dissimilarity matrix (for your own dataset containing at least four instances with two attributes) using Python
16. Visualize the datasets using matplotlib in python.(Histogram, Box plot, Bar chart, Pie chart etc.,)



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		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>COMPUTER NETWORKS LAB</b>					

**Course Objectives:**

Learn basic concepts of computer networking and acquire practical notions of protocols with the emphasis on TCP/IP. A lab provides a practical approach to Ethernet/Internet networking: networks are assembled, and experiments are made to understand the layered architecture and how do some important protocols work

**Course Outcomes:**

By the end of the course student will be able to

- Know how reliable data communication is achieved through data link layer.
- Suggest appropriate routing algorithm for the network.
- Provide internet connection to the system and its installation.
- Work on various network management tools

**List of Experiments:**

1. Study of Network devices in detail and connect the computers in Local Area Network.
2. Write a Program to implement the data link layer framing methods such as
  - i) Character stuffing ii) bit stuffing.
3. Write a Program to implement data link layer framing method checksum.
4. Write a program for Hamming Code generation for error detection and correction.
5. Write a Program to implement on a data set of characters the three CRC polynomials – CRC 12, CRC 16 and CRC CCIP.
6. Write a Program to implement Sliding window protocol for Goback N.
7. Write a Program to implement Sliding window protocol for Selective repeat.
8. Write a Program to implement Stop and Wait Protocol.
9. Write a program for congestion control using leaky bucket algorithm
10. Write a Program to implement Dijkstra’s algorithm to compute the Shortest path through a graph.
11. Write a Program to implement Distance vector routing algorithm by obtaining routing table at each node (Take an example subnet graph with weights indicating delay between nodes).
12. Write a Program to implement Broadcast tree by taking subnet of hosts.
13. Wireshark
  - i. Packet Capture Using Wire shark
  - ii. Starting Wire shark
  - iii. Viewing Captured Traffic
  - iv. Analysis and Statistics & Filters.
14. How to run Nmap scan
15. Operating System Detection using Nmap
16. Do the following using NS2 Simulator
  - i. NS2 Simulator-Introduction
  - ii. Simulate to Find the Number of Packets Dropped
  - iii. Simulate to Find the Number of Packets Dropped by TCP/UDP
  - iv. Simulate to Find the Number of Packets Dropped due to Congestion
  - v. Simulate to Compare Data Rate& Throughput.





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		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>ANIMATION COURSE: ANIMATION DESIGN</b> <b>(Skill Oriented Course)</b>					

**Course Objectives:**

The main objective of this course is to understand 2-D and 3-D animation using Adobe package

**Course Outcomes:**

At the end of the Course, Student will be able to:

- learn various tools of digital 2-D animation
- understand production pipeline to create 2-D animation.
- apply the tools to create 2D animation for films and videos
- understand different styles and treatment of content in 3D model creation
- apply tools to create effective 3D modelling texturing and lighting

**List of Experiments:**

1. Adobe Photoshop:
  - a. Create your visiting card
  - b. Create Title for any forthcoming film
2. Draw Cartoon Animation using reference
3. Creating Frame by Frame animation
4. Create a scene by using Mask layers animation
5. Adobe Illustrator:
 

Packet Design(Toothpaste packet, Soap cover, any Food product)
6. Create any model of the male or female character
7. Create any Model of Cars or Bike
8. Create any Model of any animal.
9. Create any Model of any birds, fishes, and worms.
10. Create and Convert 2D objects into 3D objects
11. Create an animated 3D titling with sound
12. Create any Model some objects such as chairs, tables, fruits, utensils

**List of Augmented Experiments: (Weeks 13 – Week 16)**

(Any two of the following experiments can be performed)

1. Animate day and night scene of a street with the help of lighting
2. Create a human character using Character studio and animate the same
3. Create a natural outdoor or indoor scene.
4. Apply texture on various objects and characters

**Reference Books:**

1. Flash MX 2004, Thyagarajan Anbumani, TMH.
2. Brian Underdahl, The Complete Reference – Macromedia Flash Mx2004, 2nd edition – TMH.

**Web Links:**

1. [https://onlinecourses.swayam2.ac.in/cec21\\_cs07/preview](https://onlinecourses.swayam2.ac.in/cec21_cs07/preview)
2. [https://onlinecourses.swayam2.ac.in/ugc19\\_cs09/preview](https://onlinecourses.swayam2.ac.in/ugc19_cs09/preview)
3. [https://onlinecourses.swayam2.ac.in/ntr20\\_ed15/preview](https://onlinecourses.swayam2.ac.in/ntr20_ed15/preview)
4. [https://youtube.com/playlist?list=PLfFk8y2fd3FjeE\\_CrFASNvDLBp3yF1Hwi](https://youtube.com/playlist?list=PLfFk8y2fd3FjeE_CrFASNvDLBp3yF1Hwi)





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	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>CONTINUOUS INTEGRATION AND CONTINUOUS DELIVERY USING DevOps (Skill Oriented Course)</b>				

**Course Outcomes:**

At the end of the Course, Student will be able to:

- Understand the why, what and how of DevOps adoption
- Attain literacy on Devops
- Align capabilities required in the team
- Create an automated CICD pipeline using a stack of tools

**List of Exercises:**

**Note:** There are online courses indicated in the reference links section. Learners need to go through the contents in order to perform the given exercises

**Exercise 1:**

Reference course name : <a href="#">Software engineering and Agile software development</a>
Get an understanding of the stages in software development lifecycle, the process models, values and principles of agility and the need for agile software development. This will enable you to work in projects following an agile approach to software development.
Solve the questions <a href="#">given in the reference course name</a> to gauge your understanding of the topic

**Exercise 2:**

Reference course name: <a href="#">Development &amp; Testing with Agile: Extreme Programming</a>
Get a working knowledge of using extreme automation through XP programming practices of test first development, refactoring and automating test case writing.
Solve the questions in the “Take test” module <a href="#">given in the reference course name</a> to gauge your understanding of the topic

**Exercise 3:**

Module name : DevOps adoption in projects
It is important to comprehend the need to automate the software development lifecycle stages through DevOps. Gain an understanding of the capabilities required to implement DevOps, continuous integration and continuous delivery practices.
Solve the questions given in Quiz1, Quiz2, Quiz 3

**Exercise 4:**

Module name :Implementation of CICD with Java and open source stack
Configure the web application and Version control using Git using Git commands and version control operations.

**Exercise 5:**

Module Name: Implementation of CICD with Java and open source stack
Configure a static code analyzer which will perform static analysis of the web application code and identify the coding practices that are not appropriate. Configure the profiles and dashboard of the static code analysis tool.



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**Exercise 6:**

Module Name: Implementation of CICD with Java and open source stack

Write a build script to build the application using a build automation tool like Maven. Create a folder structure that will run the build script and invoke the various software development build stages. This script should invoke the static analysis tool and unit test cases and deploy the application to a web application server like Tomcat.

**Exercise 7:**

Module Name: Implementation of CICD with Java and open source stack

Configure the Jenkins tool with the required paths, path variables, users and pipeline views.

**Exercise 8:**

Module name: Implementation of CICD with Java and open source stack

Configure the Jenkins pipeline to call the build script jobs and configure to run it whenever there is a change made to an application in the version control system. Make a change to the background color of the landing page of the web application and check if the configured pipeline runs.

**Exercise 9:**

Module name: Implementation of CICD with Java and open source stack

Create a pipeline view of the Jenkins pipeline used in Exercise 8. Configure it with user defined messages.

**Exercise 10 :**

Module name: Implementation of CICD with Java and open source stack

In the configured Jenkins pipeline created in Exercise 8 and 9, implement quality gates for static analysis of code.

**Exercise 11:**

Module name :Implementation of CICD with Java and open source stack

In the configured Jenkins pipeline created in Exercise 8 and 9, implement quality gates for static unit testing.

**Exercise 12:**

Module name :Course end assessment

In the configured Jenkins pipeline created in Exercise 8 and 9, implement quality gates for code coverage.

**Reference Books:**

1. Learning Continuous Integration with Jenkins: A beginner's guide to implementing Continuous Integration and Continuous Delivery using Jenkins - Nikhil Pathania ,Packt publication  
[<https://www.amazon.in/Learning-Continuous-Integration-Jenkins-Pathania/dp/1785284835>]
2. Jenkins 2 – Up and Running: Evolve Your Deployment Pipeline for Next Generation Automation - Brent Laster, O'Reilly publication  
[<https://www.amazon.in/Jenkins-2-Running-Brent-Laster/dp/1491979593>]

**Hardware and software configuration:**

1. Git [GitHub or Gitlab]
2. Sonarqube
3. Jenkins
4. JUnit
5. Eclipse



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6. Tomcat server
7. Maven
8. Cobertura or JaCoCo
9. Java SDK
10. All necessary drivers and jar files for connecting the software
11. Windows machine with 16GB RAM

**Web Links:** ( Courses mapped to Infosys Springboard platform)

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_013382690411003904735\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013382690411003904735_shared/overview) [Software Engineering and Agile software development]
2. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_01350157819497676810467](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_01350157819497676810467) [Development & Testing with Agile: Extreme Programming]
3. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_01353898917192499226\\_shared](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_01353898917192499226_shared) [DevOps CICD]



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	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>EMPLOYABILITY SKILLS-I</b>				

**Course Objectives:**

The main objective of this course is to assist students in developing employability skills and personal qualities related to gaining and sustaining employment.

**Course Outcomes:** The end of the course student will be able to

- Understand the corporate etiquette.
- Make presentations effectively with appropriate body language
- Be composed with positive attitude
- Understand the core competencies to succeed in professional and personal life

**UNIT I:**

**Analytical Thinking & Listening Skills:** Self-Introduction, Shaping Young Minds - A Talk by Azim Premji (Listening Activity), Self – Analysis, Developing Positive Attitude, Perception.

**Communication Skills:** Verbal Communication; Non Verbal Communication (Body Language)

**UNIT II:**

**Self-Management Skills:** Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities

**Etiquette:** Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

**UNIT III:**

**Standard Operation Methods:** Note Making, Note Taking, Minutes Preparation, Email & Letter Writing

**Verbal Ability:** 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:**

**Job-Oriented Skills –I:** Group Discussion, Mock Group Discussions

**UNIT V:**

**Job-Oriented Skills –II:** Resume Preparation, Interview Skills, Mock Interviews

**Text Books and Reference Books:**

1. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.
2. S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010.
3. R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand & Company Ltd., 2018.
4. Raman, Meenakshi & Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011.

**e-resources:**

1. [www.Indiabix.com](http://www.Indiabix.com)
2. [www.freshersworld.com](http://www.freshersworld.com)



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III Year – I Semester	Minor Course	L	T	P	C
		3	0	2	4

**DATABASE MANAGEMENT SYSTEMS**

**Course Objectives:**

This Course will enable students to

- introduce about database management systems
- give a good formal foundation on the relational model of data and usage of Relational Algebra
- Populate and query a database using SQL DDL/DML Commands
- Declare and enforce integrity constraints on a database
- Writing Queries using advanced concepts of SQL
- Programming PL/SQL including procedures, functions, cursors and triggers
- introduce the concepts of basic SQL as a universal Database language
- demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization

**Course Outcomes:**

By the end of the course, the student will be able to

- Describe a relational database and object-oriented database
- Create, maintain and manipulate a relational database using SQL
- Describe ER model and normalization for database design
- Examine issues in data storage and query processing and can formulate appropriate solutions
- Outline the role and issues in management of data such as efficiency, privacy, security, ethical responsibility, and strategic advantage
- Examine integrity constraints to build efficient databases
- Apply Queries using Advanced Concepts of SQL
- Build PL/SQL programs including stored procedures, functions, cursors and triggers

**UNIT I**

Introduction: Database system, Characteristics (Database Vs File System), Database Users (Actors on Scene, Workers behind the scene), Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

**UNIT II**

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion).

**UNIT III**

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams. operations.



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**UNIT IV**

SQL: Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(datable and non-updatable), relational set

**UNIT V**

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency(1NF, 2NF and 3 NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF), Fifth Normal Form (5NF).

**List of Exercises:**

1. Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
2. Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSET, Constraints. Example:- Select the roll number and name of the student who secured fourth rank in the class.
3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
4. Queries using Conversion functions (to\_char, to\_number and to\_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next\_day, add\_months, last\_day, months\_between, least, greatest, trunc, round, to\_char, to\_date)
5.
  - i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)
  - ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.
6. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.
7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE- APPLICATION ERROR.
8. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
9. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
10. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers

**Text Books:**

- 1) Database Management Systems, 3/e, Raghurama Krishnan, Johannes Gehrke, TMH
- 2) Database System Concepts, 5/e, Silberschatz, Korth, TMH
- 3) Oracle: The Complete Reference by Oracle Press
- 4) Nilesh Shah, "Database Systems Using Oracle", PHI, 2007
- 5) Rick F Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007





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**Reference Books:**

- 1) Introduction to Database Systems, 8/e C J Date, PEA.
- 2) Database Management System, 6/e Ramez Elmasri, Shamkant B. Navathe, PEA
- 3) Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105175/>
- 2) <https://www.geeksforgeeks.org/introduction-to-nosql/>



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>MACHINE LEARNING</b>				

**Course Objectives:**

- Identify problems that are amenable to solution by ANN methods, and which ML methods may be suited to solving a given problem.
- Formalize a given problem in the language/framework of different ANN methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).

**Course Outcomes:** After the completion of the course, student will be able to

- Explain the fundamental usage of the concept Machine Learning system
- Demonstrate on various regression Technique
- Analyze the Ensemble Learning Methods
- Illustrate the Clustering Techniques and Dimensionality Reduction Models in Machine Learning.
- Discuss the Neural Network Models and Fundamentals concepts of Deep Learning

**Unit I:**

**Introduction-** Artificial Intelligence, Machine Learning, Deep learning, Types of Machine Learning Systems, Main Challenges of Machine Learning.

**Statistical Learning:** Introduction, Supervised and Unsupervised Learning, Training and Test Loss, Tradeoffs in Statistical Learning, Estimating Risk Statistics, Sampling distribution of an estimator, Empirical Risk Minimization.

**Unit II:**

**Supervised Learning**(Regression/Classification):Basic Methods: Distance based Methods, Nearest Neighbours, Decision Trees, Naive Bayes, **Linear Models:** Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, **Binary Classification:** Multiclass/Structured outputs, MNIST, Ranking.

**Unit III:**

**Ensemble Learning and Random Forests:** Introduction, Voting Classifiers, Bagging and Pasting, Random Forests, Boosting, Stacking.

**Support Vector Machine:** Linear SVM Classification, Nonlinear SVM Classification SVM Regression, Naïve Bayes Classifiers.

**Unit IV:**

**Unsupervised Learning Techniques:** Clustering, K-Means, Limits of K-Means, Using Clustering for Image Segmentation, Using Clustering for Preprocessing, Using Clustering for Semi-Supervised Learning, DBSCAN, Gaussian Mixtures.

**Dimensionality Reduction:** The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA, Using Scikit-Learn, Randomized PCA, Kernel PCA.

**Unit V:**

**Neural Networks and Deep Learning:** Introduction to Artificial Neural Networks with Keras, Implementing MLPs with Keras, Installing TensorFlow 2, Loading and Preprocessing Data with TensorFlow.



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**Text Books:**

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Publications, 2019
2. Data Science and Machine Learning Mathematical and Statistical Methods, Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, 25th November 2020

**Reference Books:**

1. Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, 2012.



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>COMPILER DESIGN</b>					

**Course Objectives:**

Understand the basic concept of compiler design, and its different phases which will be helpful to construct new tools like LEX, YACC, etc.

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

- Demonstrate phases in the design of compiler
- Organize Syntax Analysis, Top Down and LL(1) grammars
- Design Bottom Up Parsing and Construction of LR parsers
- Analyze synthesized, inherited attributes and syntax directed translation schemes
- Determine algorithms to generate code for a target machine

**UNIT I: Lexical Analysis:** Language Processors, Structure of a Compiler, Lexical Analysis, The Role of the Lexical Analyzer, Bootstrapping, Input Buffering, Specification of Tokens, Recognition of Tokens, Lexical Analyzer Generator-LEX, Finite Automata, Regular Expressions and Finite Automata, Design of a Lexical Analyzer Generator.

**UNIT II: Syntax Analysis:** The Role of the Parser, Context-Free Grammars, Derivations, Parse Trees, Ambiguity, Left Recursion, Left Factoring, **Top Down Parsing:** Pre Processing Steps of Top Down Parsing, Backtracking, Recursive Descent Parsing, LL (1) Grammars, Non-recursive Predictive Parsing, Error Recovery in Predictive Parsing.

**UNIT III: Bottom Up Parsing:** Introduction, Difference between LR and LL Parsers, Types of LR Parsers, Shift Reduce Parsing, SLR Parsers, Construction of SLR Parsing Tables, More Powerful LR Parsers, Construction of CLR (1) and LALR Parsing Tables, Dangling Else Ambiguity, Error Recovery in LR Parsing, Handling Ambiguity Grammar with LR Parsers.

**UNIT III: Syntax Directed Translation:** Syntax-Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax Directed Translation, Syntax-Directed Translation Schemes, Implementing L-Attributed SDD's. **Intermediate Code Generation:** Variants of Syntax Trees, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Control Flow, Backpatching, Intermediate Code for Procedures.

**UNIT IV: Run Time Environments:** Storage Organization, Run Time Storage Allocation, Activation Records, Procedure Calls, Displays, **Code Optimization:** The Principle Sources of Optimization, Basic Blocks, Optimization of Basic Blocks, Structure Preserving Transformations, Flow Graphs, Loop Optimization, Data-Flow Analysis, Peephole Optimization

**UNIT V: Code Generation:** Issues in the Design of a Code Generator, Object Code Forms, Code Generation Algorithm, Register Allocation and Assignment.

**Text Books:**

1. Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Pearson Publishers, 2007.



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**Reference Books:**

1. Compiler Construction, Principles and Practice, Kenneth C Loudon, Cengage Learning, 2006
2. Modern compiler implementation in C, Andrew W Appel, Revised edition, Cambridge University Press.
3. Optimizing Compilers for Modern Architectures, Randy Allen, Ken Kennedy, Morgan Kaufmann, 2001.
4. Levine, J.R., T. Mason and D. Brown, Lex and Yacc, edition, O'Reilly & Associates, 1990



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<b>CRYPTOGRAPHY AND NETWORK SECURITY</b>				

**Course Objectives:**

The main objectives of this course are to explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, public key algorithms, design issues and working principles of various authentication protocols and various secure communication standards including Kerberos, IPsec, and SSL/TLS.

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

- Explain different security threats and countermeasures and foundation course of cryptography mathematics.
- Classify the basic principles of symmetric key algorithms and operations of some symmetric key algorithms and asymmetric key cryptography
- Revise the basic principles of Public key algorithms and Working operations of some Asymmetric key algorithms such as RSA, ECC and some more
- Design applications of hash algorithms, digital signatures and key management techniques
- Determine the knowledge of Application layer, Transport layer and Network layer security Protocols such as PGP, S/MIME, SSL,TSL, and IPsec .

**UNIT I:**

**Basic Principles :** Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography.

**UNIT II:**

**Symmetric Encryption:** Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.

**UNIT III:**

**Asymmetric Encryption:** Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography

**UNIT IV:**

**Data Integrity, Digital Signature Schemes & Key Management :** Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, Key Management.

**UNIT V:**

**Network Security-I:** Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, **Network Security-II :** Security at the Network Layer: IPsec, System Security

**Text Books:**

1. Cryptography and Network Security, 3<sup>rd</sup> Edition Behrouz A Forouzan, Deb deep Mukhopadhyay, McGraw Hill,2015
2. Cryptography and Network Security,4<sup>th</sup> Edition, William Stallings, (6e) Pearson,2006
3. Everyday Cryptography, 1<sup>st</sup> Edition, Keith M.Martin, Oxford,2016

**Reference Books:**

1. Network Security and Cryptography, 1<sup>st</sup> Edition, Bernard Meneges, Cengage Learning,2018



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>MOBILE COMPUTING (Professional Elective-II)</b>					

**Course Objectives:**

- To understand the fundamentals of mobile communication
- To understand the architecture of various Wireless Communication Networks
- To understand the significance of different layers in mobile system Course Contents

**Course Outcomes:** Upon completion of the course, the students will be able to:

- Develop a strong grounding in the fundamentals of mobile Networks
- Apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
- Comprehend, design, and develop a lightweight network stack
- Analyze the Mobile Network Layer system working
- Explain about the WAP Model

**UNIT I: Introduction to Wireless Networks:** Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems: Frequency Management and Channel Assignment, types of hand-off and their characteristics.

**UNIT II: MAC –** Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM: Architecture Location tracking and call setup, Mobility management, Handover, Security, GSM, SMS, International roaming for GSM, call recording functions, subscriber and service data management, DECT, TETRA, UMTS, IMT-2000.

**UNIT III: Wireless LAN:** Infrared vs. Radio transmission, Infrastructure, Adhoc Network, IEEE 802.11 WLAN Standards, Architecture, Services, HIPERLAN, Bluetooth Architecture & protocols.

**UNIT IV: Mobile Network Layer:** Mobile IP, Dynamic Host Configuration Protocol, Mobile Transport Layer, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/Fast recovery, Transmission/Time-out freezing, Selective retransmission, Transaction Oriented TCP.

**UNIT V: Support for Mobility:** Wireless Application Protocol: Architecture, Wireless Datagram Protocol, Wireless Transport Layer Security, Wireless Transaction Protocol, Wireless Session Protocol, Wireless Application Environment, Wireless Markup Language, WML Scripts, Wireless Telephone Application.

**Text Books:**

1. Jochen Schiller, “Mobile Communication”, Second Edition, Pearson Education, 2008.

**Reference Books:**

1. William Stallings, “Wireless Communications and Networks”, Second Edition, Pearson Education, 2004.
2. C. Siva Ram Murthy, B. S. Manoj, “Adhoc Wireless Networks: Architectures and Protocols”, Second Edition, Pearson Education, 2008.





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<b>BIG DATA ANALYTICS</b> <b>(Professional Elective II)</b>				

**Course Objectives:**

- To optimize business decisions and create competitive advantage with Big Data analytics
- To learn to analyze the big data using intelligent techniques
- To introduce programming tools PIG & HIVE in Hadoop ecosystem

**Course Outcomes:**

At the end of the course, the students will be able to

- Illustrate big data challenges in different domains including social media, transportation, finance and medicine
- Use various techniques for mining data stream
- Design and develop Hadoop
- Identify the characteristics of datasets and compare the trivial data and big data for various applications
- Explore the various search methods and visualization techniques

**UNIT I**

Introduction: Introduction to big data: Introduction to Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting.

**UNIT II**

Stream Processing: Mining data streams: Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform (RTAP) Applications, Case Studies - Real Time Sentiment Analysis - Stock Market Predictions.

**UNIT III**

Introduction to Hadoop: Hadoop: History of Hadoop, the Hadoop Distributed File System, Components of Hadoop Analysing the Data with Hadoop, Scaling Out, Hadoop Streaming, Design of HDFS, Java interfaces to HDFS Basics, Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling, Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features Hadoop environment.

**UNIT IV**

Frameworks and Applications: Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive services, HiveQL, Querying Data in Hive, fundamentals of HBase and ZooKeeper.

**UNIT V**

Predictive Analytics and Visualizations: Predictive Analytics, Simple linear regression, Multiple linear regression, Interpretation of regression coefficients, Visualizations, Visual data analysis techniques, interaction techniques, Systems and application



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**Text Books:**

1. Tom White, “Hadoop: The Definitive Guide”, Third Edition, O’reilly Media, Fourth Edition, 2015.
2. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill Publishing, 2012.
3. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP, 2012

**Reference Books:**

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.
2. Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, “Harness the Power of Big Data: The IBM Big Data Platform”, Tata McGraw Hill Publications, 2012.
3. Arshdeep Bahga and Vijay Madisetti, “Big Data Science & Analytics: A Hands On Approach”, VPT, 2016.
4. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)”, John Wiley & Sons, 2014.

**Software Links:**

1. Hadoop: <http://hadoop.apache.org/>
2. Hive: <https://cwiki.apache.org/confluence/display/Hive/Home>
3. Piglatin: <http://pig.apache.org/docs/r0.7.0/tutorial.html>



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<b>OBJECT ORIENTED ANALYSIS AND DESIGN</b> <b>(Professional Elective II)</b>					

**Course Objectives:** The main objective is the students to

- Become familiar with all phases of OOAD.
- Master the main features of the UML.
- Master the main concepts of Object Technologies and how to apply them at work and develop the ability to analyze and solve challenging problem in various domains.
- Learn the Object design Principles and understand how to apply them towards Implementation.

**Course Outcomes:** After finishing this course student will be able to:

- Analyze the nature of complex system and its solutions.
- Illustrate & relate the conceptual model of the UML, identify & design the classes and relationships
- Analyze & Design Class and Object Diagrams that represent Static Aspects of a Software System and apply basic and Advanced Structural Modeling Concepts for designing real time applications.
- Analyze & Design behavioral aspects of a Software System using Use Case, Interaction and Activity Diagrams.
- Analyze & Apply techniques of State Chart Diagrams and Implementation Diagrams to model behavioral aspects and Runtime environment of Software Systems.

**UNIT I:**

**Introduction:** The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Organized and Disorganized Complexity, Bringing Order to Chaos, Designing Complex Systems. **Case Study:** System Architecture: Satellite-Based Navigation

**UNIT II:**

**Introduction to UML:** Importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, Architecture, and Software Development Life Cycle. **Basic Structural Modeling:** Classes, Relationships, common Mechanisms, and diagrams. **Case Study:** Control System: Traffic Management.

**UNIT III:**

**Class & Object Diagrams:** Terms, concepts, modeling techniques for Class & Object Diagrams. **Advanced Structural Modeling:** Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages. **Case Study:** AI: Cryptanalysis.

**UNIT IV:**

**Basic Behavioral Modeling-I:** Interactions, Interaction diagrams Use cases, Use case Diagrams, Activity Diagrams. **Case Study:** Web Application: Vacation Tracking System

**UNIT V:**

**Advanced Behavioral Modeling:** Events and signals, state machines, processes and Threads, time and space, state chart diagrams. **Architectural Modeling:** Component, Deployment, Component diagrams and Deployment diagrams

**Case Study:** Weather Forecasting



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**Text Books:**

1. Grady BOOCH, Robert A. Maksimchuk, Michael W. ENGLE, Bobbi J. Young, Jim Conallen, Kellia Houston , “Object- Oriented Analysis and Design with Applications”, 3rd edition, 2013, PEARSON.
2. Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modeling Language User Guide, Pearson Education.

**Reference Books:**

1. Meilir Page-Jones: Fundamentals of Object Oriented Design in UML, Pearson Education.
2. Pascal Roques: Modeling Software Systems Using UML2, WILEY- Dreamtech India Pvt. Ltd.
3. Atul Kahate: Object Oriented Analysis & Design, The McGraw-Hill Companies.
4. Applying UML and Patterns: An introduction to Object – Oriented Analysis and Design and Unified Process, Craig Larman, Pearson Education.



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<b>NETWORK PROGRAMMING</b> <b>(Professional Elective II)</b>					

**Course Objectives:**

Having successfully completed this course, the student will be able to:

- Demonstrate mastery of main protocols comprising the Internet.
- Develop skills in network programming techniques.
- Implement network services that communicate through the Internet.
- Apply the client-server model in networking applications.
- Practice networking commands available through the operating system

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

- Identifying different models and sockets
- Demonstrate different TCP Echo server functions and I/O models
- Rationalize IPV4 and IPV6 Socket options
- Identifying daemon processing and Advanced input and output functions
- Analyze Broadcasting and multicasting

**UNIT I:**

**Introduction to Network Programming:** Introduction to Network Programming: OSI model, UNIX standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application Elementary Sockets: Sockets introduction, Elementary TCP sockets.

**UNIT II:**

**TCP client server:** Introduction, TCP Echo server functions, Normal startup, terminate and signal handling server process termination, Crashing and Rebooting of server host shutdown of server host.I/O Multiplexing: I/O Models, the select and poll functions, Batch input and buffering, shutdown function.

**UNIT III:**

**UDP and Socket options: Elementary UDP sockets:** Introduction UDP Echo server functions, lost datagram, summary of UDP example, Lack of flow control with UDP. **Socket options:** getsockopt and setsockopt functions. Socket states, Generic socket options IPV4 socket options, IPV6 socket options, ICMPV6 socket options and TCP socket options, SCTP socket options, fcntl function.

**UNIT IV:**

**Advanced Sockets and Daemon Processes:** IPV4 and IPV6 interoperability, introduction, IPV4 client: IPV6 server, IPV6 client: IPV4 Server, IPV6 Address-testing macros. Daemon Processes and inetdSuperserver –Introduction, syslogd Daemon, syslog Function, daemon\_init Function, inetd Daemon, daemon\_inetd. Advanced I/O functions: Socket timeouts, recv and send functions, ready and writev functions, recvmsg and send msg functions, Ancillary data.

**UNIT V:**

**Broadcasting and Multicasting:** Broadcasting introduction, broadcast addresses, unicast versus Broadcast, dg\_cli function using broadcasting, race conditions, Multicasting addresses, multicasting versus broadcasting on a LAN, multicasting on a WAN, source-specific multicast, multicast socket options. **Raw Sockets:** Introduction, Raw Socket Creation, Raw Socket Output, Raw Socket Input, Ping Program, Traceroute Program



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**Text Books:**

1. UNIX Network Programming, by W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, Pearson Education
2. UNIX Network Programming, 1st Edition, W. Richard Stevens. PHI.

**Reference Books:**

1. UNIX Systems Programming using C++ T CHAN, PHI.
2. UNIX for Programmers and Users, 3rd Edition Graham GLASS, King abls, Pearson Education
3. Advanced UNIX Programming 2nd Edition M. J. ROCHKIND, Pearson Education



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<b>MEAN STACK DEVELOPMENT</b> <b>(Job Oriented Course)</b>					

**Course Outcomes:**

At the end of the Course, Student will be able to:

- Build static web pages using HTML 5 elements.
- Apply JavaScript to embed programming interface for web pages and also to perform Client side validations.
- Build a basic web server using Node.js, work with Node Package Manager (NPM) and recognize the need for Express.js.
- Develop JavaScript applications using typescript and work with document database using MongoDB.
- Utilize Angular JS to design dynamic and responsive web pages.

**UNIT-I:**

**HTML 5:** Introduction to Web, Overview of Web Technologies, HTML - Introduction, HTML - Need, Case-insensitivity, Platform-independency, DOCTYPE Declaration, Types of Elements, HTML Elements - Attributes, Metadata Element, Sectioning Elements, Paragraph Element, Division and Span Elements, List Element, Link Element, Character Entities, HTML5 Global Attributes, Creating Table Elements, Table Elements : Colspan/ Rowspan Attributes, border, cellspacing and cellpadding attributes, Creating Form Elements, Input Elements - Attributes, Color and Date Pickers, Select and Datalist Elements, Editing Elements, Media, Iframe, Why HTML Security, HTML Injection, Clickjacking, HTML5 Attributes & Events Vulnerabilities, Local Storage Vulnerabilities, HTML5 - Cross-browser support, Best Practices For HTML Web Pages.

**UNIT-II:**

**JavaScript:** Why we need JavaScript, What is JavaScript, Environment Setup, Working with Identifiers, Type of Identifiers, Primitive and Non Primitive Data Types, Operators and Types of Operators, Types of Statements, Non - Conditional Statements, Types of Conditional Statements, If and Switch Statements, Types of Loops, Types of Functions, Declaring and Invoking Function, Arrow Function, Function Parameters, Nested Function, Built-in Functions, Variable Scope in Functions, Working With Classes, Creating and Inheriting Classes, In-built Events and Handlers, Working with Objects, Types of Objects, Creating Objects, Combining and cloning Objects using Spread operator, Destructuring Objects, Browser and Document Object Model, Creating Arrays, Destructuring Arrays, Accessing Arrays, Array Methods, Introduction to Asynchronous Programming, Callbacks, Promises, Async and Await, Executing Network Requests using Fetch API, Creating and consuming Modules.

**UNIT-III:**

**Node.js:** Why and What Node.js, How to use Node.js, Create a web server in Node.js, Node Package Manager, Modular programming in Node.js, Restarting Node Application, File Operations.

**Express.js:** Express Development Environment, Defining a route, Handling Routes, Route and Query Parameters, How Middleware works, Chaining of Middlewares, Types of Middlewares, Connecting to MongoDB with Mongoose, Validation Types and Defaults, Models, CRUD Operations, API Development, Why Session management, Cookies, Sessions, Why and What Security, Helmet Middleware, Using a Template Engine Middleware, Stylus CSS Preprocessor.





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**UNIT-IV:**

**Typescript:** Installing TypeScript, Basics of TypeScript, Function, Parameter Types and Return Types, Arrow Function, Function Types, Optional and Default Parameters, Rest Parameter, Creating an Interface, Duck Typing, Function Types, Extending Interfaces, Classes, Constructor, Access Modifiers, Properties and Methods, Creating and using Namespaces, Creating and using Modules, Module Formats and Loaders, Module Vs Namespace, What is Generics, What are Type Parameters, Generic Functions, Generic Constraints.

**MongoDB:** Introduction Module Overview, Document Database Overview, Understanding JSON, MongoDB Structure and Architecture, MongoDB Remote Management, Installing MongoDB on the local computer (Mac or Windows), Introduction to MongoDB Cloud, Create MongoDB Atlas Cluster, GUI tools Overview, Install and Configure MongoDB Compass, Introduction to the MongoDB Shell, MongoDB Shell JavaScript Engine, MongoDB Shell JavaScript Syntax, Introduction to the MongoDB Data Types, Introduction to the CRUD Operations on documents, Create and Delete Databases and Collections, Introduction to MongoDB Queries.

**UNIT-V:**

What is Angular, Features of Angular, Angular Application Setup, Components and Modules, Executing Angular Application, Elements of Template, Change Detection, Structural Directives - ngIf, ngFor, ngSwitch, Custom Structural Directive, Attribute Directives - ngStyle, ngClass, Custom Attribute Directive, Property Binding, Attribute Binding, Style and Event Binding, Built in Pipes, Passing Parameters to Pipes, Nested Components Basics, Passing data from Container Component to Child Component, Passing data from Child Component to ContainerComponent, Shadow DOM, Component Life Cycle, Template Driven Forms, Model Driven Forms or Reactive Forms, Custom Validators in Reactive Forms, Custom Validators in Template Driven forms, Dependency Injection, Services Basics, RxJS Observables, Server Communication using HttpClient, Communicating with different backend services using Angular HttpClient, Routing Basics, Router Links, Route Guards, Asynchronous Routing, Nested Routes.

**Text Books:**

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson.
2. Pro Mean Stack Development, 1st Edition, Eyal Leshem, Apress O'Reilly.
3. Full Stack JavaScript Development with MEAN, Colin J Ihrig, Adam Bretz, 1<sup>st</sup> edition, SitePoint, SitePoint Pty. Ltd., O'Reilly Media.
4. MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly.

**Reference Books:**

1. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech.
2. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda SKatila, Cengage Learning.

**Web Links:**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_17739732834840810000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_17739732834840810000_shared/overview) (HTML5)
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_18109698366332810000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_18109698366332810000_shared/overview) (Javascript)
3. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_32407835671946760000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_32407835671946760000_shared/overview) (Node.js & Express.js)
4. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_9436233116512678000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_9436233116512678000_shared/overview) (Typescript)
5. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_20858515543254600000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_20858515543254600000_shared/overview) (Angular JS)
6. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_013177169294712832113\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overview) (MongoDB)



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<b>III Year – II Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>MACHINE LEARNING USING PYTHON LAB</b>					

**Course Objectives:**

This course will enable students to learn and understand different Data sets in implementing the machine learning algorithms.

**Course Outcomes (Cos):** At the end of the course, student will be able to

- Implement procedures for the machine learning algorithms
- Design and Develop Python programs for various Learning algorithms
- Apply appropriate data sets to the Machine Learning algorithms
- Develop Machine Learning algorithms to solve real world problems

**Requirements:** Develop the following program using Anaconda/ Jupiter/ Spider and evaluate ML models.

**Experiment-1:**

Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

**Experiment-2:**

For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

**Experiment-3:**

Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

**Experiment-4:**

Exercises to solve the real-world problems using the following machine learning methods: a) Linear Regression b) Logistic Regression c) Binary Classifier

**Experiment-5:** Develop a program for Bias, Variance, Remove duplicates , Cross Validation

**Experiment-6:** Write a program to implement Categorical Encoding, One-hot Encoding

**Experiment-7:**

Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

**Experiment-8:**

Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

**Experiment-9:** Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.



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**Experiment-10:**

Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

**Experiment-11:** Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

**Experiment-12:** Exploratory Data Analysis for Classification using Pandas or Matplotlib.

**Experiment-13:**

Write a Python program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set

**Experiment-14:**

Write a program to Implement Support Vector Machines and Principle Component Analysis

**Experiment-15:**

Write a program to Implement Principle Component Analysis



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		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>COMPILER DESIGN LAB</b>					

**Course Objectives:**

To enlighten the student with knowledge base in compiler design and its applications

**Course Outcomes:** The end of the course student will be able to

- Design simple lexical analyzers
- Determine predictive parsing table for a CFG
- Apply Lex and Yacc tools
- Examine LR parser and generating SLR Parsing table
- Relate Intermediate code generation for subset C language

**List of Experiments:**

1. Write a C program to identify different types of Tokens in a given Program.
2. Write a Lex Program to implement a Lexical Analyzer using Lex tool.
3. Write a C program to Simulate Lexical Analyzer to validating a given input String.
4. Write a C program to implement the Brute force technique of Top down Parsing.
5. Write a C program to implement a Recursive Descent Parser.
6. Write C program to compute the *First* and *Follow* Sets for the given Grammar.
7. Write a C program for eliminating the left recursion and left factoring of a given grammar
8. Write a C program to check the validity of input string using Predictive Parser.
9. Write a C program for implementation of LR parsing algorithm to accept a given input string.
10. Write a C program for implementation of a Shift Reduce Parser using Stack Data Structure to accept a given input string of a given grammar.
11. Simulate the calculator using LEX and YACC tool.
12. Generate YACC specification for a few syntactic categories.
13. Write a C program for generating the three address code of a given expression/statement.
14. Write a C program for implementation of a Code Generation Algorithm of a given expression/statement.

**Text Books & Reference Books :**

1. Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Pearson Publishers, 2007.
2. John R Levine, Tony Mason, Doug Brown, "Lex and Yacc", Orielly, 2nd Edition, 2009.



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		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>
<b>CRYPTOGRAPHY NETWORK SECURITY LAB</b>					

**Course Objectives:**

- To learn basic understanding of cryptography, how it has evolved, and some key encryption techniques used today.
- To understand and implement encryption and decryption using Ceaser Cipher, Substitution Cipher, Hill Cipher.

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

- Apply the knowledge of symmetric cryptography to implement encryption and decryption using Ceaser Cipher, Substitution Cipher, Hill Cipher
- Demonstrate the different algorithms like DES, BlowFish, and Rijndael, encrypt the text “Hello world” using Blowfish Algorithm.
- Analyze and implement public key algorithms like RSA, Diffie-Hellman Key Exchange mechanism, the message digest of a text using the SHA-1 algorithm

**List of Experiments:**

1. Write a C program that contains a string (char pointer) with a value \Hello World’. The program should XOR each character in this string with 0 and displays the result.
2. Write a C program that contains a string (char pointer) with a value \Hello World’. The program should AND or and XOR each character in this string with 127 and display the result
3. Write a Java program to perform encryption and decryption using the following algorithms:
  - a) Ceaser Cipher
  - b) Substitution Cipher
  - c) Hill Cipher
4. Write a Java program to implement the DES algorithm logic
5. Write a C/JAVA program to implement the BlowFish algorithm logic
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Using Java Cryptography, encrypt the text “Hello world” using BlowFish. Create your own key using Java key tool.
8. Write a Java program to implement RSA Algorithm
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.



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	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>BIG DATA: SPARK (Skill Oriented Course)</b>				

**Course Objectives:**

The main objective of the course is to process Big Data with advance architecture like spark and streaming data in Spark

**Course Outcomes:**

By the end of the course , the student will be able to

- Develop MapReduce Programs to analyze large dataset Using Hadoop and Spark
- Write Hive queries to analyze large dataset Outline the Spark Ecosystem and its components
- Perform the filter, count, distinct, map, flatMap RDD Operations in Spark.
- Build Queries using Spark SQL
- Apply Spark joins on Sample Data Sets
- Make use of sqoop to import and export data from hadoop to database and vice-versa

**List of Experiments:**

1.

<b>EXPERIMENT-1:</b>
To Study of Big Data Analytics and Hadoop Architecture
(i) know the concept of big data architecture
(ii) know the concept of Hadoop architecture
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**2. Loading DataSet in to HDFS for Spark Analysis**

<b>EXPERIMENT-2:</b>
Installation of Hadoop and cluster management
(i) Installing Hadoop single node cluster in ubuntu environment
(ii) Knowing the differencing between single node clusters and multi-node clusters
(iii) Accessing WEB-UI and the port number
(iv) Installing and accessing the environments such as hive and sqoop
(We can restrict to standalone or if the facilities available can try for pseudo-distribution mode {or} fully distribution mode)
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01329503531746099243539_shared?collectionId=lex_auth_01329503580490137643544_shared&amp;collectionType=Collection">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01329503531746099243539_shared?collectionId=lex_auth_01329503580490137643544_shared&amp;collectionType=Collection</a>

<b>EXPERIMENT-3:</b>
File management tasks & Basic linux commands
(i) Creating a directory in HDFS
(ii) Moving forth and back to directories
(iii) Listing directory contents
(iv) Uploading and downloading a file in HDFS
(v) Checking the contents of the file





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(vi) Copying and moving files
(vii) Copying and moving files between local to HDFS environment
(viii) Removing files and paths
(ix) Displaying few lines of a file
(x) Display the aggregate length of a file
(xi) Checking the permissions of a file
(xii) Zipping and unzipping the files with & without permission pasting it to a location
(xiii) Copy, Paste commands
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<b>EXPERIMENT-4:</b>
Map-reducing
(i) Definition of Map-reduce
(ii) Its stages and terminologies
(iii) Word-count program to understand map-reduce
(Mapper phase, Reducer phase, Driver code)
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01257421539761356848_shared?collectionId=lex_auth_01256841991858585686_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01257421539761356848_shared?collectionId=lex_auth_01256841991858585686_shared&amp;collectionType=Course</a>

<b>EXPERIMENT-5:</b>
Implementing Matrix-Multiplication with Hadoop Map-reduce

<b>EXPERIMENT-6:</b>
Compute Average Salary and Total Salary by Gender for an Enterprise.

<b>EXPERIMENT-7:</b>
(i) Creating hive tables(External and internal)
(ii) Loading data to external hive tables from sql tables(or)Structured c.s.v using scoop
(iii) Performing operations like filterations and updations
(iv) Performing Join(inner, outer etc)
(v) Writing User defined function on hive tables
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/webmodule/lex_auth_01257841711418572848_s_hared?collectionId=lex_auth_01258388119638835242_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/webmodule/lex_auth_01257841711418572848_s_hared?collectionId=lex_auth_01258388119638835242_shared&amp;collectionType=Course</a>

<b>EXPERIMENT-8:</b>
Create a sql table of employees
Employee table with id,designation
Salary table (salary ,dept id)
Create external table in hive with similar schema of above tables,Move data to hive using scoop and load the contents into tables,filter a new table and write a UDF to encrypt the table with AES-algorithm, Decrypt it with key to show contents





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**EXPERIMENT-9:**

- (i) Pyspark Definition(Apache Pyspark) and difference between Pyspark, Scala, pandas
- (ii) Pyspark files and class methods
- (i) get(file name)
- (ii) get root directory()

**EXPERIMENT-10 :**

Pyspark -RDD'S

- (i) what is RDD's?
- (ii) ways to Create RDD
- (i) parallelized collections
- (ii) external dataset
- (iii) existing RDD's
- (iv) Spark RDD's operations
- (Count, foreach(), Collect, join,Cache())

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**EXPERIMENT-11 :**

Perform pyspark transformations

- (i) map and flatMap
- (ii) to remove the words, which are not necessary to analyze this text.
- (iii) groupBy
- (iv) What if we want to calculate how many times each word is coming in corpus ?
- (v) .How do I perform a task (say count the words 'spark' and 'apache' in rdd3) separatly on each partition and get the output of the task performed in these partition ?
- (vi) unions of RDD
- (vii) join two pairs of RDD Based upon their key

[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01330150584451891225182\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01330150584451891225182_shared/overview)

**EXPERIMENT-12:**

Pyspark sparkconf-Attributes and applications

- (i) What is Pyspark spark conf ()
- (ii) Using spark conf create a spark session to write a dataframe to read details in a c.s.v and later move that c.s.v to another location



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**Hardware and software configuration:**

**Hardware Configuration for each Node (Suggested)**

**Operating System:**

NAME="Red Hat Enterprise Linux Server", VERSION="7.9 (Maipo)"

**CPU Architecture:** x86\_64

**CPU op-mode(s):** 32-bit, 64-bit

**CPU(s):** 32

**RAM:** 64G

**Software Required**

Java: openjdk version "1.8.0\_202" ( installed in all nodes)

For Hive metastore – we have installed MySQL

MySQL: Ver 8.0.19 for Linux on x86\_64 (MySQL Community Server - GPL)

**Resource Links for installation**

- Hadoop Installation steps: [Apache Hadoop 3.3.2 – Hadoop: Setting up a Single Node Cluster.](#) & [Apache Hadoop 3.3.2 – Hadoop Cluster Setup](#)
- Links to download different versions of Hadoop : [Index of /hadoop/ common \(apache.org\)](#) & [Index of /dist/hadoop/core \(apache.org\)](#)

**Text Books:**

1. Spark in Action, Marko Bonaci and Petar Zecevic, Manning.
2. PySpark SQL Recipes: With HiveQL, Dataframe and Graphframes, Raju Kumar Mishra and Sundar Rajan Raman, Apress Media.

<b>Web Links:</b>	
1.	<a href="https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0133015058445189122518_2_shared/overview">https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0133015058445189122518_2_shared/overview</a>
2.	<a href="https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01258388119638835242_s_hared/overview">https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01258388119638835242_s_hared/overview</a>
3.	<a href="https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126052684230082561692_shared/overview">https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126052684230082561692_shared/overview</a>



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	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>MEAN STACK TECHNOLOGIES-MODULE I</b> <b>(HTML 5, JAVASCRIPT, EXPRESS.JS, NODE.JS AND TYPESCRIPT)</b> <b>(Skill Oriented Course)</b>				

**Course Outcomes:**

At the end of the Course, Student will be able to:

- Develop professional web pages of an application using HTML elements like lists, navigations, tables, various form elements, embedded media which includes images, audio, video and CSS Styles.
- Utilize JavaScript for developing interactive HTML web pages and validate form data.
- Build a basic web server using Node.js and also working with Node Package Manager (NPM).
- Build a web server using Express.js
- Make use of Typescript to optimize JavaScript code by using the concept of strict type checking.

**List of Exercises**

<b>1.a</b>	<b>Course Name:</b> HTML5 - The Language
	<b>Module Name:</b> Case-insensitivity, Platform-independency, DOCTYPE Declaration, Types of Elements, HTML Elements - Attributes, Metadata Element
	Include the Metadata element in Homepage.html for providing description as "IEKart's is an online shopping website that sells goods in retail. This company deals with various categories like Electronics, Clothing, Accessories etc.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28320667711144660000_shared?collectionId=lex_177397328348408100_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28320667711144660000_shared?collectionId=lex_177397328348408100_00_shared&amp;collectionType=Course</a>
<b>1.b</b>	<b>Course Name:</b> HTML5 - The Language
	<b>Module Name:</b> Sectioning Elements
	Enhance the Homepage.html of IEKart's Shopping Application by adding appropriate sectioning elements.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6372291347110857000_shared?collectionId=lex_1773973283484081000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6372291347110857000_shared?collectionId=lex_1773973283484081000_0_shared&amp;collectionType=Course</a>
<b>1.c</b>	<b>Course Name:</b> HTML5 - The Language
	<b>Module Name:</b> Paragraph Element, Division and Span Elements, List Element
	Make use of appropriate grouping elements such as list items to "About Us" page of IEKart's Shopping Application
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32785192040894940000_shared?collectionId=lex_177397328348408100_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32785192040894940000_shared?collectionId=lex_177397328348408100_00_shared&amp;collectionType=Course</a>
<b>1.d</b>	<b>Course Name:</b> HTML5 - The Language
	<b>Module Name:</b> Link Element
	Link "Login", "SignUp" and "Track order" to "Login.html", "SignUp.html" and "Track.html" page respectively. Bookmark each category to its details of IEKart's Shopping application.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15515105953273338000_shared?collectionId=lex_177397328348408100_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15515105953273338000_shared?collectionId=lex_177397328348408100_00_shared&amp;collectionType=Course</a>
<b>1.e</b>	<b>Course Name:</b> HTML5 - The Language
	<b>Module Name:</b> Character Entities
	Add the © symbol in the Home page footer of IEKart's Shopping application.



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	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_547667376938096260_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_547667376938096260_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course</a>
<b>1.f</b>	<b>Course Name:</b> HTML5 - The Language
	<b>Module Name:</b> HTML5 Global Attributes
	Add the global attributes such as contenteditable, spellcheck, id etc. to enhance the Signup Page functionality of IEKart's Shopping application.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28723566050321920000_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28723566050321920000_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course</a>
<b>2.a</b>	<b>Course Name:</b> HTML5 - The Language
	<b>Module Name:</b> Creating Table Elements, Table Elements : Colspan/Rowspan Attributes, border, cellpadding, cellspacing attributes
	Enhance the details page of IEKart's Shopping application by adding a table element to display the available mobile/any inventories.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013168035284033536113_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013168035284033536113_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course</a>
<b>2.b</b>	<b>Course Name:</b> HTML5 - The Language
	<b>Module Name:</b> Creating Form Elements, Color and Date Pickers, Select and Datalist Elements
	Using the form elements create Signup page for IEKart's Shopping application.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13975270903118459000_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13975270903118459000_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course</a>
<b>2.c</b>	<b>Course Name:</b> HTML5 - The Language
	<b>Module Name:</b> Input Elements - Attributes
	Enhance Signup page functionality of IEKart's Shopping application by adding attributes to input elements.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_14048414537062347000_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_14048414537062347000_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course</a>
<b>2.d</b>	<b>Course Name:</b> HTML5 - The Language
	<b>Module Name:</b> Media, Iframe
	Add media content in a frame using audio, video, iframe elements to the Home page of IEKart's Shopping application.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_30738402225794945000_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_30738402225794945000_shared?collectionId=lex_17739732834840810000_shared&amp;collectionType=Course</a>
<b>3.a</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Type of Identifiers
	Write a JavaScript program to find the area of a circle using radius (var and let - reassign and observe the difference with var and let) and PI (const)
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013053264414818304732_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013053264414818304732_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>3.b</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Primitive and Non Primitive Data Types
	Write JavaScript code to display the movie details such as movie name, starring, language, and ratings. Initialize the variables with values of appropriate types. Use template literals wherever necessary.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-">https://infyspringboard.onwingspan.com/web/en/viewer/web-</a>



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	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_21528322245232402000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">module/lex_21528322245232402000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>3.c</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Operators and Types of Operators
	Write JavaScript code to book movie tickets online and calculate the total price, considering the number of tickets and price per ticket as Rs. 150. Also, apply a festive season discount of 10% and calculate the discounted amount.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13808338384481720000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13808338384481720000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>3.d</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Types of Statements, Non - Conditional Statements, Types of Conditional Statements, if Statements, switch Statements
	Write a JavaScript code to book movie tickets online and calculate the total price based on the 3 conditions: (a) If seats to be booked are not more than 2, the cost per ticket remains Rs. 150. (b) If seats are 6 or more, booking is not allowed. (c) If se
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_16257498471333610000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_16257498471333610000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>3.e</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Types of Loops
	Write a JavaScript code to book movie tickets online and calculate the total price based on the 3 conditions: (a) If seats to be booked are not more than 2, the cost per ticket remains Rs. 150. (b) If seats are 6 or more, booking is not allowed. (c) If
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6238536888292970000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6238536888292970000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>4.a</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Types of Functions, Declaring and Invoking Function, Arrow Function, Function Parameters, Nested Function, Built-in Functions, Variable Scope in Functions
	Write a JavaScript code to book movie tickets online and calculate the total price based on the 3 conditions: (a) If seats to be booked are not more than 2, the cost per ticket remains Rs. 150. (b) If seats are 6 or more, booking is not allowed. (c) If
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15455199570613326000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15455199570613326000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>4.b</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Working With Classes, Creating and Inheriting Classes
	Create an Employee class extending from a base class Person. Hints: (i) Create a class Person with name and age as attributes. (ii) Add a constructor to initialize the values (iii) Create a class Employee extending Person with additional attributes role
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012599811117760512458_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012599811117760512458_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>4.c</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> In-built Events and Handlers
	Write a JavaScript code to book movie tickets online and calculate the total price based on the 3 conditions: (a) If seats to be booked are not more than 2, the cost per ticket remains Rs. 150. (b) If seats are 6 or more, booking is not allowed. (c) If se
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_4192188372573027000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_4192188372573027000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>





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	<a href="#">0_shared&amp;collectionType=Course</a>
<b>4.d</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Working with Objects, Types of Objects, Creating Objects, Combining and cloning Objects using Spread operator, Destructuring Objects, Browser Object Model, Document Object Model
	If a user clicks on the given link, they should see an empty cone, a different heading, and a different message and a different background color. If user clicks again, they should see a re-filled cone, a different heading, a different message, and a diffe
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13197025862804100000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13197025862804100000_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>5.a</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Creating Arrays, Destructuring Arrays, Accessing Arrays, Array Methods
	Create an array of objects having movie details. The object should include the movie name, starring, language, and ratings. Render the details of movies on the page using the array.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013053270191734784711_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013053270191734784711_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>5.b</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Introduction to Asynchronous Programming, Callbacks, Promises, Async and Await, Executing Network Requests using Fetch API
	Simulate a periodic stock price change and display on the console. Hints: (i) Create a method which returns a random number - use Math.random, floor and other methods to return a rounded value. (ii) Invoke the method for every three seconds and stop when
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012599811633905664460_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012599811633905664460_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>5.c</b>	<b>Course Name:</b> Javascript
	<b>Module Name:</b> Creating Modules, Consuming Modules
	Validate the user by creating a login module. Hints: (i) Create a file login.js with a User class. (ii) Create a validate method with username and password as arguments. (iii) If the username and password are equal it will return "Login Successful" else w
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013052857053585408667_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013052857053585408667_shared?collectionId=lex_18109698366332810000_shared&amp;collectionType=Course</a>
<b>6.a</b>	<b>Course Name:</b> Node.js
	<b>Module Name:</b> How to use Node.js
	Verify how to execute different functions successfully in the Node.js platform.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_19002830632103186000_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_19002830632103186000_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course</a>
<b>6.b</b>	<b>Course Name:</b> Node.js
	<b>Module Name:</b> Create a web server in Node.js
	Write a program to show the workflow of JavaScript code executable by creating web server in Node.js.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28177338996267815000_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28177338996267815000_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course</a>



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<b>6.c</b>	<b>Course Name:</b> Node.js
	<b>Module Name:</b> Modular programming in Node.js
	Write a Node.js module to show the workflow of Modularization of Node application.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28865394191004004000_shared?collectionId=lex_324078356719467600_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28865394191004004000_shared?collectionId=lex_324078356719467600_00_shared&amp;collectionType=Course</a>
<b>6.d</b>	<b>Course Name:</b> Node.js
	<b>Module Name:</b> Restarting Node Application
	Write a program to show the workflow of restarting a Node application.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9174073856000159000_shared?collectionId=lex_3240783567194676000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9174073856000159000_shared?collectionId=lex_3240783567194676000_0_shared&amp;collectionType=Course</a>
<b>6.e</b>	<b>Course Name:</b> Node.js
	<b>Module Name:</b> File Operations
	Create a text file src.txt and add the following data to it. Mongo, Express, Angular, Node.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33376440180246100000_shared?collectionId=lex_324078356719467600_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33376440180246100000_shared?collectionId=lex_324078356719467600_00_shared&amp;collectionType=Course</a>
<b>7.a</b>	<b>Course Name:</b> Express.js
	<b>Module Name:</b> Defining a route, Handling Routes, Route Parameters, Query Parameters
	Implement routing for the AdventureTrails application by embedding the necessary code in the routes/route.js file.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_29394215542149950000_shared?collectionId=lex_324078356719467600_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_29394215542149950000_shared?collectionId=lex_324078356719467600_00_shared&amp;collectionType=Course</a>
<b>7.b</b>	<b>Course Name:</b> Express.js
	<b>Module Name:</b> How Middleware works, Chaining of Middlewares, Types of Middlewares
	In myNotes application: (i) we want to handle POST submissions. (ii) display customized error messages. (iii) perform logging.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13930661312009580000_shared?collectionId=lex_324078356719467600_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_13930661312009580000_shared?collectionId=lex_324078356719467600_00_shared&amp;collectionType=Course</a>
<b>7.c</b>	<b>Course Name:</b> Express.js
	<b>Module Name:</b> Connecting to MongoDB with Mongoose, Validation Types and Defaults
	Write a Mongoose schema to connect with MongoDB.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035588775485440691_shared?collectionId=lex_324078356719467600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035588775485440691_shared?collectionId=lex_324078356719467600000_shared&amp;collectionType=Course</a>
<b>7.d</b>	<b>Course Name:</b> Express.js
	<b>Module Name:</b> Models
	Write a program to wrap the Schema into a Model object.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035593896869888662_shared?collectionId=lex_324078356719467600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035593896869888662_shared?collectionId=lex_324078356719467600000_shared&amp;collectionType=Course</a>
<b>8.a</b>	<b>Course Name:</b> Express.js
	<b>Module Name:</b> CRUD Operations
	Write a program to perform various CRUD (Create-Read-Update-Delete) operations using Mongoose library functions.





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	<p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035684270129152696_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035684270129152696_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course</a></p>
<b>8.b</b>	<b>Course Name:</b> Express.js
	<b>Module Name:</b> API Development
	In the myNotes application, include APIs based on the requirements provided. (i) API should fetch the details of the notes based on a notesID which is provided in the URL. Test URL - http://localhost:3000/notes/7555 (ii) API should update the details bas
	<p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035745250975744755_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013035745250975744755_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course</a></p>
<b>8.c</b>	<b>Course Name:</b> Express.js
	<b>Module Name:</b> Why Session management, Cookies
	Write a program to explain session management using cookies.
	<p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24299316914857090000_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24299316914857090000_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course</a></p>
<b>8.d</b>	<b>Course Name:</b> Express.js
	<b>Module Name:</b> Sessions
	Write a program to explain session management using sessions.
	<p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_905413034723449100_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_905413034723449100_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course</a></p>
<b>8.e</b>	<b>Course Name:</b> Express.js
	<b>Module Name:</b> Why and What Security, Helmet Middleware
	Implement security features in myNotes application
	<p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_31677453061177940000_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_31677453061177940000_shared?collectionId=lex_32407835671946760000_shared&amp;collectionType=Course</a></p>
<b>9.a</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Basics of TypeScript
	On the page, display the price of the mobile-based in three different colors. Instead of using the number in our code, represent them by string values like GoldPlatinum, PinkGold, SilverTitanium.
	<p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28910354929502245000_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28910354929502245000_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a></p>
<b>9.b</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Function
	Define an arrow function inside the event handler to filter the product array with the selected product object using the productId received by the function. Pass the selected product object to the next screen.
	<p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10783156469383723000_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10783156469383723000_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a></p>
<b>9.c</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Parameter Types and Return Types
	Consider that developer needs to declare a function - getMobileByVendor which accepts string as input parameter and returns the list of mobiles.
	<p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712912427057152901_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712912427057152901_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a></p>



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<b>9.d</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Arrow Function
	Consider that developer needs to declare a manufacturer's array holding 4 objects with id and price as a parameter and needs to implement an arrow function - myfunction to populate the id parameter of manufacturers array whose price is greater than or equ
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712910875500544904_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712910875500544904_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>9.e</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Optional and Default Parameters
	Declare a function - getMobileByManufacturer with two parameters namely manufacturer and id, where manufacturer value should passed as Samsung and id parameter should be optional while invoking the function, if id is passed as 101 then this function shoul
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712914940641280906_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712914940641280906_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>10.a</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Rest Parameter
	Implement business logic for adding multiple Product values into a cart variable which is type of string array.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712921860915200909_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712921860915200909_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>10.b</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Creating an Interface
	Declare an interface named - Product with two properties like productId and productName with a number and string datatype and need to implement logic to populate the Product details.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712925244276736910_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712925244276736910_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>10.c</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Duck Typing
	Declare an interface named - Product with two properties like productId and productName with the number and string datatype and need to implement logic to populate the Product details.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712925995458560912_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712925995458560912_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>10.d</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Function Types
	Declare an interface with function type and access its value.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712948945346560918_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712948945346560918_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>11.a</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Extending Interfaces
	Declare a productList interface which extends properties from two other declared interfaces like Category,Product as well as implementation to create a variable of this interface type.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/hands-">https://infyspringboard.onwingspan.com/web/en/viewer/hands-</a>



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	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3705824317381604400_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">on/lex_auth_012712951652139008920_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>11.b</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Classes
	Consider the Mobile Cart application, Create objects of the Product class and place them into the productList array.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3705824317381604400_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3705824317381604400_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>11.c</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Constructor
	Declare a class named - Product with the below-mentioned declarations: (i) productId as number property (ii) Constructor to initialize this value (iii) getProductId method to return the message "Product id is <<id value>>".
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712954616782848927_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712954616782848927_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>11.d</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Access Modifiers
	Create a Product class with 4 properties namely productId, productName, productPrice, productCategory with private, public, static, and protected access modifiers and accessing them through Gadget class and its methods.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712953517170688931_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/hands-on/lex_auth_012712953517170688931_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>12.a</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Properties and Methods
	Create a Product class with 4 properties namely productId and methods to setProductId() and getProductId().
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9356738095572543000_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9356738095572543000_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>12.b</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Creating and using Namespaces
	Create a namespace called ProductUtility and place the Product class definition in it. Import the Product class inside productList file and use it.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_20787271128051925000_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_20787271128051925000_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>12.c</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> Creating and using Modules
	Consider the Mobile Cart application which is designed as part of the functions in a module to calculate the total price of the product using the quantity and price values and assign it to a totalPrice variable.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24788158187785620000_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24788158187785620000_shared?collectionId=lex_9436233116512678000_shared&amp;collectionType=Course</a>
<b>12.d</b>	<b>Course Name:</b> Typescript
	<b>Module Name:</b> What is Generics, What are Type Parameters, Generic Functions, Generic Constraints
	Create a generic array and function to sort numbers as well as string values.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-">https://infyspringboard.onwingspan.com/web/en/viewer/web-</a>



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[module/lex\\_446287045482942800\\_shared?collectionId=lex\\_9436233116512678000\\_shared&collectionType=Course](https://infyspringboard.onwingspan.com/en/app/toc/lex_446287045482942800_shared?collectionId=lex_9436233116512678000_shared&collectionType=Course)

**Software configuration and installation**

1. HTML & Javascript

- Simple editors such as Notepad or go for IDEs like Visual Studio Code(recommended), Eclipse etc. which makes coding easier.
- And, to execute application, you can use any commonly used browser such as Google Chrome(recommended), Mozilla Firefox etc
- Setup details: [Environmental Setup for HTML5 - Viewer Page | Infosys Springboard \(onwingspan.com\)](#)
- [Environment Setup: Internal - Viewer Page | Infosys Springboard \(onwingspan.com\)](#)

2. Node JS

Download **Node.js** from the official site

Setup details : [How to use Node.js - Viewer Page | Infosys Springboard \(onwingspan.com\)](#)

3. Typescript

[Installing TypeScript - Internal - Viewer Page | Infosys Springboard \(onwingspan.com\)](#)

**Text Books:**

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson.
2. Pro Mean Stack Development, 1st Edition, Eyal Elrom, Apress O'Reilly.
3. Full Stack JavaScript Development with MEAN, Colin J Ihrig, Adam Bretz, 1st edition, SitePoint, SitePoint Pty. Ltd., O'Reilly Media.

**Reference Books:**

1. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech.
2. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda S Katila, Cengage Learning.

**Web Links:**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_17739732834840810000\\_shared/overview\(HTML5\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_17739732834840810000_shared/overview(HTML5))
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_18109698366332810000\\_shared/overview\(Javascript\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_18109698366332810000_shared/overview(Javascript))
3. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_32407835671946760000\\_shared/overview\(Node.js & Express.js\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_32407835671946760000_shared/overview(Node.js & Express.js))
4. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_9436233116512678000\\_shared/overview\(Typescript\)](https://infyspringboard.onwingspan.com/en/app/toc/lex_9436233116512678000_shared/overview(Typescript))



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<b>III Year – II Semester</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>EMPLOYABILITY SKILLS-II</b>				

**Course Objectives:**

The main objective of this course is to assist students in developing employability skills and personal qualities related to gaining and sustaining employment.

**Course Outcomes:** After completion of this course

- Solve various Basic Mathematics problems by following different methods
- Follow strategies in minimizing time consumption in problem solving Apply shortcut methods to solve problems
- Confidently solve any mathematical problems and utilize these mathematical skills both in their professional as well as personal life.
- Analyze, summarize and present information in quantitative forms including table, graphs and formulas

**UNIT I:**

**Numerical ability I:** Number system, HCF & LCM, Average, Simplification, Problems on numbers

**Numerical ability II:** Ratio & Proportion, Partnership, Percentages, Profit & Loss

**UNIT II:**

**Arithmetical ability I:** Problems on ages, Time & Work, Pipes & Cistern, Chain Rule.

**Arithmetical ability II:** Time & Distance, Problems on boats & Steams, Problems on Trains

**UNIT III:**

**Arithmetical ability III:** Allegation, Simple interest and compound interest, Races & Games of skills, Calendar and Clock,

**Logical ability:** Permutations and Combination and Probability.

**UNIT IV:**

**Mensuration:** Geometry, Areas, Volumes

**UNIT V:**

**Data interpretation:** Tabulation, Bar graphs, Pie charts, line graphs

**Text Books And Reference Books:**

1. R. S. Aggarwal “Quantitative Aptitude”, Revised ed., S Chand publication, 2017  
ISBN:8121924987

**E- resources:**

1. [https://blog.feedspot.com/aptitude\\_youtube\\_channels/](https://blog.feedspot.com/aptitude_youtube_channels/)
2. [https://www.tutorialspoint.com/quantitative\\_apititude/](https://www.tutorialspoint.com/quantitative_apititude/)
3. <https://www.careerbless.com/aptitude/qa/home.php>





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<b>III Year – II Semester</b>	<b>Minor Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<b>DATA STRUCTURES AND ALGORITHMS</b>					

**Course Objectives:**

The objective of the course is to

- Introduce the fundamental concept of data structures and abstract data types
- Emphasize the importance of data structures in developing and implementing efficient algorithms
- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms
- Demonstrate the different data structures implementation

**Course Outcomes:**

After completing this course a student will be able to:

- Use basic data structures such as arrays and linked list.
- Programs to demonstrate fundamental algorithmic problems including Tree Traversals, Graph traversals, and shortest paths.
- Use various searching and sorting algorithms.

**UNIT I:**

Data Structures - Definition, Classification of Data Structures, Operations on Data Structures, Abstract Data Type (ADT), Preliminaries of algorithms. Time and Space complexity.

Searching - Linear search, Binary search, Fibonacci search.

Sorting- Insertion sort, Selection sort, Exchange (Bubble sort, quick sort), distribution (radix sort), merging (Merge sort) algorithms.

**UNIT II:**

Linked List: Introduction, Single linked list, Representation of Linked list in memory, Operations on Single Linked list-Insertion, Deletion, Search and Traversal ,Reversing Single Linked list, Applications on Single Linked list- Polynomial Expression Representation

,Addition and Multiplication, Sparse Matrix Representation using Linked List, Advantages and Disadvantages of Single Linked list, Double Linked list-Insertion, Deletion, Circular Linked list-Insertion, Deletion.

**UNIT III:**

Queues: Introduction to Queues, Representation of Queues-using Arrays and using Linked list, Implementation of Queues-using Arrays and using Linked list, Application of Queues- Circular Queues, Deques, Priority Queues, Multiple Queues.

Stacks: Introduction to Stacks, Array Representation of Stacks, Operations on Stacks, Linked list Representation of Stacks, Operations on Linked Stack, Applications-Reversing list, Factorial Calculation, Infix to Postfix Conversion, Evaluating Postfix Expressions.

**UNIT IV:**

Trees: Basic Terminology in Trees, Binary Trees-Properties, Representation of Binary Trees using Arrays and Linked lists. Binary Search Trees- Basic Concepts, BST Operations: Insertion, Deletion, Tree Traversals,



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**UNIT V:**

Graphs: Basic Concepts, Representations of Graphs-Adjacency Matrix and using Linked list, Graph Traversals (BFT & DFT), Applications- Minimum Spanning Tree Using Prims & Kruskals Algorithm, Dijkstra's shortest path

**Exercise -1 (Searching):**

- Write C program that use both recursive and non recursive functions to perform Linear search for a Key value in a given list.
- Write C program that use both recursive and non recursive functions to perform Binary search for a Key value in a given list.

**Exercise -2 (Sorting-I):**

- Write C program that implement Bubble sort, to sort a given list of integers in ascending order
- Write C program that implement Quick sort, to sort a given list of integers in ascending order
- Write C program that implement Insertion sort, to sort a given list of integers in ascending order

**Exercise -3(Sorting-II):**

- Write C program that implement radix sort, to sort a given list of integers in ascending order
- Write C program that implement merge sort, to sort a given list of integers in ascending order

**Exercise -4(Singly Linked List):**

- Write a C program that uses functions to create a singly linked list
- Write a C program that uses functions to perform insertion, deletion operations on a singly linked list
- Write a C program to reverse elements of a single linked list.

**Exercise -5(Queue)**

- Write C program that implement Queue (its operations) using arrays.
- Write C program that implement Queue (its operations) using linked lists

**Exercise -6(Stack)**

- Write C program that implement stack (its operations) using arrays
- Write C program that implement stack (its operations) using Linked list
- Write a C program that uses Stack operations to evaluate postfix expression

**Exercise -7(Binary Tree)**

Write a recursive C program for traversing a binary tree in preorder, inorder and postorder.

**Exercise -8(Binary Search Tree)**

- Write a C program to Create a BST
- Write a C program to insert a node into and delete a node from a BST.

**Text Books:**

- Data Structures Using C. 2<sup>nd</sup> Edition. Reema Thareja, Oxford.
- Data Structures and algorithm analysis in C, 2<sup>nd</sup>ed, Mark Allen Weiss.

**Reference Books:**

- Fundamentals of Data Structures in C, 2<sup>nd</sup> Edition, Horowitz, Sahni, Universities Press.
- Data Structures: A PseudoCode Approach, 2/e, Richard F. Gilberg, Behrouz A. Forouzon, Cengage.
- Data Structures with C, Seymour Lipschutz TMH





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**e-Resources:**

- 1) <http://algs4.cs.princeton.edu/home/>
- 2) [https://faculty.washington.edu/jstraub/dsa/Master\\_2\\_7a.pdf](https://faculty.washington.edu/jstraub/dsa/Master_2_7a.pdf)



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>CLOUD COMPUTING (Professional Elective-III)</b>				

**Course Objectives:**

- To explain the evolving computer model caned cloud computing.
- To introduce the various levels of services that can be achieved by cloud.
- To describe the security aspects in cloud.
- To motivate students to do programming and experiment with the various cloud computing environments.

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

- Illustrate the key dimensions of the challenge of Cloud Computing
- Classify the Levels of Virtualization and mechanism of tools.
- Analyze Cloud infrastructure including Google Cloud and Amazon Cloud.
- Create Combinatorial Auctions for cloud resource and design scheduling algorithms for computing cloud
- Assess control storage systems and cloud security, the risks involved its impact and develop cloud application

**UNIT I: Systems Modeling, Clustering and Virtualization:** Scalable Computing over the Internet-The Age of Internet Computing, Scalable computing over the internet, Technologies for Network Based Systems, System models for Distributed and Cloud Computing, , Performance, Security and Energy Efficiency

**UNIT II: Virtual Machines and Virtualization of Clusters and Data Centers:** Implementation Levels of Virtualization, Virtualization Structures/ Tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

**UNIT III: Cloud Platform Architecture:** Cloud Computing and Service Models, Public Cloud Platforms, Service Oriented Architecture, Programming on Amazon AWS and Microsoft Azure

**UNIT IV: Cloud Resource Management and Scheduling:** Policies and Mechanisms for Resource Management, Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds-Fair Queuing, Start Time Fair Queuing.

**UNIT V: Storage Systems:** Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system.

**Text Books:**

1. Distributed and Cloud Computing, Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra MK Elsevier.
2. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.

**Reference Books:**

1. Cloud Computing, A Hands on approach, ArshadeepBahga, Vijay Madiseti, University Press
2. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
3. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>NEURAL NETWORKS AND SOFT COMPUTING</b> <b>(Professional Elective-III)</b>				

**Course Objectives:** The main objective of the course is

- To introduce the foundations of Artificial Neural Networks.
- To acquire the knowledge on Soft Computing Concepts.
- To learn various types of Genetic algorithms and its applications.
- To gain knowledge to apply optimization strategies.

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

- Understand the concepts of Artificial intelligence and soft computing techniques
- Analyze the concepts of Neural Networks and select the Learning Networks in modeling real world systems.
- Implement the concepts of Fuzzy reasoning and concepts of Genetic algorithm and its applications to soft computing.
- Classify Biologically inspired algorithm such as neural networks, genetic algorithms, ant colony optimization, and bee colony optimization.
- Design hybrid system incorporating neural network, genetic algorithms, fuzzy systems.

**UNIT I: Soft Computing and Artificial Intelligence:** Introduction of Soft Computing, Soft Computing vs. Hard Computing, Various Types of Soft Computing Techniques, Applications of Soft Computing, AI Search Algorithm, Predicate Calculus, Rules of Inference, Semantic Networks, Frames, Objects, Hybrid Models.

**UNIT II: Artificial Neural Networks and Paradigms:** Introduction to Neuron Model, Neural Network Architecture, Learning Rules, Perceptrons, Single Layer Perceptrons, Multilayer Perceptrons, Back propagation Networks, Kohonen's self organizing networks, Hopfield network, Applications of NN.

**UNIT III: Fuzzy Logic:** Introduction, Fuzzy sets and Fuzzy reasoning, Basic functions on fuzzy sets, relations, rule based models and linguistic variables, fuzzy controls, Fuzzy decision making, applications of fuzzy logic.

**UNIT IV: Genetic Algorithms and Swarm Optimizations:** Introduction, Genetic Algorithm, Fitness Computations, Cross Over, Mutation, Evolutionary Programming, Classifier Systems, Genetic Programming Parse Trees, Variants of GA, Applications, Ant Colony Optimization, Particle Swarm Optimization, Artificial Bee Colony Optimization.

**UNIT V: Hybrid Systems:** Neuro fuzzy hybrid systems, Adaptive neuro fuzzy inference systems, Fuzzy backpropagation network, Genetic neuro hybrid system, Genetic algorithm based backpropagation network, Genetic-fuzzy hybrid systems.

**Text Books:**

1. Simon S. Haykin, Neural Networks, Prentice Hall, 2nd edition.
2. S. Rajasekaran & G. A. Vijayalakshmi Pai “Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications”, PHI,2003.



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**Reference Books:**

1. S. N. Sivanandam & S. N. Deepa "Principles of Soft Computing" Wiley – India, 2nd Edition, 2007.
2. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall, 1998.
3. Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, 1994
4. Zimmermann, "Fuzzy Set Theory and its Application", 3rd Edition.
5. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y, 1989.
6. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill, 3rd edition 2009.



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<b>IV Year – I Semester</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>AD-HOC AND SENSOR NETWORKS</b> <b>(Professional Elective-III)</b>					

**Course Objectives:**

From the course the student will learn

- Architect sensor networks for various application setups.
- Devise appropriate data dissemination protocols and model links cost.
- Understanding of the fundamental concepts of wireless sensor networks and has a basic knowledge of the various protocols at various layers.
- Evaluate the performance of sensor networks and identify bottlenecks.

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

- Evaluate the principles and characteristics of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks.
- Determine the principles and characteristics of wireless sensor networks.
- Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc sensor networks.
- Illustrate the various sensor network Platforms, tools and applications.
- Demonstrate the issues and challenges in security provisioning and also familiar with the mechanisms for implementing security and trust mechanisms in MANETs and WSNs.

**UNIT I: Introduction to Ad Hoc Wireless Networks-** Cellular and Ad Hoc Wireless Networks, Characteristics of MANETs, Applications of MANETs, Issues and Challenges of MANETs, Ad Hoc Wireless Internet, MAC protocols for Ad hoc Wireless Networks-Issues, Design Goals and Classifications of the MAC Protocols.

**UNIT II: Routing Protocols for Ad Hoc Wireless Networks-** Issues in Designing a Routing Protocol, Classifications of Routing Protocols, Topology-based versus Position-based Approaches, Issues and design goals of a Transport layer protocol, Classification of Transport layer solutions, TCP over Ad hoc Wireless Networks, Solutions for TCP over Ad Hoc Wireless Networks, Other Transport layer protocols.

**UNIT III: Security protocols for Ad hoc Wireless Networks-** Security in Ad hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad hoc Wireless Networks, Cooperation in MANETs, Intrusion Detection Systems.

**UNIT IV: Basics of Wireless Sensors and Applications-** The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications, Data Retrieval in Sensor Networks-Classification of WSNs, MAC layer, Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.

**UNIT V: Security in WSNs-** Security in WSNs, Key Management in WSNs, Secure Data Aggregation in WSNs, Sensor Network Hardware-Components of Sensor Mote, Sensor Network Operating Systems– TinyOS, LA-TinyOS, SOS, RETOS, Imperative Language-nesC, **Dataflow Style Language-TinyGALS**, Node-Level Simulators, NS-2 and its sensor network extension, TOSSIM.



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**Text Books:**

1. Ad Hoc Wireless Networks – Architectures and Protocols, 1<sup>st</sup> edition, C. Siva Ram Murthy, B. S. Murthy, Pearson Education, 2004
2. Ad Hoc and Sensor Networks – Theory and Applications, 2<sup>nd</sup> edition *Carlos Corderio Dharma P. Aggarwal*, World Scientific Publications / Cambridge University Press, March 2006

**Reference Books:**

1. Wireless Sensor Networks: An Information Processing Approach, 1<sup>st</sup> edition, *Feng Zhao, Leonidas Guibas*, Elsevier Science imprint, Morgan Kauffman Publishers, 2005, rp2009
2. Wireless Ad hoc Mobile Wireless Networks – Principles, Protocols and Applications, 1<sup>st</sup> edition, Subir Kumar Sarkar, et al., Auerbach Publications, Taylor & Francis Group, 2008
3. Ad hoc Networking, 1<sup>st</sup> edition, *Charles E. Perkins*, Pearson Education, 2001
4. Wireless Ad hoc Networking, 1<sup>st</sup> edition, *Shih-Lin Wu, Yu-Chee Tseng*, Auerbach Publications, Taylor & Francis Group, 2007
5. Wireless Sensor Networks – Principles and Practice, 1<sup>st</sup> edition, Fei Hu, Xiaojun Cao, An Auerbach book, CRC Press, Taylor & Francis Group, 2010



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>CYBER SECURITY &amp; FORENSICS</b> <b>(Professional Elective-III)</b>					

**Course Objectives:**

The aim of the course is to

- identify security risks and take preventive steps
- understand the forensics fundamentals
- understand the evidence capturing process
- understand the preservation of digital evidence

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

- Explain the Cybercrime Fundamentals
- Describe the types of attacks on networks
- Analyze various tools available for Cybercrime Investigation
- Explain the Computer Forensics and Investigation Fundamentals and tools
- Analyze the legal perspectives of Cybercrime

**UNIT I: Introduction to Cybercrime:** Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyberstalking, Cybercafe and Cybercrimes, Botnets. Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.

**UNIT II: Tools and Methods :** Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, Sniffers, Spoofing, Session Hijacking Buffer over flow, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Identity Theft (ID Theft), Foot Printing and Social Engineering, Port Scanning, Enumeration.

**UNIT III: Cyber Crime Investigation:** Introduction, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

**UNIT IV: Computer Forensics and Investigations:** Understanding Computer Forensics, Preparing for Computer Investigations. Current Computer Forensics Tools: Evaluating Computer Forensics Tools, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Graphics and Network Forensics, E-mail Investigations, Cell Phone and Mobile Device Forensics.

**UNIT V: Cyber Crime Legal Perspectives:** Introduction, Cybercrime and the Legal Landscape around the World, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyberlaw, Technology and Students: Indian Scenario.





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**Text Books:**

1. Sunit Belapure Nina Godbole “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, WILEY, 2011.
2. Nelson Phillips and Enfinger Steuart, “Computer Forensics and Investigations”, Cengage Learning, New Delhi, 2009.

**Reference Books:**

1. Michael T. Simpson, Kent Backman and James E. Corley, “Hands on Ethical Hacking and Network Defence”, Cengage, 2019.
2. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
3. Alfred Basta, Nadine Basta, Mary Brown and Ravinder Kumar “Cyber Security and Cyber Laws”, Cengage, 2018.

**E-Resources:**

1. CERT-In Guidelines- <http://www.cert-in.org.in/>
2. <https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks> [ Online Course]
3. <https://computersecurity.stanford.edu/free-online-videos> [ Free Online Videos]
4. Nikolai Zeldovich. 6.858 Computer Systems Security. Fall 2014. Massachusetts Institute of Technology: MIT OpenCourseWare, <https://ocw.mit.edu> License: Creative Commons BY-NC-SA.



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<b>DEEP LEARNING TECHNIQUES</b> <b>(Professional Elective-IV)</b>				

**Course Objectives:** The main objective of the course is to make students:

- Learn deep learning methods for working with sequential data,
- Learn deep recurrent and memory networks,
- Learn deep Turing machines,
- Apply such deep learning mechanisms to various learning problems.
- Know the open issues in deep learning, and have a grasp of the current research directions.

**Course Outcomes:** After the completion of the course, student will be able to

- Demonstrate the fundamental concepts learning techniques of Artificial Intelligence, Machine Learning and Deep Learning.
- Discuss the Neural Network training, various random models.
- Explain the Techniques of Keras, TensorFlow, Theano and CNTK
- Classify the Concepts of CNN and RNN
- Implement Interactive Applications of Deep Learning.

**UNIT I:**

**Fundamentals of Deep Learning:** Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines, **Fundamentals of Machine Learning:** Four Branches of Machine Learning, Evaluating Machine learning Models, Overfitting and Underfitting. [Text Book 2]

**UNIT II: Introducing Deep Learning:** Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks. [Text Book3]

**UNIT III: Neural Networks:** Anatomy of Neural Network, Introduction to Keras: Keras, TensorFlow, Theano and CNTK, Setting up Deep Learning Workstation, Classifying Movie Reviews: Binary Classification, Classifying newswires: Multiclass Classification. [Text Book 2]

**UNIT IV:**

**Convolutional Neural Networks:** Nerual Network and Representation Learning, Convolutional Layers, Multichannel Convolution Operation, **Recurrent Neural Networks:** Introduction to RNN, RNN Code, PyTorch Tensors: Deep Learning with PyTorch, CNN in PyTorch. [Text Book 3]

**UNIT V:**

**Interactive Applications of Deep Learning:** Machine Vision, Natural Language processing, Generative Adversial Networks, Deep Reinforcement Learning. [Text Book 1]

**Deep Learning Research:** Autoencoders, Deep Generative Models: Boltzmann Machines Restricted Boltzmann Machines, Deep Belief Networks. [Text Book 1]

**Text Books:**

1. Deep Learning- Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, 2016
2. Deep Learning with Python - Francois Chollet, Released December 2017, Publisher(s): Manning Publications, ISBN: 9781617294433
3. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence - Jon Krohn, Grant Beyleveld, Aglaé Bassens, Released September 2019, Publisher(s): Addison-Wesley Professional, ISBN: 9780135116821



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4. Deep Learning from Scratch - Seth Weidman, Released September 2019, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492041412

**Reference Books:**

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Matrix Computations, Golub, G.,H., and Van Loan,C.,F, JHU Press,2013.
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.

**Web Link:**

1. Swayam NPTEL: Deep Learning: [https://onlinecourses.nptel.ac.in/noc22\\_cs22/preview](https://onlinecourses.nptel.ac.in/noc22_cs22/preview)



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<b>SOCIAL NETWORKS &amp; SEMANTIC WEB</b> <b>(Professional Elective-IV)</b>					

**Course Objectives:**

- To learn Web Intelligence
- To learn Knowledge Representation for the Semantic Web
- To learn Ontology Engineering
- To learn Semantic Web Applications, Services and Technology
- To learn Social Network Analysis and semantic web

**Course Outcomes:** After the completion of the course, student will be able to

- Demonstrate social network analysis and measures.
- Analyze random graph models and navigate social networks data
- Apply the network topology and Visualization tools.
- Analyze the experiment with small world models and clustering models.
- Compare the application driven virtual communities from social network Structure.

**UNIT I: Web Intelligence:** Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today’s Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

**UNIT II: Knowledge Representation for the Semantic Web:** Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web –Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.

**UNIT III: Ontology Engineering:** Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

**UNIT IV: Semantic Web Applications, Services and Technology:** Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base ,XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods,

**UNIT V: Social Network Analysis and semantic web:** What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks, Building Semantic Web Applications with social network features.

**Text Books:**

1. Thinking on the Web – Berners Lee, Godel and Turing, Wiley inter science, 2008.
2. Social Networks and the Semantic Web, Peter Mika, Springer, 2007.



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**Reference Books:**

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J. Davies, R. Studer, P. Warren, John Wiley & Sons.
2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers,(Taylor & Francis Group)
3. Information sharing on the semantic Web – Heiner Stuckenschmidt; Frank Van Harmelen, Springer Publications.
4. Programming the Semantic Web, T. Segaran, C. Evans, J. Taylor, O'Reilly, SPD.



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<b>COMPUTER VISION (Professional Elective-IV)</b>				

**Course Objectives:**

To introduce students the fundamentals of image formation; To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition; To develop an appreciation for various issues in the design of computer vision and object recognition systems; and To provide the student with programming experience from implementing computer vision and object recognition applications.

**Course Outcomes:** After completing the course Student will be able to:

1. Identify basic concepts, terminology, theories, models and methods in the field of computer vision,
2. Describe known principles of feature detection and matching,
3. Describe basic methods of computer vision related to image stitching, photography like high dynamic range imaging and blur removal.
4. Suggest a design of a computer vision system for a 3D Reconstruction, Albedos, image based rendering views and depths.

**UNIT I: Introduction:** Image Formation: Geometric Primitives and Transformation, Photometric Image Formation, Digital Camera, Image Processing: Point Operators, Linear Filtering, More Neighborhood Operators, Fourier Transforms, Pyramids and Wavelets, Geometric Transformations, Global Optimization.

**UNIT II: Feature Detection and Matching:** Points and Patches, Edges, Lines, Segmentation: Active Contours, Split and Merge, Mean Shift and Mode Finding, Normalized Cuts, Feature-Based Alignment: 2D and 3D Feature-based Alignment, Pose Estimation, Geometric Intrinsic Calibration.

**UNIT III: Structure and Motion:** Triangular, Two-frame Structure from Motion, Factorization, Bundle Adjustment, Constrained Structure and Motion, Dense Motion Estimation: Translation Alignment, Parametric Motion, Spline-based Motion, Optical Flow, Layered motion

**UNIT IV: Image Stitching:** Motion Models, Global Alignment, Composing, Computational Photography: Photometric Calibration, High Dynamic Range Imaging, Super-Resolution and Blur Removal, image Matting and Compositing, Texture Analysis and Synthesis.

**UNIT V: 3D Reconstruction:** Shape From X, Active Range Finding, Surface Representation, Point-based Representation, Volumetric Representation, Model-based Reconstruction, Recovering Texture Maps and Albedos, Image- based Rendering: View Interpolation, Layered Depth Images, Light Fields and Lumigraphs, Environment Mattes, Video-based Rendering.

**Text Books:**

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited, 2011.
2. Simon J.D Prince, Computer Vision: Models, Learning and Inference, 1<sup>st</sup> Edition, 2012.

**Reference Books:**

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
2. Haralick & Shapiro, “Computer and Robot Vision”, Vol II
3. Gerard Medioni and Sing Bing Kang “Emerging topics in computer vision” 166

**NPTEL LINK:** [https://onlinecourses.nptel.ac.in/noc22\\_ee48/preview](https://onlinecourses.nptel.ac.in/noc22_ee48/preview)



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<b>BLOCK-CHAIN TECHNOLOGIES (Professional Elective-V)</b>					

**Course Objectives:**

To understand block chain technology and Cryptocurrency works

**Course Outcomes:**

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

- Demonstrate the block chain basics, Crypto currency
- To compare and contrast the use of different private vs. public block chain and use cases
- Design an innovative Bit coin Block chain and scripts, Block chain Science on varies coins
- Classify Permission Block chain and use cases – Hyper ledger, Corda
- Make Use of Block-chain in E-Governance, Land Registration, Medical Information Systems and others

**UNIT I: Introduction:** Introduction, basic ideas behind block chain, how it is changing the landscape of digitalization, introduction to cryptographic concepts required, Block chain or distributed trust, Currency, Cryptocurrency, How a Cryptocurrency works, Financial services, Bitcoin prediction markets.

**UNIT II:** Hashing, public key cryptosystems, private vs public block chain and use cases, Hash Puzzles, Extensibility of Block chain concepts, Digital Identity verification, Block chain Neutrality, Digital art, Block chain Environment

**UNIT III: Introduction to Bitcoin :** Bitcoin Block chain and scripts, Use cases of Bitcoin Blockchain scripting language in micropayment, escrow etc Downside of Bit coin mining, Block chain Science: Grid coin, Folding coin, Block chain Genomics, Bit coin MOOCs.

**UNIT IV:** Ethereum continued, IOTA, The real need for mining, consensus, Byzantine Generals Problem, and Consensus as a distributed coordination problem, Coming to private or permissioned block chains, Introduction to Hyper ledger, Currency, Token, Campus coin, Coin drop as a strategy for Public adoption, Currency Multiplicity, Demurrage currency

**UNIT V:** Technical challenges, Business model challenges, Scandals and Public perception, Government Regulations, Uses of Block chain in E-Governance, Land Registration, Medical Information Systems.

**Text Books:**

1. Blockchain Blue print for Economy by Melanie Swan

**Reference Books:**

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps 1st Edition, by Daniel Drescher





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<b>WIRELESS NETWORK SECURITY (Professional Elective-V)</b>				

**Course Objectives:**

The objective of this course is to understand the importance of Wireless networks security and its application

**Course Outcomes:** After the completion of the course, student will be able to

- Explain the Threats in networks and provide Authentication to real time problems.
- Identify and investigate in-depth both early and contemporary threats to wireless networks security
- Ability to analyze and determine for any organization the database security requirements and appropriate solutions
- Determined IP Security Issues and solve real time problems.
- Build wireless Development Strategies in real time issues

**UNIT I: Introduction to Wireless:** History of Wireless Technologies, History of Wireless Security, State of the Wireless Security Industry, 2001 **Wireless Threats:** Uncontrolled Terrain, Communications Jamming, DoS Jamming, Injections and Modifications of Data, Man-in-the-Middle (MITM) Attack, Rogue Client, Rogue Network Access Points, Attacker Equipment,

**UNIT II: Introduction to Wireless Security Protocols and Cryptography:** Recovery the FUD, OSI Model, OSI Simplified, Internet Model, Wireless LAN Security Protocols, Cryptography, SSL/TLS, Secure Shell Protocols, Terminal Access and File Transfer, Port Forwarding a Word of Caution, Man-in-the-Middle of SSL/TLS and SSH, WTLS, WEP, 802.1x, IP Security

**UNIT III:**

**Security Considerations to Wireless Devices:** Wireless Device Security Issues, Physical Security, Information Leakage, Device Security Features, Application Security, Detailed Device Analysis, Laptops, Personal Digital Assistants (PDAS), Wireless Infrastructure **Wireless Technologies and Applications:** Introduction to Cellular Networks- FDMA, TDMA, CDMA, Spread Spectrum Primer, Analogy, TDMA Vs CDMA, PDC, Security Threats

**UNIT IV:**

**Introduction to Wireless Data Networks:** Cellular Digital Packet Data (CDPD), CDPD Architecture, CDPD Security, Mobitex- Mobitex Architecture, Mobitex Security Architecture, Security Issues, Gateway, Security Model **Wireless Standards and Technologies:** Current and Future Technologies- Infrared, Radio, Spread Spectrum, OFDM, Current and Future Standards- IEEE 802 Standards, ETSI, Home RF, Ultra-wide band Radio (UWB)

**UNIT V: Wireless Deployment Strategies:** Implementing Wireless LAN's- Security Considerations Common Wireless Network Applications, Enterprise Campus Designs, Wireless IST Design, Retail and Manufacturing Design, Small Office/Home Office Design (SOHO)

**Text Books:**

1. Wireless Security, Merritt Maxim and David Pollino, Osborne/McGraw Hill, New Delhi, 2005
2. Wireless Security Models: Threats and Solutions, Nichols and Lekka, Tata McGraw Hill, New Delhi 2006



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**Reference Books:**

1. Behrouz A.Forouzan, —Cryptography & Network Security, Tata McGraw Hill, India, New Delhi, 2009
2. William Stallings, —Cryptography and Network Security, Prentice Hall, New Delhi, 2006
3. Bruce Schneier, “Applied Cryptography”, John Wiley & Sons, New York, 2004



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<b>ETHICAL HACKING</b> <b>(Professional Elective-V)</b>					

**Course Objectives:**

- The aim of the course is to introduce the methodologies and framework of ethical hacking for enhancing the security.
- The course includes-Impacts of Hacking; Types of Hackers; Information Security Models, Information Security Program, Business Perspective, Planning a Controlled Attack
- Framework of Steps (Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Deliverable and Integration)

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

- Explain the concepts related to hacking, ports and protocols, pen testing and virtualization
- Determine the applicable footprinting techniques and scanning methods
- Explain the process of system hacking and Explain the concepts Trojans, backdoors, worms and virus and it's countermeasures
- Demonstrate systematic understanding of the concepts of Sniffing and Social Engineering and it's attacks
- Determine the applicable methods of cryptography, steganography and Vulnerability Assessment

**UNIT I:**

**Introduction to Hacking:** Hacking, Types and phases of hacking, **Introduction to Ports & Protocols:** Ports, Protocols, Primary Network Types, **Virtualization & Introduction to Kali Linux:** Virtualization, Virtualization software, supported platforms, **Introduction to Penetration Testing:** Penetration test, Categories and Types of Penetration tests, Structure of Penetration Test Report.

**UNIT II:**

**Footprinting:** Footprinting, Types, Using ping and ns Lookup commands in Windows command line, **Scanning:** Scanning, Basics of Scanning, Basic Techniques of Scanning, Enumerating DNS using dnsenum, Performing flag scan using hping3.

**UNIT III:**

**Hacking into System:** System Hacking, Password Cracking, Default password databases, Manual and Automated Password Cracking, Process of System Hacking, Using Keyloggers, **Trojans & Backdoors:** Trojans, Working of Trojan, Infection Techniques, Attack, Lifecycle and Classification of Virus, Worms, Virus Construction Kit.

**UNIT IV:**

**Sniffing, Packet Analysis & Session Hijacking:** Sniffing, Packet Analysis, Types of Sniffing, Active and Passive Sniffing Techniques, Session Hijacking, **Social Engineering:** Social Engineering, Process, Identity Theft, Human and Computer Based Social Engineering Techniques, Phishing Process, Types of Phishing Attacks, Social Engineering Toolkit (SET)

**UNIT V:**

**Cryptography:** Cryptography, Digital Signature, Hash Functions, **Steganography:** Steganography Process, watermarking, Steganography Methods and Attacks, Steganography tools, **Vulnerability Assessment:** Vulnerability, The Open Web Application Security Project (OWASP), Prevention, Damn Vulnerable Web Application (DVWA), installation and testing of DVWA



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**Text Books:**

1. Hacking: Be a Hacker with Ethics, Harsh Bothra, Khanna Publications, 2019
2. Ethical Hacking and Penetration Testing Guide, Rafay Baloch, 2014

**Reference Books:**

1. Kali Linux Wireless Penetration Testing Beginner's Guide, Vivek Ramachandran, Cameron Buchanan, Packt Publishing, 2015
2. SQL Injection Attacks and Defense, 1<sup>st</sup> Edition, Justin Clarke-Salt, Syngress Publication
3. Mastering Modern Web Penetration Testing, Prakhar Prasad, Packt Publishing, October 2016



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>API AND MICROSERVICES</b> <b>(Job Oriented Course)</b>				

**Course Outcomes:**

At the end of this course, the student will be able to

- Develop a Spring Data JPA application with Spring Boot
- Implement CRUD operations using Spring Data JPA
- Implement pagination and sorting mechanism using Spring Data JPA
- Implement query methods for querying the database using Spring Data JPA
- Implement a custom repository to customize a querying mechanism using Spring Data JPA
- Understand update operation using query approaches in Spring Data JPA
- Implement Spring Transaction using Spring Data JPA
- Develop RESTful endpoints using Spring REST Processing URI parameters
- Write RESTful services using Spring REST that consumes and produces data in different formats
- Handle exceptions and errors in Spring REST endpoints
- Write Spring based REST clients to consume RESTful services programmatically
- Create secure RESTful endpoints using Spring Security Document and version the Spring REST endpoints Implement CORS in a Spring REST application

**UNIT I:**

**Spring 5 Basics :** Why Spring, What is Spring Framework, Spring Framework - Modules, Configuring IoC container using Java-based configuration, Introduction To Dependency Injection, Constructor Injection, Setter Injection, What is AutoScanning

**UNIT II:**

**Spring Boot:** Creating a Spring Boot Application, Spring Boot Application Annotation, What is Autowiring , Scope of a bean, Logger, Introduction to Spring AOP, Implementing AOP advices, Best Practices : Spring Boot Application

**UNIT III:**

**Spring Data JPA with Boot:** Limitations of JDBC API, Why Spring Data JPA, Spring Data JPA with Spring Boot, Spring Data JPA Configuration, Pagination and Sorting, Query Approaches, Named Queries and Query, Why Spring Transaction, Spring Declarative Transaction, Update Operation in Spring Data JPA, Custom Repository Implementation, Best Practices - Spring Data JPA

**UNIT IV:**

**Web Services:** Why Web services, SOA - Service Oriented Architecture, What are Web Services, Types of Web Services, SOAP based Web Services, RESTful Web Services, How to create RESTful Services

**UNIT V:**

**Spring REST:** Spring REST - An Introduction, Creating a Spring REST Controller, @RequestBody and ResponseEntity, Parameter Injection, Usage of @PathVariable, @RequestParam and @MatrixVariable, Exception Handling, Data Validation, Creating a REST Client, Versioning a Spring REST endpoint, Enabling CORS in Spring REST, Securing Spring REST endpoints

**Hardware and software configuration**

- 4 or 8 GB RAM/126 GB ROM
- Swagger tool suite(opensource)
- OpenJDK 17 or Java 11,Maven 3.2 or above and MySQL 8.0 or above, Spring Tool suite, Postman



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**Text Books:**

1. Spring in action, 5th Edition, Author: Craig Walls, Ryan Breidenbach, Manning books

**Web Links [Courses mapped to Infosys Springboard platform]:**

**Infosys Springboard courses:**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01296689056211763272\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01296689056211763272_shared/overview) [Spring 5 Basics with Spring Boot]
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_4313461831752789500\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_4313461831752789500_shared/overview) [Spring Data JPA with Boot]
3. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_012731900963905536190\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012731900963905536190_shared/overview) [Spring REST]

**Web references:**

1. <a href="#">Dependency Injection in spring - javatpoint</a>
2. <a href="#">Autowiring in Spring - javatpoint</a>
3. <a href="https://docs.spring.io/spring-boot/docs/2.0.x/reference/html/using-boot-using-springbootapplication-annotation.html">https://docs.spring.io/spring-boot/docs/2.0.x/reference/html/using-boot-using-springbootapplication-annotation.html</a>
4. <a href="#">Autowiring in Spring - javatpoint</a> , <a href="https://www.baeldung.com/spring-bean-scopes">https://www.baeldung.com/spring-bean-scopes</a>
5. <a href="#">Spring Boot Logging   How does logging works in spring boot with example (educba.com)</a>
6. <a href="#">Spring AOP Tutorial   Aspect Oriented Programming - javatpoint</a>
7. <a href="#">Spring Boot Best Practices (javaguides.net)</a>
8. <a href="#">Introduction to Spring Data JPA   SpringHow</a>
9. <a href="https://asbnotebook.com/spring-data-jpa-crud-example/">https://asbnotebook.com/spring-data-jpa-crud-example/</a> , <a href="https://www.bezkoder.com/spring-boot-jpa-crud-rest-api/">https://www.bezkoder.com/spring-boot-jpa-crud-rest-api/</a>
10. <a href="#">Pagination and Sorting using Spring Data JPA - PagingAndSortingRepository (javaguides.net)</a>
11. <a href="https://www.javaguides.net/2018/11/spring-data-jpa-query-creation-from-method-names.html">https://www.javaguides.net/2018/11/spring-data-jpa-query-creation-from-method-names.html</a> , <a href="https://www.javaguides.net/2022/02/spring-data-jpa-namedqueries-example.html">https://www.javaguides.net/2022/02/spring-data-jpa-namedqueries-example.html</a>
12. <a href="https://javadeveloperzone.com/spring/spring-declarative-transaction-management/">https://javadeveloperzone.com/spring/spring-declarative-transaction-management/</a>
13. <a href="https://javadeveloperzone.com/spring/spring-declarative-transaction-management/">https://javadeveloperzone.com/spring/spring-declarative-transaction-management/</a>
14. <a href="https://javabeat.net/spring-data-custom-repository/">https://javabeat.net/spring-data-custom-repository/</a>
15. <a href="https://www.jrebel.com/blog/jpa-application-performance-best-practices">https://www.jrebel.com/blog/jpa-application-performance-best-practices</a>
16. <a href="https://www.javatpoint.com/service-oriented-architecture">https://www.javatpoint.com/service-oriented-architecture</a> , <a href="https://www.javatpoint.com/web-services-tutorial">https://www.javatpoint.com/web-services-tutorial</a>
17. <a href="https://www.javatpoint.com/soap-web-services">https://www.javatpoint.com/soap-web-services</a> , <a href="https://www.javatpoint.com/restful-web-services">https://www.javatpoint.com/restful-web-services</a>
18. <a href="#">RESTful Web Services - javatpoint</a>
19. <a href="https://www.javatpoint.com/restful-web-services-spring-boot">https://www.javatpoint.com/restful-web-services-spring-boot</a>
20. <a href="https://www.javatpoint.com/restful-web-services-spring-boot">https://www.javatpoint.com/restful-web-services-spring-boot</a> <a href="https://dzone.com/articles/lifecycle-of-a-request-response-process-for-a-spring">https://dzone.com/articles/lifecycle-of-a-request-response-process-for-a-spring</a>
21. <a href="https://www.ibm.com/docs/en/was/8.5.5?topic=applications-defining-uri-patterns-resources-in-restful">https://www.ibm.com/docs/en/was/8.5.5?topic=applications-defining-uri-patterns-resources-in-restful</a>
22. <a href="https://www.baeldung.com/exception-handling-for-rest-with-spring">https://www.baeldung.com/exception-handling-for-rest-with-spring</a>
23. <a href="https://howtodoinjava.com/spring-boot2/resttemplate/spring-restful-client-resttemplate-example/">https://howtodoinjava.com/spring-boot2/resttemplate/spring-restful-client-resttemplate-example/</a>
24. <a href="https://www.javatpoint.com/restful-web-services-versioning">https://www.javatpoint.com/restful-web-services-versioning</a>



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25. <https://spring.io/guides/gs/rest-service-cors/>

26. <https://www.javatpoint.com/restful-web-services-basic-authentication-with-spring-security>

27. <https://www.springboottutorial.com/rest-api-best-practices-with-java-and-spring>





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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>SECURE CODING TECHNIQUES</b> <b>(Job Oriented Course)</b>					

**Course Outcomes:**

At the end of the Course, student will be able to:

- Differentiate the objectives of information security
- Understand the trend, reasons and impact of the recent Cyber attacks
- Understand OWASP design principles while designing a web application
- Understand Threat modelling
- Importance of security in all phases of SDLC
- Write secure coding using some of the practices in C/C++/Java and Python programming languages

**UNIT I:**

**Network and Information security Fundamentals:** Network Basics, Network Components, Network Types, Network Communication Types, Introduction to Networking Models, Cyber Security Objectives and Services, Other Terms of Cyber Security, Myths Around Cyber Security, Myths Around Cyber Security, Recent Cyber Attacks, Generic Conclusion about Attacks, Why and What is Cyber Security, Categories of Attack

**UNIT II:**

**Introduction to Cyber security:** Introduction to OWASP Top 10, A1 Injection, A1 Injection Risks Root Causes and its Mitigation, A1 Injection, A2 Broken Authentication and Session Management, A7 Cross Site Scripting XSS, A3 Sensitive Data Exposure, A5 Broken Access Control, A4 XML External Entity (XEE), A6 Security Misconfiguration, A7 Missing Function Level Access Control, A8 Cross Site Request Forgery CSRF, A8 Insecure Deserialization, A9 Using Components With Known Vulnerabilities, A10 Unvalidated Redirects and Forwards, A10 Insufficient Logging and Monitoring, Secure Coding Practices, Secure Design Principles, Threat Modeling, Microsoft SDL Tool

**UNIT III:**

**Secure coding practices and OWASP Top 10:** Declarative Security, Programmatic Security, Concurrency, Configuration, Cryptography, Input and Output Sanitization, Error Handling, Input Validation, Logging and auditing, Session Management, Exception Management, Safe APIs, Type Safety, Memory Management, Tokenizing, Sandboxing, Static and dynamic testing, vulnerability scanning and penetration testing

**UNIT IV:**

**Secure coding practices in C/C++ and Java:** Potential Software Risks in C/C++, Defensive coding, Preventative Planning, Clean Code, Iterative Design, Assertions, Pre Post Conditions, Low level design inspections, Unit Tests

Java- Managing Denial of Service, Securing Information, Data Integrity, Accessibility and Extensibility, Securing Objects, Serialization Security

**UNIT V:**

**Secure coding in Python:** Interactive Python Scripting, Python Variables, Conditionals, Loops, Functions, External Modules, File operations, Web requests



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**Text Books:**

1. Networking Fundamentals, 2019 edition, Packt, Author: Gordon Davies
2. Principles of Information Security, Authors: Michael E. Whitman and Herbert J. Mattord, Course technology incorp.
3. CSSLP SECURE SOFTWARE LIFECYCLE PROFESSIONAL ALL-IN-ONE EXAM GUIDE, Third Edition, 3rd Edition, Authors: Wm. Arthur Conklin, Daniel Paul Shoemaker, Released February 2022, Publisher(s): McGraw-Hill, ISBN: 9781264258215
4. OCP Oracle Certified Professional Java SE 11 Programmer II Study Guide: Exam 1Z0-816 and Exam 1Z0-817 Paperback – 6 August 2020, Authors: Scott Selikoff , Jeanne Boyarsky
5. OWASP 2017 Handbook,

[https://owasp.org/www-pdf-archive/OWASP\\_Top\\_10\\_2017\\_RC2\\_Final.pdf](https://owasp.org/www-pdf-archive/OWASP_Top_10_2017_RC2_Final.pdf)

**Web Links:**

**Infosys Springboard courses**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_012683751296065536354\\_shared/contents](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012683751296065536354_shared/contents) [Network Fundamentals]
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_3388902307073574000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_3388902307073574000_shared/overview) [Introduction to cybersecurity]
3. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_0135015696571596809160](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_0135015696571596809160) [Certified Secure Software Lifecycle Professional (CSSLP) 2019: Secure Coding Practices]
4. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_0135015689927557129660](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_0135015689927557129660) [OWASP Top 10: Web Application Security]
5. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_01350159304097792013093](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_01350159304097792013093) [Defensive coding fundamentals in C and C++]
6. [https://infyspringboard.onwingspan.com/en/viewer/html/lex\\_auth\\_01350159172969267213125](https://infyspringboard.onwingspan.com/en/viewer/html/lex_auth_01350159172969267213125) [Java SE 11 Programmer II: Secure Coding in Java SE 11 Applications]
7. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01350158164493107211192/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01350158164493107211192/overview) [Security Programming: Python Scripting Essentials]

**Web references:**

1. <https://www.stealthlabs.com/blog/infographic-top-15-cybersecurity-myths-vs-reality/>
2. <https://microage.ca/cybersecurity-layering-approach/>
3. <https://www.synopsys.com/glossary/what-is-threat-modeling.html#:~:text=Threat%20modeling%20is%20a%20structured,An%20abstraction%20of%20the%20system>
4. <https://www.microsoft.com/en-us/securityengineering/sdl/threatmodeling>
5. <https://www.checkpoint.com/cyber-hub/threat-prevention/what-is-sandboxing/>
6. <https://www.skillsoft.com/course/defensive-coding-fundamentals-for-cc-f44c02f9-1bcc-11e7-b15b-0242c0a80b07#:~:text=Defensive%20Programming%20is%20a%20methodology,%2C%20testing%2C%20and%20input%20validation>
7. <https://www.oracle.com/java/technologies/javase/seccodeguide.html>
8. <https://www.skillsoft.com/course/security-programming-python-scripting-essentials-be99adad-1f65-47a8-a4b5-6b5346072b8e>



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	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY</b>				

**Human Values Courses**

This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course named as “H-102 Universal Human Values 2: Understanding Harmony” is designed which may be covered in their III or IV semester. During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

**Universal Human Values 2: Understanding Harmony**

Course code: HSMC (H-102)

Credits: L-T-P-C 2-1-0-3 or 2L:1T:0P 3 credits

Pre-requisites: None. Universal Human Values 1 (desirable)

**1. Objective:**

**The objective of the course is four fold:**

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

**2. Course Topics:**

**The course has 28 lectures and 14 practice sessions in 5 modules:**

**Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

**Module 2: Understanding Harmony in the Human Being - Harmony in Myself!**

4. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
5. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility
6. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)
7. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’
8. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
9. Programs to ensure Sanyam and Health.



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Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

**Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**

10. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
11. Understanding the meaning of Trust; Difference between intention and competence
12. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
13. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
14. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

**Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

**Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics**

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. 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.
26. Case studies of typical holistic technologies, management models and production systems
27. 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
28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

**3. READINGS:**

**3.1 Text Book**

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



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**3.2 Reference Books**

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

**4. MODE OF CONDUCT (L-T-P-C 2-1-0-3 or 2L:1T:0P 3 credits)**

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the student explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than "extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty. Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

**5. ASSESSMENT:**

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor: 10 marks

Self-assessment: 10 marks

Assessment by peers: 10 marks

Socially relevant project/Group Activities/Assignments: 20 marks

Semester End Examination: 50 marks





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The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

**6. OUTCOME OF THE COURSE:**

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

- a) faculty-student or mentor-mentee programs throughout their time with the institution
- b) Higher level courses on human values in every aspect of living. E.g. as a professional



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		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>PYTHON: DEEP LEARNING (Skill Oriented Course)</b>					

**Course Outcomes:**

At the end of the Course, Student will be able to:

- Demonstrate the basic concepts fundamental learning techniques and layers.
- Discuss the Neural Network training, various random models.
- Apply various optimization algorithms to comprehend different activation functions to understand hyper parameter tuning
- Build a convolutional neural network, and understand its application to build a recurrent neural network, and understand its usage to comprehend auto encoders to briefly explain transfer learning

**Pre-requisite knowledge :**

- Exploratory data analysis: Collecting, importing, pre-processing, organizing, exploring, analyzing data and deriving insights from data  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_012666909428129792728\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012666909428129792728_shared/overview)
- Data visualization using Python: Data visualization functions and plots  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_0126051913436938241455\\_share\\_d/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126051913436938241455_share_d/overview)
- Regression analysis: Regression, types, linear, polynomial, multiple linear, Generalized linear regression models  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01320408013336576065\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01320408013336576065_shared/overview)
- Clustering using Python: Clustering, techniques, Assessment and evaluation  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_0130441799423426561190\\_share\\_d/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130441799423426561190_share_d/overview)
- Machine learning using Python: Machine learning fundamentals, Regression, classification, clustering, introduction to artificial neural networks  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_012600400790749184237\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012600400790749184237_shared/overview)
- Time series analysis : Patterns, decomposition models, smoothing time, forecasting data  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_0126051804744253441280\\_share\\_d/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126051804744253441280_share_d/overview)

**List of Exercises:**

**Note:** There are online courses indicated in the reference links section. Learners need to go through the contents in order to perform the given exercises

**Exercise 1:**

Course name : .Build a Convolution Neural Network for Image Recognition.
Go through the modules of the course mentioned and answer the self-assessment questions given in the link below at the end of the course.
<a href="#">Self Assessment - Deep Learning - Viewer Page   Infosys Springboard (onwingspan.com)</a>





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**Exercise 2:**

Module name : Understanding and Using ANN : Identifying age group of an actor

Exercise : Design Artificial Neural Networks for Identifying and Classifying an actor using Kaggle Dataset.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_012776492416663552259\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_share&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012776492416663552259_shared?collectionId=lex_auth_01274814254931148859_share&collectionType=Course)

**Exercise 3:**

Module name : Understanding and Using CNN : Image recognition

Exercise: Design a CNN for Image Recognition which includes hyperparameter tuning.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_012785694443167744910\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_share&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012785694443167744910_shared?collectionId=lex_auth_01274814254931148859_share&collectionType=Course)

**Exercise 4:**

Module name : Predicting Sequential Data

Exercise: Implement a Recurrence Neural Network for Predicting Sequential Data.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_01279144948849868822\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_share&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_01279144948849868822_shared?collectionId=lex_auth_01274814254931148859_share&collectionType=Course)

**Exercise 5:**

Module Name: Removing noise from the images

Exercise: Implement Multi-Layer Perceptron algorithm for Image denoising hyperparameter tuning.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_012792058258817024272\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_share&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012792058258817024272_shared?collectionId=lex_auth_01274814254931148859_share&collectionType=Course)

**Exercise 6:**

Module Name: Advanced Deep Learning Architectures

Exercise: Implement Object Detection Using YOLO.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_013102923373297664873\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_share&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013102923373297664873_shared?collectionId=lex_auth_01274814254931148859_share&collectionType=Course)

**Exercise 7:**

Module Name: Optimization of Training in Deep Learning

Exercise Name: Design a Deep learning Network for Robust Bi-Tempered Logistic Loss.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_013107917226680320184\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_share&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013107917226680320184_shared?collectionId=lex_auth_01274814254931148859_share&collectionType=Course)

**Exercise 8:**

Module name: Advanced CNN

Exercise: Build AlexNet using Advanced CNN.

[https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_013111844422541312984\\_shared?collectionId=lex\\_auth\\_01274814254931148859\\_share&collectionType=Course](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013111844422541312984_shared?collectionId=lex_auth_01274814254931148859_share&collectionType=Course)



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**Exercise 9:**

Module name: Autoencoders Advanced
Exercise: Demonstration of Application of Autoencoders.
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0131164551289896962081_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0131164551289896962081_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course</a>

**Exercise 10 :**

Module name: Advanced GANs
Exercise: Demonstration of GAN.
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0131155456664289281901_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0131155456664289281901_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course</a>

**Exercise 11:**

Module name : Capstone project
Exercise : Complete the requirements given in capstone project
Description: In this capstone, learners will apply their deep learning knowledge and expertise to a real world challenge.
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course</a>

**Exercise 12:**

Module name : Capstone project
Exercise : Complete the requirements given in capstone project
<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared?collectionId=lex_auth_01274814254931148859_shared&amp;collectionType=Course</a>

**Reference Books:**

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.

**Hardware and software configuration:**

Experimental Environment	Configuration Instructions	
Hardware Environment	CPU	Intel® Core™ i7-6700 CPU 4GHz
	GPU	Nvidia GTX 750, 4GB
	Memory	8 GB
Software Environment	Operating System	Ubuntu 14.04, 64 bit
	Programming Environment	Tensorflow deep learning framework and Python language

**Web Links: [Courses mapped to Infosys Springboard platform]**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_012782105116811264219\\_shared/contents](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012782105116811264219_shared/contents) [Introduction to Deep Learning]
2. [https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex\\_auth\\_013119291805696000651\\_shared](https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_013119291805696000651_shared) [Deep learning for Developers]



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<b>IV Year – I Semester</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>MEAN STACK TECHNOLOGIES-MODULE II- ANGULAR JS, MONGODB (Skill Oriented Course)</b>				

**Course Outcomes:**

- Build a component-based application using Angular components and enhance their functionality using directives.
- Utilize data binding for developing Angular forms and bind them with model data.
- Apply Angular built-in or custom pipes to format the rendered data.
- Develop a single page applic
- ation by using synchronous or asynchronous Angular routing.
- Make use of MongoDB queries to perform CRUD operations on document database.

**List of Exercises:**

<b>1.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Angular Application Setup
	Observe the link <a href="http://localhost:4200/welcome">http://localhost:4200/welcome</a> on which the mCart application is running. Perform the below activities to understand the features of the application.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24049616594198490000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24049616594198490000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>1.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Components and Modules
	Create a new component called hello and render Hello Angular on the page
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28217843279641040000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_28217843279641040000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>1.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Elements of Template
	Add an event to the hello component template and when it is clicked, it should change the courseName.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_19226434057992030000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_19226434057992030000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>1.d</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Change Detection
	progressively building the PoolCarz application
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2560981637120771000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2560981637120771000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>2.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Structural Directives - ngIf
	Create a login form with username and password fields. If the user enters the correct credentials, it should render a "Welcome <<username>>" message otherwise it should render "Invalid Login!!! Please try again..." message
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637402260439042595_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637402260439042595_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course</a>



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<b>2.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> ngFor
	Create a courses array and rendering it in the template using ngFor directive in a list format.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32795774277593590000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32795774277593590000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>2.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> ngSwitch
	Display the correct option based on the value passed to ngSwitch directive.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_23388127475984175000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_23388127475984175000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>2.d</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Custom Structural Directive
	Create a custom structural directive called 'repeat' which should repeat the element given a number of times.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24073319904331424000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24073319904331424000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>3.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Attribute Directives - ngStyle
	Apply multiple CSS properties to a paragraph in a component using ngStyle.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24037156998765367000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24037156998765367000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>3.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> ngClass
	Apply multiple CSS classes to the text using ngClass directive.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3459610297074182000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3459610297074182000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>3.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Custom Attribute Directive
	Create an attribute directive called 'showMessage' which should display the given message in a paragraph when a user clicks on it and should change the text color to red.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_14783742359773809000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_14783742359773809000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>4.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Property Binding
	Binding image with class property using property binding.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_8951964709153619000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_8951964709153619000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>4.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Attribute Binding
	Binding colspan attribute of a table element to the class property.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7154252883180625000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7154252883180625000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>



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<b>4.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Style and Event Binding
	Binding an element using inline style and user actions like entering text in input fields.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7417401021103822000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_7417401021103822000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>5.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Built in Pipes
	Display the product code in lowercase and product name in uppercase using built-in pipes.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_11810543990912035000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_11810543990912035000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>5.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Passing Parameters to Pipes
	Apply built-in pipes with parameters to display product details.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_21187073707540988000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_21187073707540988000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>5.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Nested Components Basics
	Load CoursesListComponent in the root component when a user clicks on the View courses list button.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24231999287700136000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_24231999287700136000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>6.a</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Passing data from Container Component to Child Component
	Create an AppComponent that displays a dropdown with a list of courses as values in it. Create another component called the CoursesList component and load it in AppComponent which should display the course details. When the user selects a course from the
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15758356947336235000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_15758356947336235000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>6.b</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Passing data from Child Component to ContainerComponent
	Create an AppComponent that loads another component called the CoursesList component. Create another component called CoursesListComponent which should display the courses list in a table along with a register .button in each row. When a user clicks on th
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2494980689916818400_shared?collectionId=lex_20858515543254600000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2494980689916818400_shared?collectionId=lex_20858515543254600000_0_shared&amp;collectionType=Course</a>
<b>6.c</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Shadow DOM
	Apply ShadowDOM and None encapsulation modes to components.
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10312243404892470000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10312243404892470000_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a>
<b>6.d</b>	<b>Course Name:</b> Angular JS
	<b>Module Name:</b> Component Life Cycle





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	Override component life-cycle hooks and logging the corresponding messages to understand the flow. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10818939635948007000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_10818939635948007000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>7.a</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Template Driven Forms Create a course registration form as a template-driven form. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2810668513603024400_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_2810668513603024400_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>7.b</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Model Driven Forms or Reactive Forms Create an employee registration form as a reactive form. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33704702617536004000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33704702617536004000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>7.c</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Custom Validators in Reactive Forms Create a custom validator for an email field in the employee registration form ( reactive form) <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33728128192769250000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_33728128192769250000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>8.a</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Custom Validators in Template Driven forms Create a custom validator for the email field in the course registration form. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_27688491925133280000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_27688491925133280000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>8.b</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Services Basics Create a Book Component which fetches book details like id, name and displays them on the page in a list format. Store the book details in an array and fetch the data using a custom service. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32584403823635940000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_32584403823635940000_shared?collectionId=lex_208585155432546000_00_shared&amp;collectionType=Course</a>
<b>8.c</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> RxJS Observables Create and use an observable in Angular. <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6209609363905256000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_6209609363905256000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a>
<b>9.a</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Server Communication using HttpClient Create an application for Server Communication using HttpClient <a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637395317063682615_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_0127637395317063682615_shared?collectionId=lex_208585155432546000000_shared&amp;collectionType=Course</a>
<b>9.b</b>	<b>Course Name:</b> Angular JS <b>Module Name:</b> Communicating with different backend services using Angular



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	<p>HttpClient</p> <p>Create a custom service called ProductService in which Http class is used to fetch data stored in the JSON files.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_4266333361795059700_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_4266333361795059700_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a></p>
10.	<p><b>Course Name:</b> Angular JS</p> <p><b>a</b> <b>Module Name:</b> Routing Basics, Router Links</p> <p>Create multiple components and add routing to provide navigation between them.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3782024852517635000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_3782024852517635000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a></p>
10.	<p><b>Course Name:</b> Angular JS</p> <p><b>b</b> <b>Module Name:</b> Route Guards</p> <p>Considering the same example used for routing, add route guard to BooksComponent. Only after logging in, the user should be able to access BooksComponent. If the user tries to give the URL of Bookscomponent in another tab or window, or if the user tries</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_30303325731876470000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_30303325731876470000_shared?collectionId=lex_2085851554325460000_00_shared&amp;collectionType=Course</a></p>
10.	<p><b>Course Name:</b> Angular JS</p> <p><b>c</b> <b>Module Name:</b> Asynchronous Routing</p> <p>Apply lazy loading to BookComponent. If lazy loading is not added to the demo, it has loaded in 1.14 s. Observe the load time at the bottom of the browser console. Press F12 in the browser and click the Network tab and check the Load time</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9878739890118246000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_9878739890118246000_shared?collectionId=lex_2085851554325460000_0_shared&amp;collectionType=Course</a></p>
10.	<p><b>Course Name:</b> Angular JS</p> <p><b>d</b> <b>Module Name:</b> Nested Routes</p> <p>Implement Child Routes to a submodule.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012768043900444672140_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/web-module/lex_auth_012768043900444672140_shared?collectionId=lex_20858515543254600000_shared&amp;collectionType=Course</a></p>
11.	<p><b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide</p> <p><b>a</b> <b>Module Name:</b> Installing MongoDB on the local computer, Create MongoDB Atlas Cluster</p> <p>Install MongoDB and configure ATLAS</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821437313024030083_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821437313024030083_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course</a></p>
11.	<p><b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide</p> <p><b>b</b> <b>Module Name:</b> Introduction to the CRUD Operations</p> <p>Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove()</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821874166169630118_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821874166169630118_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course</a></p>
12.	<p><b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide</p> <p><b>a</b> <b>Module Name:</b> Create and Delete Databases and Collections</p> <p>Write MongoDB queries to Create and drop databases and collections.</p> <p><a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821654">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_01281821654</a></p>





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	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_013177169294712832113_shared&amp;collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">119219230121_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course</a>
<b>12.</b>	<b>Course Name:</b> MongoDB Essentials - A Complete MongoDB Guide
<b>b</b>	<b>Module Name:</b> Introduction to MongoDB Queries
	Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate().
	<a href="https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_0132890816264519682505_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course">https://infyspringboard.onwingspan.com/web/en/viewer/video/lex_auth_0132890816264519682505_shared?collectionId=lex_auth_013177169294712832113_shared&amp;collectionType=Course</a>

**Text Books:**

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson.
2. Pro Mean Stack Development, 1st Edition, ELadElrom, Apress O'Reilly.
3. Full Stack JavaScript Development with MEAN, Colin J Ihrig, Adam Bretz, 1st edition, SitePoint, SitePoint Pty. Ltd., O'Reilly Media.
4. MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow, O'Reilly

**Software configuration and installation:**

1. Angular  
 Setup details: Angular Application Setup - Internal - Viewer Page | Infosys Springboard (onwingspan.com)
2. MongoDB  
 TOC - MongoDB Essentials - A Complete MongoDB Guide | Infosys Springboard (onwingspan.com)

**Web Links:**

1. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_20858515543254600000\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_20858515543254600000_shared/overview) (Angular JS)
2. [https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_013177169294712832113\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overview) (MongoDB)



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<b>IV Year – I Semester</b>	<b>Minor Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<b>SOFTWARE ENGINEERING</b>					

**Course Objectives:**

This course is designed to acquire the generic software development skill through various stages of software life cycle and also to ensure the quality of software through software development with various protocol based environment

**Course Outcomes:**

Students taking this subject will gain software engineering skills in the following areas:

- Ability to transform an Object-Oriented Design into high quality, executable code
- Skills to design, implement, and execute test cases at the Unit and Integration level
- Compare conventional and agile software methods
- Prepare SRS document, design document, test cases and software configuration management and risk management related document.
- Develop function oriented and object oriented software design using tools like rational rose.
- Use modern engineering tools necessary for software project management, estimations, time management and software reuse
- Generate test cases for software testing

**UNIT I**

The Nature of Software, Software Engineering, The Software Process, Software Engineering Practice, Software Myths. A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models, Process Technology.

**UNIT II**

Agility, Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Other Agile Process Models, A Tool Set for the Agile Process, Software Engineering Knowledge, Core Principles, Principles That Guide Each Framework Activity, Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements.

**UNIT III**

Requirements Analysis, Scenario-Based Modeling, UML Models That Supplement the Use Case, Data Modeling Concepts, Class-Based Modeling, Requirements Modeling Strategies, Flow-Oriented Modeling, Creating a Behavioral Model, Patterns for Requirements Modelling,.

**UNIT IV**

Design within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model, Software Architecture, Architectural Genres, Architectural Styles, Assessing Alternative Architectural Designs, Architectural Mapping Using Data Flow, Components, Designing Class-Based Components, Conducting Component-Level Design, Component-Level Design for WebApps, Designing Traditional Components, Component- Based Development.

**UNIT V**

The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation, Elements of Software Quality Assurance, SQA Tasks, Goals & Metrics, Statistical SQA, Software Reliability, A Strategic Approach to Software Testing, Strategic Issues, Test Strategies



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for Conventional Software, Test Strategies for Object-Oriented Software, Test Strategies for WebApps, Validation Testing, System Testing, The Art of Debugging, Software Testing Fundamentals, Internal and External Views of Testing, White-Box Testing, Basis Path Testing.

**List of Experiments:**

- 1) Perform the following, for the following experiments:
  - i. Do the Requirement Analysis and Prepare SRS
  - ii. Draw E-R diagrams, DFD, CFD and structured charts for the project.
- 1) Course Registration System
- 2) Students Marks Analyzing System
- 3) Online Ticket Reservation System
- 4) Stock Maintenance
- 5) Draw the UML Diagrams for the problem 1,2, 3, 4.
- 6) Design the test cases for e-Commerce application (Flipcart, Amazon)
- 7) Design and Implement ATM system through UML Diagrams.

**Text Books:**

- 1) Software Engineering a practitioner's approach, Roger S. Pressman, Seventh Edition, McGraw Hill Higher Education.
- 2) Software Engineering, Ian Sommerville, Ninth Edition, Pearson.

**Reference Books:**

- 1) Software Engineering, A Precise Approach, PankajJalote, Wiley India, 2010.
- 2) Software Engineering, Ugrasen Suman, Cengage.

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105182/>



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## **MINOR COURSES**

### **PART –B**



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>COMPUTATIONAL THINKING</b>					

**Course Objective:**

- The subject is aimed at students with little or no programming experience.
- It aims to provide students with an understanding of the role computation can play in solving problems.
- It also aims to help students, regardless of their major, to feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals.

**Course Outcomes:**

After studying this course, Student should be able to:

1. Describe the skills that are involved in computational thinking
2. Demonstrate the concepts of Boolean Logic and Software Development.
3. Analyze the concepts of algorithmic thinking as modeling and abstraction as encapsulation.
4. Illustrate the distinctive nature of data organization, White box and Black box testing.
5. Student will be aware of a range of applications of computational thinking in different disciplines, Authentication and authorization.

**UNIT I:**

**Introduction:** Computers, Computational Thinking, Abacus to Machine, The First Software, The First Modern Computer, Moore’s Law, **Real-World Information Becomes Computable Data**, Information and Data, Converting Information into Data, Data Capacity, Data Compression

**UNIT II:**

**Logic:** Boolean Logic, Applications of Propositional Logic, **Solving Problems**, Logical Reasoning, Decomposition: Software Design, Decomposition: Other Uses, Abstraction: Class Diagrams, Abstraction: Use Case Diagrams

**UNIT III:**

**Algorithmic Thinking:** Algorithms, Software and Programming, Languages, Actions, **Modeling Solutions:** Activity Diagrams, Selection in Activity Diagrams, Repetition in Activity Diagrams, Control Abstraction in Activity Diagrams, States and State Diagrams, Behavior in State Diagrams,

**UNIT IV:**

**Data Organization:** Names, Lists, Graphs, Hierarchies, **Algorithmic Thinking:** Von Neumann Architecture, Spreadsheets, Text Processing, Patterns, Computer Errors, Software Correctness, Verification, Software Testing, White Box Testing, Black Box Testing with Equivalence Partitioning, Boundary Value Analysis

**UNIT V:**

**Concurrent Activity:** Parallelism or Concurrency, Scheduling, Sorting Networks, **Information Security:** Security, Foundations, Common Forms of Cybercrime, Secure- Step 1: Authenticate, Secure- Step 2: Authorization, All a Matter of Risk



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**Text Book:**

1. David Riley, Kenny A. Hunt, Computational Thinking for the Modern Problem Solver, 2014.
2. G Venkatesh, Madhavan Mukund, Computational Thinking: A Primer for Programmers and Data Scientists, 2021.

**Reference Books:**

1. Paolo Ferragina, Fabrizio Luccio, Computational Thinking: First Algorithms, then coding, Springer, 2018.
2. Karl Beecher, computational thinking: A beginner's guide to problem-solving and programming, 2017.

**NPTEL Link:** Physics through Computational Thinking:  
[https://onlinecourses.nptel.ac.in/noc22\\_ph12/preview](https://onlinecourses.nptel.ac.in/noc22_ph12/preview)



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		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<b>OBJECT ORIENTED PROGRAMMING THROUGH JAVA</b>					

**Course Objectives:**

The learning objectives of this course are:

- To identify Java language components and how they work together in applications
- To learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- To learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- Practice programming in the Java
- Gain knowledge of object-oriented paradigm in the Java programming language

**Course Outcomes:**

By the end of the course, the student will be

- Evaluate default value of all primitive data type, Operations, Expressions, Control- flow, Strings
- Determine Class, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrating simple inheritance, multi-level inheritance, Exception handling mechanism
- Construct Threads, Event Handling, implement packages, developing applets

**UNIT I**

Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator ( = ), Basic Arithmetic Operators, Increment (++) and Decrement ( - - ) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

Control Statements: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?., Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

**UNIT II**

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

**UNIT III**

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-





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dimensional Arrays, Arrays of Varying Lengths, Three- dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

**UNIT IV**

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Random Class, Time Package, Formatting for Date/Time in Java,

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions, try-with-resources, Catching Subclass Exception, Custom Exceptions, Nested try and catch Blocks, Rethrowing Exception, Throws Clause.

**UNIT V**

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Methods for Comparison of Strings, Methods for Modifying Strings, Methods for Searching Strings, Data Conversion and Miscellaneous Methods, Class String Buffer, Class String Builder.

**List of Experiments:**

**Exercise - 1 (Basics)**

- Write a JAVA program to display default value of all primitive data type of JAVA
- Write a java program that display the roots of a quadratic equation  $ax^2+bx=0$ . Calculate the discriminate D and basing on value of D, describe the nature of root.

**Exercise - 2 (Operations, Expressions, Control-flow, Strings)**

- Write a JAVA program to search for an element in a given list of elements using binary search mechanism.
- Write a JAVA program to sort for an element in a given list of elements using bubble sort
- Write a JAVA program using StringBuffer to delete, remove character.

**Exercise - 3 (Class, Objects)**

- Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.
- Write a JAVA program to implement constructor.

**Exercise - 4 (Methods)**

- Write a JAVA program to implement constructor overloading.
- Write a JAVA program implement method overloading.

**Exercise - 5 (Inheritance)**

- Write a JAVA program to implement Single Inheritance
- Write a JAVA program to implement multi level Inheritance



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**Exercise - 6** (Inheritance - Continued)

- a) Write a JAVA program give example for “super” keyword.
- b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?

**Exercise - 7** (Exception)

- a) Write a JAVA program that describes exception handling mechanism
- b) Write a JAVA program Illustrating Multiple catch clauses

**Exercise – 8** (Runtime Polymorphism)

Write a JAVA program that implements Runtime polymorphism

**Exercise – 9** (User defined Exception)

- a) Write a JAVA program for creation of Illustrating throw
- b) Write a JAVA program for creation of Illustrating finally

**Text Books:**

- 1) JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
- 2) The complete Reference Java, 8th edition, Herbert Schildt, TMH.

**References Books:**

- 1) Introduction to java programming, 7th edition by Y Daniel Liang, Pearson
- 2) Murach's Java Programming, Joel Murach

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105191/>
- 2) [https://www.w3schools.com/java/java\\_data\\_types.asp](https://www.w3schools.com/java/java_data_types.asp)



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		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<b>DATA ANALYTICS USING PYTHON</b>					



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>ARTIFICIAL INTELLIGENCE</b>					

**Course Objectives:** The student will be able to

- Know the methodology of Problem solving
- Implement basic AI algorithms
- Design and carry out an empirical evolution of different algorithms on a problem formalization

**Course Outcomes (COs):** At the end of the course, student will be able to

- Understand the fundamental concepts in Artificial Intelligence
- Analyze the applications of search strategies and problem reductions
- Apply the mathematical logic concepts.
- Develop the Knowledge representations in Artificial Intelligence.
- Explain the Fuzzy logic systems.

**UNIT I:**

**Introduction to artificial intelligence:** Introduction ,history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI.

**UNIT II:**

**Problem solving: state-space search and control strategies:** Introduction, general problem solving, characteristics of problem

**Search Strategies:** exhaustive searches, heuristic search techniques, iterative-deepening A\*, constraint satisfaction

**UNIT III:**

**Logic concepts:** Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, predicate logic

**UNIT IV:**

**Knowledge representation:** Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR

**Advanced knowledge representation techniques:** Introduction, conceptual dependency theory, script structure.

**UNIT V:**

**Expert system and applications:** Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems blackboard systems truth maintenance systems, application of expert systems, list of shells and tools.

**Text Books:**

1. Artificial Intelligence, Saroj Kaushik, CENGAGE Learning,
2. Artificial intelligence, A modern Approach , 2<sup>nd</sup> ed, Stuart Russel, Peter Norvig, PEA
3. Artificial Intelligence, Rich, Kevin Knight, Shiv Shankar B Nair, 3<sup>rd</sup> ed, TMH
4. Introduction to Artificial Intelligence, Patterson, PHI



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**Reference Books:**

1. Artificial intelligence, structures and Strategies for Complex problem solving, -George F Luger, 5<sup>th</sup> ed, PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer
3. Artificial Intelligence, A new Synthesis, Nils J Nilsson, Elsevier



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<b>PART B</b>	<b>Minor Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<b>UNIX AND SHELL PROGRAMMING</b>					

**Course Objectives:**

Understating the shell commands, shell programming, system calls of files and processes, signals, inter-process communication concepts and programming, TCP and UDP.

**Course Outcomes:** After finishing this course student will be able to:

- Gain good knowledge on Unix commands and awareness of shell programming
- Know about different system calls for files and directories
- Ability to know the working of processes and signals
- Application of client server program for IPC
- Knowledge about socket programming

**UNIT-I:**

Introduction, Architecture of unix, Responsibilities of shell, unix file system, vi editor. **Unix commands:** Some Basic Commands, file utilities, process utilities, text processing utilities, network utilities, disk utilities, backup utilities , Security by file permissions.

**UNIT-II:**

**Shell Programming:** shell variables, The Export command, The Profile File a Script Run During starting, The First Shell Script, The read command, Positional Parameters, The \$? Variable , Knowing the exit Status- More about the Set Command, The Exit command, Branching Control Structures, Loop Control Structures, The Continue and Break Statement- The Expr Command, Performing Integer Arithmetic- Real Arithmetic in Shell Programs- The here Document(<<), The Sleep Command, Debugging Scripts, The Script command, The Eval command, The Exec Command, Sample programs.

**UNIT-III:**

**Files** - Introduction, file descriptors, open, creat, read, write, close, lseek, dup2, file status information-stat family, file and record locking- fcntl function, file permissions - chmod, fchmod, file ownership-chown, lchown, links-soft and hard links-symlink, link, unlink.

**UNIT IV:**

**Directories**-Creating, removing and changing Directories-mkdir, rmdir, chdir, obtaining current working directory-getcwd, Directory contents, Scanning Directories-opendir, readdir, closedir, rewinddir functions.

**UNIT V:**

**Process Control:** process identifiers, fork function, vfork function, exit function, wait and waitpid functions, exec functions, user identification. **Signals:** signal handling using signal function, kill and raise, alarm, pause, abort and sleep functions.

**List of Experiments:**

- 1)a) Study of Unix/Linux general purpose utility command list: man,who,cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown.
- b) Study of vi editor
- c) Study of Bash shell, Bourne shell and C shell in Unix/Linux operating system
- d) Study of Unix/Linux file system (tree structure)



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e) Study of .bashrc, /etc/bashrc and Environment variables.

- 2) Write a C program that makes a copy of a file using standard I/O, and system calls
- 3) Write a C program to emulate the UNIX ls -l command.
- 4) Write a C program that illustrates how to execute two commands concurrently with a command pipe. Ex: - ls -l | sort
- 5) Implementation of fork (), wait (), exec() and exit (), System calls

**Text Books:**

4. Unix the ultimate guide, 3<sup>rd</sup> edition, Sumitabha Das, TMH.
5. Advanced programming in the Unix environment by W. Richard Stevens.
6. Unix network programming by W. Richard Stevens.

**Reference Books:**

1. Introduction to Unix and shell programming, Venkateshmurthy
2. Unix and shell programming by B.M. Harwani, OXFORD university press.





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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>CLOUD COMPUTING</b>					

**Course Objectives:**

- To explain the evolving computer model caned cloud computing.
- To introduce the various levels of services that can be achieved by cloud.
- To describe the security aspects in cloud.
- To motivate students to do programming and experiment with the various cloud computing environments.

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

- Illustrate the key dimensions of the challenge of Cloud Computing
- Classify the Levels of Virtualization and mechanism of tools.
- Analyze Cloud infrastructure including Google Cloud and Amazon Cloud.
- Create Combinatorial Auctions for cloud resource and design scheduling algorithms for computing cloud
- Assess control storage systems and cloud security, the risks involved its impact and develop cloud application

**UNIT I:**

**Systems Modeling, Clustering and Virtualization:** Scalable Computing over the Internet-The Age of Internet Computing, Scalable computing over the internet, Technologies for Network Based Systems, System models for Distributed and Cloud Computing, , Performance, Security and Energy Efficiency

**UNIT II:**

**Virtual Machines and Virtualization of Clusters and Data Centers:** Implementation Levels of Virtualization, Virtualization Structures/ Tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

**UNIT III:**

**Cloud Platform Architecture:** Cloud Computing and Service Models, Public Cloud Platforms, Service Oriented Architecture, Programming on Amazon AWS and Microsoft Azure

**UNIT IV:**

**Cloud Resource Management and Scheduling:** Policies and Mechanisms for Resource Management, Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds-Fair Queuing, Start Time Fair Queuing.

**UNIT V:**

**Storage Systems:** Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system.

**Text Books:**

3. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra MK Elsevier.
4. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.



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**Reference Books:**

4. Cloud Computing, A Hands on approach, ArshadeepBahga, Vijay Madiseti, University Press
5. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
6. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH



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## **Suggested Courses for Honors Program**



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<b>II Year - II Semester</b>	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>MATHEMATICS FOR MACHINE LEARNING (AI &amp; ML)</b>					

**Course Objectives:**

The main objectives of this course is to make student understand and apply the basic mathematical concepts that are essential for machine learning algorithms

**Course Outcomes:**

By the end of the course, the student will be able to

- understand the basic notions of machine learning and of the related basic mathematical tools;
- comprehend the basic concepts and techniques of convex optimization
- have a good knowledge of the statistical and computational properties of some well known machine learning algorithms;
- implement machine learning algorithms on synthetic and real data sets using mathematical concepts like linear algebra, probability and calculus

**UNIT-I**

Linear Algebra: Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces

**UNIT-II**

Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations

**UNIT-III**

Matrix Decompositions: Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigendecomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Phylogeny

**UNIT-IV**

Vector Calculus : Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series

**UNIT-V**

Probability and Distributions: Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform  
Continuous Optimization: Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization

**Text Books:**

1. "Mathematics for Machine Learning", Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Cambridge University Press.
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2<sup>nd</sup> Edition, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2017.



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**Reference Books:**

1. Machine Learning: An Applied Mathematics Introduction, Paul Wilmott, Panda Ohana Publishing 2019.



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>TEXT MINING AND TIME SERIES ANALYSIS (AI &amp; ML)</b>					

**Course Objectives:** This course will cover the major techniques for mining and analyzing text data to discover interesting patterns, extract useful knowledge, and support decision making, with an emphasis on statistical approaches that can be generally applied to arbitrary text data in any natural language with no or minimum human effort. Develop the skills needed to do empirical research in fields operating with time series data sets. The course aims to provide students with techniques and receipts for estimation and assessment of quality of economic models with time series data.

**Course Outcomes:**

After completing the course Student will be able to:

- Student will be aware of fundamental concepts of text mining, unsupervised information extraction.
- Student will be aware of text clustering algorithms like feature selection, distance-based clustering and latent semantic indexing.
- Student will be aware of Text classification algorithm and text mining techniques.
- Student should aware of all the characteristics of time series and measures of dependencies.
- Student will be able to understand the ARIMA Models.

**UNIT I:**

**Introduction to Text Mining:** Introduction, Algorithms for Text Mining, Information Extraction from Text: Introduction, Named Entity Recognition, Relation Extraction, Unsupervised Information Extraction. Text Summarization Techniques: Extractive Summarization, Topic Representation Approaches, Influence of Context, Indicator Representation and Machine Learning for Summarization.

**UNIT II:**

**Text Clustering Algorithms:** Introduction, Feature Selection and Transformation Methods for Text Clustering, Distance-Based Clustering Algorithms, Word and Phrase-based Clustering, Probabilistic Document Clustering and Topic Modelling. Dimensionality Reduction and Topic Modelling: Latent Semantic Indexing, Topic Models and Dimension Reduction.

**UNIT III:**

**Text Classification Algorithms:** Introduction, Feature Selection for Text Classification, Decision Tree Classifiers, Rule-based Classifier, Probabilistic and Naïve Bayes Classifiers, Linear Classifier, Proximity-based Classifier, Meta-Algorithms for Text Classification, Probabilistic Models for Text Mining: Mixture models, Stochastic Processes in Bayesian Nonparametric Models, Graphical Models.

**UNIT IV:**

**Characteristics of Time Series:** Introduction, Nature of Time Series Data, Time Series Statistical Models, Measures of Dependence: Autocorrelation and Cross-Correlation, Stationary Time Series, Time Series Regression and Exploratory Data Analysis: Classical Regression, Exploratory Data Analysis, Smoothing.



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**UNIT V:**

**ARIMA Models:** Introduction, Autoregressive Moving Average Models, Difference Equations, Autocorrelation and Partial Autocorrelation, Building ARIMA Models, Multiplicative Seasonal ARIMA Models, Spectral Analysis and Filtering: Cyclical Behaviour and Periodicity, Spectral Density, Periodogram and Discrete Fourier Transform, Nonparametric and Parametric Spectral Estimation, Linear Filters, Dynamic Fourier Analysis and Wavelets.

**Text Books:**

1. Charu C. Aggarwal, Chengxing Zhai, “Mining Text Data”, Kluwer Academic Publishers, Springer, 2012.
2. Robert H. Shumway and David S. Stoffer, “Time Series Analysis and Its Applications with R Examples”, Springer, 2016.

**Reference Books:**

1. James D. Hamilton, Time Series Analysis, Princeton University Press, 2004.
2. Avishek Pal and PKS Prakash, Practical Time Series Analysis, Birmingham - Mumbai, 2017.
3. Box, G.E.P., G.M. Jenkins and G.C. Reinsel. n Time Series Analysis, Forecasting, and Control, 3rd ed. Englewood Cliffs, NJ: Prentice Hall, 1994.
4. Chan, N.H. Time Series: Applications to Finance. 2002, New York: Wiley.
5. Fuller, W.A. Introduction to Statistical Time Series, 2<sup>nd</sup> ed. New York: Wiley, 1996.





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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>NATURAL LANGUAGE PROCESSING (AI &amp; ML)</b>					

**Course Objectives:**

- This course introduces the fundamental concepts and techniques of natural language processing (NLP).
- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

**Course Outcomes:** After completion of this course

- Demonstrate a given text with basic Language features
- To design an innovative application using NLP components
- Explain a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

**UNIT I:**

**Introduction :**Origins and challenges of NLP, Language Modeling: Grammar-based LM, Statistical LM, Regular Expressions, Finite-State Automata, English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

**UNIT II:**

**Word Level Analysis:** Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging, Hidden Markov and Maximum Entropy models.

**UNIT III:**

**Syntactic Analysis :** Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar, Dependency Grammar, Syntactic Parsing, Ambiguity, Dynamic Programming parsing, Shallow parsing, Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs, Feature structures, Unification of feature structures

**UNIT IV:**

**Semantics And Pragmatics:** Requirements for representation, First-Order Logic, Description Logics, Syntax-Driven Semantic analysis, Semantic attachments, Word Senses, Relations between Senses, Thematic Roles, selectional restrictions, Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods, Word Similarity using Thesaurus and Distributional methods.

**UNIT V:**

**Discourse Analysis And Lexical Resources :** Discourse segmentation, Coherence, Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm, Coreference Resolution, Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill’s Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).



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**Text Books:**

1. Daniel Jurafsky, James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, First Edition, OReilly Media, 2009.

**Reference Books:**

1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, Natural Language Processing with Java, OReilly Media, 2015.
3. Nitin Indurkha and Fred J. Damerau, Handbook of Natural Language Processing, Second, Chapman and Hall/CRC Press, 2010. Edition
4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>REINFORCEMENT LEARNING (AI &amp; ML)</b>					

**Course Objectives:**

By the end of the class students should be able to:

- Define the key features of reinforcement learning that distinguishes it from AI and non-interactive machine learning.
- Given an application problem (e.g. from computer vision, robotics, etc), decide if it should be formulated as a RL problem; if yes be able to define it formally (in terms of the state space, action space, dynamics and reward model), state what algorithm (from class) is best suited for addressing it and justify your answer.

**Course Outcomes:**

By the end of this course, students should be able to do the following:

1. Learn how to define RL problems like Tic-Tac-Toe, Multi-arm.
2. Student will be able to understand the finite markov decision processes.
3. Student will be to Understand Monte Carlo Methods and how it is work with tabular methods to solve classical control problems
4. Student should aware of Eligibility Traces and Understand how to find with approximate solutions.
5. Explore imitation learning tasks and solutions
6. Recognize current advanced techniques and applications in RL

**UNIT I:**

**Reinforcement Learning Problem:** Introduction, Elements of Reinforcement Learning, Limitations and Scope, Tic-Tac-Toe, Multi-arm Bandits:  $n$ -Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandit, Associative Search.

**UNIT II:**

**Finite Markov Decision Processes:** Agent-Environment Interface, Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation, Dynamic Programming: Policy- Evaluation, Improvement, Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming.

**UNIT III:**

**Monte Carlo Methods:** Monte Carlo- Prediction, Estimation of Action Values, Control, Control without Exploring Start, Temporal- Difference learning: TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-Policy TD Control, Q-Learning, Games, Afterstates.

**UNIT IV:**

**Eligibility Traces:**  $n$ -Step TD Prediction, Forward and Backward View of TD( $\lambda$ ), Equivalences of Forward and Backward Views,  $sar(\lambda)$ , Watkin's Q( $\lambda$ ), Off-policy Eligibility Traces using Important Sampling, Variable  $\lambda$ .

**UNIT V:**

**Planning and Learning with Tabular Methods:** Models and Planning, Integrating Planning, Acting and Learning, Prioritized Sweeping, Full vs. Sample Backups, Trajectory Sampling, Heuristic Search, Monte Carlo Tree Search.



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**Text Book:**

1. Rich S. Sutton, Andrew G. Barto, Reinforcement Learning: An Introduction, Second Edition, MIT Press, 2015.
2. Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, Reinforcement Learning Algorithms: Analysis and Applications, 1<sup>st</sup> Edition, Springer, 2021.

**Reference Books:**

1. Phil Winder, Reinforcement Learning: Industrial Applications of Intelligent Agent, 1<sup>st</sup> Edition, O'Reilly, 2020.
2. Kyriakos G. Vamvoudakis, Yan Wan, Frank, L. Lewis, Derya Cansever, Handbook of Reinforcement Learning and Control, 1<sup>st</sup> Edition, Springer, 2021.

**NPTEL Link:** Reinforcement Learning: [https://onlinecourses.nptel.ac.in/noc22\\_cs34/preview](https://onlinecourses.nptel.ac.in/noc22_cs34/preview)



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II Year - II Semester	Honors Course	L	T	P	C
		4	0	0	4
<b>INTERNET OF THINGS (Systems Engineering)</b>					

**Course Objectives:**

The main objectives of this course are

- Vision and Introduction to Internet of Things (IoT).
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art – IoT Architecture.
- Understand Real World IoT Design Constraints, Industrial Automation and Commercial.

**Course Outcomes (COs):**

At the end of the course, student will be able to

- Explain in a concise manner how the general Internet as well as Internet of Things work.
- Understand constraints and opportunities of wireless and mobile networks for Internet of Things.
- Use basic sensing and measurement and tools to determine the real-time performance of network of devices.
- Develop prototype models for various applications using IoT technology.

**UNIT I:**

**The Internet of Things:** An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples of IoTs, Design Principles For Connected Devices Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

**UNIT II:**

Business Models for Business Processes in the Internet of Things ,IoT/M2M systems LAYERS AND designs standardizations ,Modified OSI Stack for the IoT/M2M Systems, ETSI M2M domains and High-level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability

**UNIT III:**

Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.

**UNIT IV:**

Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

**UNIT V:**

Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World.



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**Text Books:**

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
2. Internet of Things, A.Bahgya and V.Madisetti, Univesity Press,2015

**Reference Books:**

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley
2. Getting Started with the Internet of Things, CunoPfister , Oreilly



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>DATA COMMUNICATIONS AND INFORMATION CODING THEORY</b> <b>(Systems Engineering)</b>					

**Course Objective:**

The objective of this course is to introduce the basic concepts of information theory and coding, including information, source coding, channel model, channel capacity, channel coding and so on.

**Course Outcomes:**

The students at the end of the course will be able to:

- Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.
- Describe the real life applications based on the fundamental theory.
- Calculate entropy, channel capacity, bit error rate, code rate, steady-state probability and so on.
- Implement the encoder and decoder of one block code or convolutional code using any program language

**UNIT I:**

Overview; Basic Concepts - Entropy and Mutual information; Lossless Source Coding – Source entropy rate; Kraft inequality; Huffman code; Asymptotic equipartition property; Universal coding; Noisy Channel Coding - Channel capacity

**UNIT II:**

Random channel codes; Noisy channel coding theorem for discrete memory-less channels; Typical sequences; Error exponents; Feedback; Continuous and Gaussian channels; Lossy Source Coding - Rate-Distortion functions; Random source codes; Joint source-channel coding and the separation theorem.

**UNIT III:**

Source coding- Text, Audio and Speech: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding

**UNIT IV:**

Source coding- Image and Video: Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

**UNIT V:**

Error control coding- Block codes: Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder – CRC Error control coding

**Text books:**

1. Mark Kelbert(Author), Yuri Suhov, Information Theory and Coding by Example, Cambridge University Press,2013

**Reference books:**

1. Simon Haykin and Michael Moher, Communication Systems, 5th Edition, Wiley, 2010
2. T.M. & Thomas, J.A. (2006). Elements of information theory. New York: Wiley.
3. Ad'amek, Foundations of coding, Wiley Interscience, 1991.
4. T. M. Cover and J. A. Thomas, Elements of information theory, Wiley, 1991.





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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>SERVICE ORIENTED ARCHITECTURES</b> <b>(Systems Engineering)</b>					

**Course Objectives:**

- To gain understanding of the basic principles of service orientation
- To learn service oriented analysis techniques
- To learn technology underlying the service design
- To learn the concepts such as SOAP, Registering and Discovering Services.

**Course Outcomes:** At the end of this course, students are expected to gain the following learning:

1. Get the foundations and concepts of service based computing
2. Advocate the importance and means of technology alignment with business
3. Understanding the basic operational model of web services,
4. Gain the knowledge of key technologies in the service oriented computing arena
5. Apply and practice the learning through a real or illustrative project/case study.

**UNIT I**

**Software Architecture:** Need for Software Architecture, Objectives of Software Architecture, Types of Information Technology (IT) Architecture, Architectural Patterns and Styles

**Architecting Process for Software Applications:** Architectural Considerations, Architecting Process for Software Applications, Level 0: High-Level Architecture, Level 1: Solution Architecture Detailed Design

**UNIT II**

**SOA and MSA Basics:** Service Orientation in Daily Life, Evolution of SOA and MSA Service-oriented Architecture and Microservices architecture –Drivers for SOA, Dimensions of SOA, Conceptual Model of SOA, Standards And Guidelines for SOA, Emergence of MSA

**Service-Oriented Architecture:** Considerations for Enterprise-wide SOA, Strawman Architecture for Enterprise-wide SOA, Enterprise SOA Reference Architecture, Object-oriented Analysis and Design (OOAD) Process, Service-oriented Analysis and Design (SOAD) Process

**UNIT III**

**Service-Oriented Applications:** Considerations for Service-oriented Applications, Patterns for SOA, Pattern-based Architecture for Service-oriented Applications, Composite Applications, Composite Application Programming Model

**Service-Oriented Analysis and Design:** Need for Models, Principles of Service Design Non-functional Properties for Services, Design of Activity Services (or Business Services) Design of Data Services, Design of Client Services, Design of Business Process Services

**UNIT IV**

**Microservices Architecture:**

**Trend in SOA – Microservices Architecture (MSA):** Services Model for Cloud and Mobile Solutions, API Adoption on the Rise, Challenges and Takeways from SOA Implementations Architecture Trend – Microservices Architecture, Microservices Architecture in Action

**Cloud and MSA:** Cloud Services, Hybrid Cloud Services, Considerations for Hybrid Cloud Services, Cloud Services and MSA, MSA for SMAC Solutions

**UNIT V**

**Mobile and MSA:** Mobile Technologies, Types of Mobile Applications, MSA for mobile solutions Case Study: SOA – Loan Management System (LMS) PoC, MSA – APIary PoC



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**Text Book:**

1. Shankar Kambhampaty, Service - Oriented Architecture & Microservices Architecture, 3ed: For Enterprise, Cloud, Big Data and Mobile , ISBN: 9788126564064,Wiley.
2. Mark Richards, Microservices vs Service-Oriented Architecture, O'Reilly Media, Inc., 2016.

**Reference Books:**

1. Thomas Erl, Services-Oriented Architecture: Concepts, Technology and Design, Prentice Hall, 2005.
2. Guido Schmutz, Peter Welkenbach, Daniel Liebhart, Service-Oriented Architecture: An Integration Blueprint, Packt Publisher, 2010.



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>DESIGN OF SECURE PROTOCOLS</b> <b>(Systems Engineering)</b>					

**Course Objectives:**

The main objective of this course is that to explore various protocols and design of various protocols with deeper security.

**Course Outcomes:**

By the end of the course Student will

- Get the exposure to various protocols.
- Gain knowledge on various secure mechanisms through set of protocols.
- Efficiently design new set of protocols.
- Learn Security issues and overcome means with protocols.

**UNIT – I:**

OSI:ISO Layer Protocols: Application Layer Protocols, TCP/IP, HTTP, SHTTP, LDAP, MIME, POP & POP3, RMON, SNMP. Presentation Layer Protocols, Light Weight Presentation Protocol Session layer protocols.

**UNIT – II:**

RPC protocols, transport layer protocols, ITOT, RDP, RUDP, TALI, TCP/UDP, compressed TCP. Network layer Protocols, routing protocols, border gateway protocol-exterior gateway protocol, internet protocol IPv4, IPv6, Internet Message Control Protocol, IRDP Transport Layer Security, TSL, SSL, DTLS

**UNIT – III :**

Data Link layer Protocol, ARP, In ARP, IPCP, IPv6CP, RARP, SLIP .Wide Area and Network Protocols, ATM protocols, Broadband Protocols, Point to Point Protocols, Other WAN Protocols, security issues.

**UNIT – IV:**

Local Area Network and LAN Protocols, ETHERNET Protocols, VLAN protocols, Wireless LAN Protocols, Metropolitan Area Network Protocol, Storage Area Network and SAN

**UNIT – V :**

Protocols, FDMA, WIFI and WIMAX Protocols, security issues. Mobile IP, Mobile Support Protocol for IPv4 and IPv6, Resource Reservation Protocol. Multicasting Protocol, VGMP, IGMP, MSDP .Network Security and Technologies and Protocols, AAA Protocols, Tunneling Protocols, Secured Routing Protocols, GRE- Generic Routing Encapsulation, IPSEC– Security.

**Text Books:**

1. Jawin: “Networks Protocols Handbook”, 3rd Edition, Jawin Technologies Inc., 2005.
2. Bruce Potter and Bob Fleck : “802.11 Security”, 1st Edition, O’Reilly Publications, 2002.

**Reference Books:**

1. Ralph Oppliger :“SSL and TSL: Theory and Practice”, 1st Edition, Arttech House, 2009.
2. Lawrence Harte: “Introduction to CDMA- Network services Technologies and Operations”, 1st Edition, Althos Publishing, 2004.
3. Lawrence Harte: “Introduction to WIMAX”, 1st Edition, Althos Publishing, 2005



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>NETWORK CODING (Systems Engineering)</b>					

**Course Objectives:**

- Students will gain the understanding of core network programming by using sockets and transport layer protocols like TCP and UDP
- Students will gain the understanding of inter process communication and implementation of different forms of IPC in client-server environment
- Students will get an exposure to various application layer protocols which are designed using sockets and transport layer protocols

**Course Outcomes:**

By the end of the course, the student will be able to

- Explain the client-server paradigm and socket structures.
- Describe the basic concepts of TCP sockets and TCP echo client-server programs.
- Discuss the UDP sockets and UDP echo client-server programs.
- Explain Socket options and ability to understand IPC
- Apply the applications of sockets and demonstrate skill to design simple applications like FTP, TELNET etc.

**UNIT-I:**

Introduction to Network Programming: OSI model, transport layer protocols: TCP, UDP and SCTP, network architecture: client-server and peer-to-peer systems, Sockets-socket Address structures: IPv4, IPv6 and Generic-value result arguments, Byte ordering functions, Byte manipulation functions, Address conversion functions

**UNIT-II:**

TCP: introduction to TCP, TCP connection establishment and termination TIME\_WAIT State. Elementary TCP sockets, Socket, connect, bind, listen, accept, fork, exec function, concurrent servers, Close function, read and write functions

**UNIT-III:**

TCP echo client server program, getsockname and getpeername functions I/O multiplexing: I/O models, Select function, TCP echo server using select function, shutdown function, Poll function

**UNIT-IV:**

UDP: Introduction to UDP, difference between TCP and UDP, recvfrom( ) and sendto( ) functions, UDP echo client server program, UDP echo client server using select function. Socket Options: IPv4 socket options, IPv6 socket options

**UNIT-V:**

Socket Options: Generic socket options, TCP socket options. IPC: Introduction to IPC, forms of IPC, UNIX kernel support for pipes, FIFO, message queues, semaphores and shared memory Network programming concepts Implementation: FTP, ping, arp, SMTP, TELNET



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**Text Books:**

1. Unix Network programming, the socket networking API, W.Richard Stevens, bill fenner, Andrew m.rudoff ,PHI.

**References Books:**

1. Advanced programming in the UNIX environment, W.Richard Stevens, pearson education



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<b>II Year - II Semester</b>	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>PRINCIPLES OF CYBER SECURITY (Information Security)</b>					

**Course Objectives:**

- To learn threats and risks within context of the cyber security architecture.
- Student should learn and Identify security tools and hardening techniques.
- To learn types of incidents including categories, responses and timelines for response.

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

- Apply cyber security architecture principles.
- Demonstrate the risk management processes and practices.
- Appraise cyber security incidents to apply appropriate response
- Distinguish system and application security threats and vulnerabilities.
- Identify security tools and hardening techniques

**UNIT-I:**

**Introduction to Cyber Security**-Cyber security objectives, roles, differences between information security and cyber security, Cyber security principles-confidentiality, integrity, availability, authentication and non repudiation

**UNIT-II:**

**Information Security within Lifecycle Management**-Lifecycle management landscape, Security architecture processes, Security architecture tools, Intermediate lifecycle management concepts, **Risks & Vulnerabilities**-Basics of risk management, Operational threat environments, Classes of attacks

**UNIT-III:**

**Incident Response**-Incident categories, Incident response, Incident recovery, **Operational security protection**-Digital and data assets, ports and protocols, Protection technologies, Identity and access Management, configuration management

**UNIT-IV:**

**Threat Detection and Evaluation Monitoring**-Vulnerability management, Security logs and alerts, Monitoring tools and appliances, **Analysis**-Network traffic analysis, packet capture and analysis

**UNIT-V:**

**Introduction to backdoor System and security**-Introduction to metasploit, backdoor, demilitarized zone (DMZ), Digital signature, Brief study on Harding of operating system.

**Text Books:**

1. NASSCOM: Security Analyst Student Hand Book, Dec 2015
2. Information Security Management Principles, Updated Edition, [David Alexander](#), [Amanda Finch](#), [David Sutton](#), BCS publishers, June 2013

**Reference Books:**

1. Cyber Security Fundamentals-Cyber Security, Network Security and Data Governance Security, 2<sup>nd</sup> Edition, ISACA Publishers, 2019



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>COMPUTATIONAL NUMBER THEORY (Information Security)</b>					

**Course Objectives:** This course will focus on designing efficient algorithms (and providing complexity analysis) for the most important problems from number theory, with major applications in coding theory and cryptography.

**Course Outcomes:**

Upon completing the course the student will be able to

- understand with basics of number theory and its applications.
- demonstrate the arithmetic of finite fields, polynomials.
- analyze the elliptic curves, testing and factorization.
- Student will be able to solve the discrete logarithms and large sparse linear systems.
- Student will be able to apply the skills for writing programs of cryptography algorithms.

**UNIT I:**

**Arithmetic of Integers:** Basic Arithmetic Operations, GCD, Congruences and Modular Arithmetic, Linear Congruences, Polynomial Congruences, Quadratic Congruences, Multiplicative Orders, Continued Fractions, Prime Number Theorem and Riemann Hypothesis, Running Times of Arithmetic Algorithms.

**UNIT II:**

**Arithmetic of Finite Fields:** Existence and Uniqueness of Finite Fields, Representation of Finite Fields, Implementation of Finite Field Arithmetic, Arithmetic of Polynomials: polynomials over Finite Fields, Finding Roots of Polynomials over Finite Fields, Factoring Polynomials over Finite Fields, Properties of Polynomials with Integer Coefficients, Factoring Polynomials with Integer Coefficients.

**UNIT III:**

**Arithmetic of Elliptic Curves:** Elliptic Curve, Elliptic-Curve Group, Elliptic Curve over Finite Fields, Pairing on Elliptic Curves, Elliptic-Curve Point Counting, Primality Testing: Introduction, Probabilistic Primality Testing, Deterministic Primality Testing, Primality Testing for Number of Special Forms.

**UNIT IV:**

**Integer Factorization:** Trial Division, Pollard’s Rho Method, Pollard’s  $p-1$  Method, Dixon’s Method, CFRAC Method, Quadratic Sieve Method, Cubic Sieve Method, Elliptic Curve Method, Number-Field Sieve Method, Discrete Logarithms: Square-Root Methods, Algorithms: Prime Fields, Fields of Characteristic Two, General Extension Fields, Elliptic Curves(ECDLP).

**UNIT V:**

**Large Sparse Linear Systems:** Structured Gaussian Elimination, Lanczos Method, Wiedemann Method, Block Methods

**Text Books:**

1. Abhijit Das, Computational Number Theory, CRC Hall, 1<sup>st</sup> Edition, 2013.
2. T. H. Cormen, C. E. Leiserson, R. Rivest and C. Stein, Introduction to Algorithms, Prentice Hall India, 2nd Edition, 2002.





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**Reference Books:**

1. Victor Shoup, A Computational Introduction to Number Theory and Algebra, 2<sup>nd</sup> Edition, Cambridge University Press, 2008.
2. R. Lidl and H. Niederreiter, Introduction to finite fields and their applications, Cambridge University Press, 2021.
3. M. Mignotte, Mathematics for computer algebra, Springer-Verlag, 1992.



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<b>CRYPTANALYSIS</b> <b>(Information Security)</b>					



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>ELLIPTIC CURVE CRYPTOGRAPHY</b> <b>(Information Security)</b>					



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		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>Honors Course</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>INTRODUCTION TO QUANTUM COMPUTING AND QUANTUM CRYPTOGRAPHY (Information Security)</b>					



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>PUBLIC KEY INFRASTRUCTURE AND TRUST MANAGEMENT (Information Security)</b>					

**Course objectives:**

The course is designed to train the graduates in depth understanding of Public Key Cryptography, Public key Infrastructure, security credentials and design new or modify existing cryptographic techniques.

**Course Outcomes:**

Graduates after completing the course shall gain:

- In depth understanding of Public key cryptography and Infrastructure.
- Ability to design and analyze Public Key cryptographic techniques.
- Ability to solve network security issues in real time applications.
- Ability to take up doctoral level research work in security.

**UNIT I:**

**Public key infrastructure:** components and architecture. PKI interoperability, deployment and assessment PKI data structures – certificates, validation, revocation, authentication, cross-certification. Repository, Certification Authority (CA) and Registration Authority (RA), trusted third party, digital certificates.

**UNIT II:**

**PKI Services:** Authentication, Integrity and Confidentiality, Mechanisms, Secure Communication, Secure Time Stamping, Non-Repudiation, Privilege Management, Certificate policies, Certificate Authority, Registration Authority.

**UNIT III:**

**Key and Certificate Management:** Key/Certificate Life Cycle Management, Certificate Revocation: Periodic Public Mechanisms, performance, Scalability and Timeliness, Multiple Key pairs, Key Pair Uses, Real-World Difficulties, Independent Certificate Management.

**UNIT IV:**

**Trust Models:** Strict Hierarchy of Certification Authorities, Distributed Trust Architecture, Web Model, User-Centric Trust, Cross-Certification, Entity Naming, Certificate Path processing, PKI Information Dissemination: Repositories and Techniques, private Dissemination, Public and Repositories, In-Band Protocol Exchange.

**UNIT V:**

**PKI Standards:** Introduction, Major Standards Activities, X.509, PKIX, X.500, LDAP, ISO TC68, ANSI X9f, S/MIME, IPsec, TLS, SPKI, OpenPGP, EDIFACT.

**Text Books:**

1. Carlisle Adams, Steve Lloyd, Understanding Public-Key Infrastructure: Concepts, Standards, and Deployment Considerations, Sams, 1999.
2. [John R. Vacca](#), Public Key Infrastructure, Building Trusted Applications and Web Services, Auerbach Publications, 2004.



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**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

**Reference Books:**

1. Messaoud Benantar, Introduction to the Public Key Infrastructure for the Internet, Pearson Education, Prentice Hall, 2011.
2. Ashutosh Saxena, Public Key Infrastructure, Tata McGraw Hill.



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	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>INFORMATION SECURITY ANALYSIS AND AUDIT (Information Security)</b>					

**Course Objectives:**

- Understanding and knowledge of Security Auditing, and introduce the Threats and defense in the systems.
- Acquiring the knowledge on Evidence collection and evaluation techniques.

**Course Outcomes:**

At the end of the course, student will be able to

- Illustrate the fundamental concepts of information security and systems auditing
- Analyze the latest trend of computer security threats and defense
- Identify security weaknesses in information systems, and rectify them with appropriate security mechanisms
- Explain the security controls in the aspects of physical, logical and operational security control and case studies
- Evaluate the security of information systems

**UNIT-I:**

**Overview of Information System Auditing-** Effect of Computers on Internal Controls, Effects of Computers on Auditing, Foundations of information Systems Auditing, Conducting an Information Systems Audit.

**UNIT-II:**

**The management Control Framework-I-** Introduction, Evaluating the planning Function, Leading Function, Controlling Function, Systems Development Management Controls, Approaches to Auditing Systems Development, Normative Models of the Systems Development Process, Evaluating the Major phases in the Systems Development Process, Programming Management Controls, Data Resource Management Controls.

**UNIT-III:**

**The Management Control Framework-II-** Security Management Controls, Operations management Controls Quality assurance Management Controls, Case Studies.

**UNIT-IV:**

**Evidence Collection-** Audit Software, Code Review, Test Data, and Code Comparison, Concurrent Auditing techniques, Interviews, Questionnaires, and Control Flowcharts. Performance Management tools- Case Studies.

**UNIT-V:**

**Evidence Evaluation-** Evaluating Asset Safeguarding and Data Integrity, Evaluating System, Effectiveness, Evaluating System Efficiency, Information Systems Audit and Management: Managing the Information Systems Audit Function.

**Text Book:**

1. Information Systems Control and Audit, 1<sup>st</sup> Edition, Ron Weber, Pearson Education, 2013

**Reference Book:**

1. Information System Audit and Assurance, D P Dube, TMH, New Delhi, 2008





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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>CLOUD AND IOT SECURITY (Information Security)</b>					

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

- Discuss about Security Requirements in IoT Architecture
- Explain Random number generation
- Demonstrate Authorization with Publish / Subscribe schemes
- Identify Lightweight and robust schemes for Privacy protection
- Explain about IoT cloud security architecture

**UNIT I:**

**Introduction: Securing Internet of Things:** Security Requirements in IoT Architecture, Security in Enabling Technologies, Security Concerns in IoT Applications. Security Architecture in the Internet of Things, Security Requirements in IoT, Insufficient Authentication /Authorization, Insecure Access Control, Threats to Access Control, Privacy, and Availability, Attacks Specific to IoT. Vulnerabilities, Secrecy and Secret-Key Capacity, Authentication/Authorization for Smart Devices, Transport Encryption, Attack, Fault trees

**UNIT II:**

**Cryptographic Fundamentals for IoT:** Cryptographic primitives and its role in IoT, Encryption and Decryption, Hashes, Digital Signatures, Random number generation, Cipher suites, key management fundamentals, cryptographic controls built into IoT messaging and communication protocols.

**UNIT III:**

**Identity & Access Management Solutions for IoT:** Identity lifecycle, authentication credentials, IoT IAM infrastructure, Authorization with Publish / Subscribe schemes and access control

**UNIT IV:**

**Privacy Preservation and Trust Models for IoT:** Concerns in data dissemination, Lightweight and robust schemes for Privacy protection, Trust and Trust models for IoT, self-organizing Things, Preventing unauthorized access.

**UNIT V:**

**Cloud Security for IoT:** Cloud services and IoT, offerings related to IoT from cloud service providers, Cloud IoT security controls, enterprise IoT cloud security architecture, New directions in cloud enabled IoT computing

**Text Books:**

1. Practical Internet of Things Security (Kindle Edition) by Bria Russell, Drew VanDuren

**References Books:**

1. Securing the Internet of Things, Elsevier
2. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>WEB SECURITY (Information Security)</b>					

**Course Objectives:**

- Underlying security principles of the web
- Overview of concrete threats against web applications
- Insights into common attacks and countermeasures
- Current best practices for secure web applications

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

- Demonstrate security concepts, security professional roles, and security resources in the context of systems and security development life cycle
- Justify applicable laws, legal issues and ethical issues regarding computer crime
- Explain the business need for security, threats, attacks, top ten security vulnerabilities, and secure software development
- Apply information security policies, standards and practices, the information security blueprint
- Analyze and describe security requirements for typical web application scenario

**UNIT-I:**

**Introduction-**A web security forensic lesson, Web languages, Introduction to different web attacks, Overview of N-tier web applications, Web Servers-Apache, IIS.

**UNIT-II:**

**Securing the Communication Channel-** Understanding the dangers of an insecure communication channel. Practical advice on deploying HTTPS, and dealing with the impact on your application, Insights into the latest evolutions for HTTPS deployments.

**UNIT-III:**

**Web Hacking Basics-** HTTP & HTTPS URL, Web under the Cover Overview of Java security Reading the HTML source, Applet Security Servlets Security Symmetric and Asymmetric Encryptions, Network security Basics, Firewalls & IDS.

**UNIT-IV:**

**Securely Handling Untrusted Data-**Investigation of injection attacks over time, Understanding the cause behind both server-side and client-side injection attacks, Execution of common injection attacks, and implementation of various defenses.

**UNIT-V:**

**Preventing Unauthorized Access-**Understanding the interplay between authentication, authorization and session management. Practical ways to secure the authentication process prevent authorization bypasses and harden session management mechanisms, Securing Large Applications, Cyber Graffiti.

**Text Books:**

1. Web Hacking: Attacks and Defense, Latest Edition , McClure, Stuart, Saumil Shah, and Shreeraj Shah, Addison Wesley, 2003
2. Professional Java Security, 1.3 Edition, Garms, Jess and Daniel Somerfield, Wrox, 2001



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		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>BLOCK CHAIN ARCHITECTURE DESIGN AND USE CASES (Information Security)</b>					

**Course Objectives:**

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

- Understand how block chain systems (mainly Bit coin and Ethereum) work and to securely interact with them,
- Design, build, and deploy smart contracts and distributed applications,
- Integrate ideas from block chain technology into their own projects.

**Course Outcomes:**

At the end of the course, student will be able to

- Demonstrate the foundation of the Block chain technology and understand the processes in payment and funding.
- Identify the risks involved in building Block chain applications.
- Review of legal implications using smart contracts.
- Choose the present landscape of Blockchain implementations and Understand Crypto currency markets
- Examine how to profit from trading crypto currencies.

**UNIT I**

Introduction, Scenarios, Challenges Articulated, Blockchain, Blockchain Characteristics, Opportunities Using Blockchain, History of Blockchain.

Evolution of Blockchain : Evolution of Computer Applications, Centralized Applications, Decentralized Applications, Stages in Blockchain Evolution, Consortia, Forks, Public Blockchain Environments, Type of Players in Blockchain Ecosystem, Players in Market.

**UNIT II**

Blockchain Concepts: Introduction, Changing of Blocks, Hashing, Merkle-Tree, Consensus, Mining and Finalizing Blocks, Currency aka tokens, security on blockchain, data storage on blockchain, wallets, coding on blockchain: smart contracts, peer-to-peer network, types of blockchain nodes, risk associated with blockchain solutions, life cycle of blockchain transaction.

**UNIT III**

Architecting Blockchain solutions: Introduction, Obstacles for Use of Blockchain, Blockchain Relevance Evaluation Framework, Blockchain Solutions Reference Architecture, Types of Blockchain Applications. Cryptographic Tokens, Typical Solution Architecture for Enterprise Use Cases, Types of Blockchain Solutions, Architecture Considerations, Architecture with Blockchain Platforms, Approach for Designing Blockchain Applications.

**UNIT IV**

Ethereum Blockchain Implementation: Introduction, Tuna Fish Tracking Use Case, Ethereum Ecosystem, Ethereum Development, Ethereum Tool Stack, Ethereum Virtual Machine, Smart Contract Programming, Integrated Development Environment, Truffle Framework, Ganache, Unit Testing, Ethereum Accounts, MyEtherWallet, Ethereum Networks/Environments, Infura, Etherscan, Ethereum Clients, Decentralized Application, Metamask, Tuna Fish Use Case Implementation, OpenZeppelin Contracts



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**UNIT V**

Hyperledger Blockchain Implementation, Introduction, Use Case – Car Ownership Tracking, Hyperledger Fabric, Hyperledger Fabric Transaction Flow, FabCar Use Case Implementation, Invoking Chaincode Functions Using Client Application.

Advanced Concepts in Blockchain: Introduction, InterPlanetary File System (IPFS), Zero-Knowledge Proofs, Oracles, Self-Sovereign Identity, Blockchain with IoT and AI/ML Quantum Computing and Blockchain, Initial Coin Offering, Blockchain Cloud Offerings, Blockchain and its Future Potential.

**Text Books:**

- 1) Ambadas, Arshad Sarfarz Ariff, Sham “Blockchain for Enterprise Application Developers”, Wiley
- 2) Andreas M. Antonopoulos, “Mastering Bitcoin: Programming the Open Blockchain”, O’Reilly

**Reference Books:**

- 1) Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph Bambara, Paul R. Allen, Mc Graw Hill.
- 2) Blockchain: Blueprint for a New Economy, Melanie Swan, O’Reilly

**e-Resources:**

- 1) <https://github.com/blockchainedindia/resources>



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

II Year - II Semester	Honors Course	L	T	P	C
		4	0	0	4

**DATA VISUALIZATION**  
**(Data Science)**

**Course Objectives:**

The main objective of this course is to make it easier to identify patterns, trends and outliers in large data sets

**Course Outcomes:**

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

- Identify and recognize visual perception and representation of data.
- Illustrate about projections of different views of objects.
- Apply various Interaction and visualization techniques.
- Analyze various groups for visualization.
- Evaluate visualizations

**UNIT-I:**

**Introduction to Data Visualizations and Perception:** Introduction of visual perception, visual representation of data, Gestalt principles, Information overload.

**UNIT-II :**

**Visual Representations:** Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

**UNIT-III :**

**Classification of Visualization Systems:** Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

**UNIT-IV :**

**Visualization of Groups:** Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.

**UNIT-V :**

**Visualization of Volumetric Data And Evaluation of Visualizations:** Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations

**Text Books:**

1. Ward, Grinstein, Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick, 2<sup>nd</sup> edition, A K Peters, Ltd 2015.

**Reference Books:**

1. Tamara Munzner, Visualization Analysis & Design ,1<sup>st</sup> edition, AK Peters Visualization Series 2014
2. Scott Murray, Interactive Data Visualization for the Web ,2<sup>nd</sup> Edition, 2017



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**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>STATISTICAL FOUNDATIONS FOR DATA SCIENCE</b> <b>(Data Science)</b>					

**Course Objectives:**

The course will introduce the fundamental concepts of probability and statistics required for a program in data science

**Course outcomes:**

By the end of the course, the student will be able to

- Use the statistical concepts in the field of data science.
- Employ the techniques and methods related to the area of data science in variety of applications.
- Apply logical thinking to understand and solve the problem in context.
- Explore statistical learning methods and their application to modern problems in science, industry, and society.
- Build analytics pipelines for regression problems and classification problems

**UNIT I:**

Basics of Data Science: Introduction; Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective; Structured thinking for solving data science problems.

**UNIT II:**

Probability, Statistics and Random Processes: Probability theory and axioms; Random variables; Probability distributions and density functions (univariate and multivariate); Expectations and moments; Covariance and correlation; Statistics and sampling distributions; Hypothesis testing of means, proportions, variances and correlations; Confidence (statistical) intervals; Correlation functions; White-noise process

**UNIT III:**

Probabilistic formulations of prediction problems: Plug-in estimators, empirical risk minimization, Linear threshold functions, perceptron algorithm, Risk bounds, Concentration inequalities, Uniform convergence, Rademacher averages; combinatorial dimensions, Convex surrogate losses for classification, Linear regression, Regularization and linear model selection, Feature Selection Methods, Cross Validation methods.

**UNIT IV:**

Game-theoretic formulations of prediction problems, High Dimensional methods, Lasso, Ridge Regression, Dimensionality Reduction, Minimax strategies for log loss, linear loss, and quadratic loss, Universal portfolios, Online convex optimization.

**UNIT V:**

Neural networks: Stochastic gradient methods, Combinatorial dimensions and Rademacher averages, Hardness results for learning, Efficient learning algorithms.

**Text Books:**

1. Bendat, J. S. and A. G. Piersol. Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA, 2010
2. Montgomery, D. C. and G. C. Runger. Applied Statistics and Probability for Engineers. 5th Edition. John Wiley & Sons, Inc., NY, USA, 2011.



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3. James, G., Witten, D., Hastie, T., Tibshirani, R. An Introduction to Statistical Learning with Applications in R, Springer, 2013.

**Reference Books:**

1. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second Edition, Springer, 2009.





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**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>MINING MASSIVE DATA SETS (Data Science)</b>					

**Course Objective:** The course will discuss data mining and machine learning algorithms for analyzing very large amounts of data. The emphasis will be on MapReduce and [Spark](#) as tools for creating parallel algorithms that can process very large amounts of data.

**Course Outcomes:**

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

1. Discuss research directions in Mining Massive Datasets, such as similarity search, streaming data, clustering, and graph mining.
2. Analyze policy, focusing on methods for mining massive datasets and potential policy and management applications, by synthesizing and summarizing the current state of the art, and facilitating discussion by posing questions, preliminary conclusions, and ideas to explore.
3. Develop a research project relevant to Mining Massive Datasets and produce a report describing the project's background, methods, results, and conclusions.
4. Knowledge of basic computer science principles and skills, at a level sufficient to write a reasonably non-trivial computer program.
5. Good knowledge of Java and Python will be extremely helpful since most assignments will require the use of Spark

**UNIT I:**

**Data Mining:** Data Mining, Statistical Limits on Data Mining, MapReduce: Distributed File Systems, MapReduce, Algorithms Using MapReduce, Extensions to MapReduce.

**UNIT II:**

**Finding Similar Items:** Applications of Near-Neighbor Search, Shingling of Documents, Distance Measures, Theory of Locality-Sensitive Functions, Applications of LSH Hashing.

**UNIT III:**

**Mining Data Streams:** Stream Data Model, Sampling Data in Streams, Filtering Streams, Link Analysis: PageRank, Efficient Computational of PageRank, Link Spam, Hubs and Authorities.

**UNIT IV:**

**Frequent Itemsets:** Market-Based Model, Market Based and A-Priori Algorithm, Limited- Pass Algorithms, Clustering: Introduction, Hierarchical Clustering and K-means Algorithm, CURE Algorithm.

**UNIT V:**

**Dimensionality Reduction:** Eigenvalues and Eigenvectors, Principal-Component Analysis, CUR Decomposition, Large-Scale Machine Learning: Machine Learning Model, Perceptrons, SVM's, Nearest Neighbors.

**Text Books:**

1. Jure Leskovec, Anand Rajaraman, Jeffery D. ULLman, Mining of Massive Datasets, Cambridge University Press, 2014.
2. Pattern Recognition and Machine Learning. Christopher Bishop. Springer-Verlag New York. 2006.



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**Reference Books:**

1. Machine Learning: A Probabilistic Perspective. Kevin Murphy. MIT Press. 2012
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Trevor Hastie, Robert Tibshirani, Jerome Friedman. Springer. 2013



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**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

	<b>Honors Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>MEDICAL IMAGE DATA PROCESSING</b> <b>(Data Science)</b>					

**Course Objectives:**

The course will provide the participants with an up-to-date background in current state-of-the-art in medical imaging and medical image analysis. The aim of the course is to show how to extract, model, and analyze information from medical data and applications in order to help diagnosis, treatment and monitoring of diseases through computer science.

**Course Outcomes:** At the End of the Course:

1. Student will be able to explain the basic concepts of Medical Imaging Technologies, Systems and Formation Principles.
2. Student will be able to analyze the Medical Image Storage and Processing.
3. Student will be able to visualize the MRI, NMR and Artifacts.
4. Student should expertise the Segmentation and Classification techniques on Medical Image Data.
5. Student will be able to analyze the Nuclear Imaging like PET, SPECT and 3D Images.

**UNIT I:**

**Introduction:** Introduction to Medical Imaging Technology, Systems, and Modalities. Brief History, Importance, Applications, Trends, Challenges. Medical Image Formation Principles: X-Ray physics, X-Ray generation, Attenuation, Scattering, Dose Basic Principles of CT, Reconstruction Methods, Artifacts, CT hardware.

**UNIT II:**

**Storage and Processing:** Medical Image Storage, Archiving and Communication Systems and Formats Picture archiving and communication system (PACS); Formats: DICOM Radiology Information Systems (RIS) and Hospital Information Systems (HIS). Medical Image Processing, Enhancement, Filtering Basic image processing algorithms Thresholding, contrast enhancement, SNR characteristics; filtering; histogram modeling.

**UNIT III:**

**Visualization:** Medical Image Visualization Fundamentals of Visualization, Surface and Volume Rendering/Visualization, Animation, Interaction. Magnetic Resonance Imaging (MRI) Mathematics of MR, Spin Physics, NMR Spectroscopy, Imaging Principles and Hardware, Image Artifacts.

**UNIT IV:**

**Segmentation And Classification:** Medical Image Segmentation, Histogram-Based Methods, Region Growing and Watersheds, Markov Random Field Models, Active Contours, Model-Based Segmentation. Multi-Scale Segmentation, Semi-Automated Methods, Clustering-Based Methods, Classification-Based Methods, Atlas-Guided Approaches, Multi-Model Segmentation. Medical Image Registration Intensity-Based Methods, Cost Functions, Optimization Techniques.

**UNIT V:**

**Nuclear Imaging:** PET and SPECT Ultrasound Imaging Methods, Mathematical Principles, Resolution, Noise Effect, 3D Imaging, Positron Emission Tomography, Single Photon Emission Tomography, Ultrasound Imaging, Applications. Medical Image Search and Retrieval Current Technology in Medical Image Search, Content-Based Image Retrieval, New Trends: Ontologies, Applications, Other Applications Of Medical Imaging Validation, Image Guided Surgery, Image Guided Therapy, Computer Aided Diagnosis/Diagnostic Support Systems.



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**Text Books:**

1. Paul Suetens, "Fundamentals of Medical Imaging", Second Edition, Cambridge University Press, 2009.
2. J. Michael Fitzpatrick and Milan Sonka, "Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis", SPIE Publications, 2009.

**Reference Books:**

1. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2005.
2. Geoff Dougherty, "Digital Image Processing for Medical Applications", First Edition, Cambridge University Press, 2009.
3. Jerry L. Prince and Jonathan Links, "Medical Imaging Signals and Systems", First Edition 1, Prentice Hall, 2005.
4. John L. Semmlow, "Biosignal and Medical Image Processing", Second Edition, CRC Press, 2008.

**Open Electives to be offered by CSE / IT for other Branches:**

<p><b>Open Elective-I:</b></p> <ol style="list-style-type: none"><li>1. Data Structures</li><li>2. Object Oriented Programming through JAVA</li><li>3. Data Base Management Systems</li><li>4. Computer Graphics</li><li>5. Advanced UNIX Programming</li><li>6. Computer Organization and Architecture</li><li>7. Operating Systems</li></ol>	<p><b>Open Elective-II:</b></p> <ol style="list-style-type: none"><li>1. Python Programming</li><li>2. Web Technologies</li><li>3. Soft Computing</li><li>4. Distributed Computing</li><li>5. AI and ML for Robotics</li><li>6. Computer Networks</li><li>7. Big Data Analytics</li><li>8. Computational Tools</li></ol>
<p><b>Open Elective-III:</b></p> <ol style="list-style-type: none"><li>1. AI Tools &amp; Techniques</li><li>2. Image Processing</li><li>3. Information Security</li><li>4. Mobile Application Development</li><li>5. Data Science</li><li>6. Cyber Security</li><li>7. Introduction to Internet of Things</li></ol>	<p><b>Open Elective-IV:</b></p> <ol style="list-style-type: none"><li>1. MEAN Stack Technologies</li><li>2. Deep Learning Techniques</li><li>3. Cloud computing with AWS</li><li>4. Block Chain Technologies</li><li>5. Cryptography &amp; Network Security</li><li>6. Introduction to Machine Learning</li><li>7. Machine Learning with Python</li></ol>

**Open Electives to be offered by CSE/IT for other Branches**

		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Data Structures (Open Elective-I)</b>					

**Course Objectives:**

- Solve problems using data structures such as linear lists, stacks, queues, hash tables
- Be familiar with advanced data structures such as balanced search trees, AVL Trees, and B Trees.

**Course Outcomes:** By the end of the course student will be able to

- Select appropriate data structures as applied to specified problem definition.
- Summarize and understand the practical applications of several advanced techniques like Hashing and Analyzing and Implement appropriate sorting /searching technique for given problems.
- Demonstrate the operations such as Insertion, Deletion and Search on Data structures like Binary Search Tree and solve the problems.
- Demonstrate the operations such as Insertion, Deletion and Search on Advanced Data structures like Heaps, AVL trees and B Trees.
- Comparisons of trees like Red Black trees and B-Trees etc. and priority queue operations.

**UNIT- I: Introduction to Data Structures:** Abstract Data Types (ADTs), The List ADT: Simple Array Implementation of Lists, Simple Linked Lists, Doubly Linked Lists, Circularly Linked Lists. The Stack ADT: The Stack Model, Implementation of Stacks, Applications of Stack. The Queue ADT: Queue Model, Array Implementation of Queues, Application of Queues. Stacks and Queue implementation using linked list.

**UNIT-II: Searching:** List Searches, Linear and Binary Search Methods.

**Sorting:** Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap sort.

**Hashing:** Hash Function, Separate Chaining, Collision Resolution-Separate Chaining.

**UNIT- III: Trees:** Binary Trees- Implementation, Expression Trees. Binary Search Trees- find, findMin and findMax, insert, delete operations.

**UNIT- IV: Trees:** AVL Trees- Single and Double Rotation, Operations.

**B-Tree:** searching, insertion, deletion

**UNIT -V:**



**Trees:** Introduction to Red-Black, splay trees and Comparison of Search Trees  
**Priority Queues:** Priority Queue Models, Simple Implementations.

**Text Books:**

1. Data Structures and Algorithm Analysis, 4<sup>th</sup> Edition, Mark Allen Weiss, Pearson.
2. Data Structures: A PseudoCode Approach with C, 2<sup>nd</sup> Edition, Richard F. Gilberg, & Behrouz A. Forouzon, Cengage.

**References Books:**

1. Data Structures, Algorithms and Applications in java, 2/e, Sartaj Sahni, University Press.
2. Data Structures using C, 2/e, Reema Thareja

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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Object Oriented Programming through JAVA (Open Elective-I)</b>					

**Course Objective:** Implementing programs for user interface and application development using core java principles

**Course Outcomes:** By the end of the course student will be able to

- Discuss and understand java programming constructs, Control structures
- Illustrate and experiment Object Oriented Concepts like classes, objects
- Apply Object Oriented Constructs such as Inheritance, interfaces, and exception handling
- Construct applications using multithreading and I/O
- Develop Dynamic User Interfaces using applets and Event Handling in java

**UNIT I:** Focus on object oriented concepts and java program structure and its installation, Introduction to OOP Introduction, Need of Object Oriented Programming, Principles of Object Oriented Languages, Procedural languages Vs OOP, Applications of OOP, History of JAVA, Java Virtual Machine, Java Features.

**UNIT II:** Comprehension of java programming constructs, control structures in Java Programming Constructs Variables , Primitive Datatypes, Identifiers-Naming Conventions, Keywords, Literals, Operators-Binary, Unary and ternary, Expressions, Precedence rules and Associativity, Primitive Type Conversion and Casting, Flow of control Branching, Conditional, loops.,

**UNIT III:** Classes and Objects- classes, Objects, Creating Objects, Methods, constructors, Constructor overloading, cleaning up unused objects-Garbage collector, Class variable and Methods-Static keyword, this keyword, Arrays, Command line arguments **Interfaces and exception handling Inheritance:** Types of Inheritance, Deriving classes using extends keyword, Method overloading, super keyword, final keyword, Abstract class Interfaces,

**UNIT IV:** Understanding of Thread concepts and I/O in Java MultiThreading: java.lang.Thread, The main Thread, Creation of new threads, Thread priority, Multithreading- Using isAlive() and join(), Synchronization, suspending and Resuming threads, Communication between Threads.

**UNIT V:** Being able to build dynamic user interfaces using applets and Event handling in java Swing: Introduction , javax.swing package , JFrame, JApplet,

JPanel, Components in swings, Layout Managers, JList and JScroll Pane, Split Pane, JTabbedPane, Dialog Box.

**Text Books:**

1. The Complete Reference Java, 8ed, Herbert Schildt, TMH
2. Programming in JAVA, Sachin Malhotra, Saurabh choudhary, Oxford.

**Reference Books:**

1. JAVA Programming, K.Rajkumar.Pearson
2. Core JAVA, Black Book, Nageswara Rao, Wiley, Dream Tech
3. JAVA for Beginners, 4e, Joyce Farrell, Ankit R. Bhavsar, Cengage Learning.
3. Object oriented programming with JAVA, Essentials and Applications, Raj Kumar Bhuyya, Selvi, Chu TMH
5. Introduction to Java programming, 7th ed, Y Daniel Liang, Pearson  
Core JAVA for Beginners, Rashmi Kanta Das, Vikas.
6. Object Oriented Programming through JAVA , P Radha Krishna , University Press

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<b>Data Base Management Systems (Open Elective-I)</b>					

**Course Objectives:**

To learn the principles of systematically designing and using large scale Database Management Systems for various applications.

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

- Illustrate the concept of databases, database management systems, database languages, database structures and their work
- Apply ER modeling and Relational modeling for designing simple databases.
- Summarize the concepts related to relational model and SQL and Write database queries using relational algebra and structured query language.
- Design and develop databases from the real world by applying the concepts of Normalization.
- Outline the issues associated with Transaction Management and Recovery, Tree Structured Indexing

**UNIT I: Overview of Database System:** Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Informational Retrieval, Specialty Databases, Database Users and Administrators, History of Database Systems. **[Text Book -2]**

**UNIT II: Introduction to Database Design:** Database Design and ER Diagrams, Entities, Attributes and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design with the ER Model, Extended ER features **[Text Book -1]**

**UNIT III: Relational Model:** Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity Constraints, Querying Relational Data, Logical Database Design: ER to Relational, Introduction to Views, Destroying/Altering Tables and Views **[Text Book -1]**

**UNIT IV: SQL: Queries, Constraints, Triggers:** The Form of a Basic SQL Query, UNION, INTERSECT and EXCEPT, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers, Exceptions, Procedures, Functions **[Text Book -1]**

**UNIT V: Normal Forms:** Introduction to Schema Refinement, Functional Dependencies, Reasoning about FDs, Normal Forms, Properties of Decompositions, Normalization. **[Text Book -1]**

**Text Books:**

1. Data base Management Systems, 3/e, Raghurama Krishnan, Johannes Gehrke, Mc Graw-Hill
2. Data base System Concepts, 6/e, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Mc Graw-Hill

**Reference Books:**

1. Database Systems, 6/e Ramez Elmasri, Shamkant B. Navathe, Pearson
2. Introduction to Database Systems, 8/e, C J Date, Pearson
3. Database Systems, 9/e, Carlos Coronel, Steven Morris, Peter Rob, Cengage

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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Computer Graphics (Open Elective-I)</b>					

**Course Objectives:**

- To develop, design and implement two and three dimensional graphical structures
- To enable students to acquire knowledge Multimedia compression and animations
- To learn Creation, Management and Transmission of Multimedia objects.

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

- Acquire the basics of computer graphics, different graphics systems and applications of computer graphics with various algorithms for line, circle and ellipse drawing objects for 2D transformations
- Explain projections and visible surface detection techniques for display of 3D scene on 2D screen
- Develop scene with basic graphic primitive algorithms using OPENGL programming.
- Know and be able to Explain selected among models for lighting/shading: Color, ambient light; distant and light with sources; Phong reflection model; and shading (flat, smooth, Gourand, Phong).
- Illustrate able to create the general software architecture of programs that use 3D object sets with computer graphics

**UNIT I: 2D Primitives :** Output primitives, Line, Circle and Ellipse drawing algorithms, Attributes of output primitives, Two dimensional Geometric transformations, Two dimensional viewing, Line, Polygon, Curve clipping algorithms

**UNIT II: 3D Concepts:** Parallel and Perspective projections, Three dimensional object representation, Polygons, Curved lines, Splines, Quadric Surfaces, Visualization of data sets, 3D transformations, Viewing, Visible surface identification.

**UNIT III: Graphics Programming :** Color Models – RGB, YIQ, CMY, HSV, Animations, General Computer Animation, Raster, Keyframe, Graphics programming using OPENGL, Basic graphics primitives, Drawing three dimensional objects.

**UNIT IV: Rendering :** Introduction to Shading models, Flat and Smooth shading, Adding texture to faces, Adding shadows of objects, Building a camera in a program, Creating shaded objects, Rendering texture, Drawing Shadows.

**UNIT V: Fractals:** Fractals and Self similarity, Peano curves, Creating image by iterated functions, Mandelbrot sets, Julia Sets, Random Fractals

**Text Books:**

1. Donald Hearn, Pauline Baker, Computer Graphics – C Version, second edition, Pearson Education, 2004.
2. F.S. Hill, Computer Graphics using OpenGL, Second edition, Pearson Education, 2003.

**Reference Books:**

1. James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, Computer Graphics- Principles and practice, Second Edition in C, Pearson Education, 2007.



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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Advanced UNIX Programming (Open Elective-I)</b>					

**Course Objectives:**

Understating the shell commands, shell programming, system calls of files and processes, signals, inter-process communication concepts and programming, TCP and UDP.

**Course Outcomes:**

After finishing this course student will be able to:

- Gain good knowledge on Unix commands AND Awareness of shell programming
- Know about different system calls for files and directories
- Ability to know the working of processes and signals
- Application of client server program for IPC
- Knowledge about socket programming

**UNIT-I:** Introduction, Architecture of unix, Responsibilities of shell, unix file system, vi editor. **Unix commands:** Some Basic Commands, file utilities, process utilities, text processing utilities, network utilities, disk utilities, Security by file permissions.

**UNIT-II: Shell Programming:** shell variables, The Export command, The Profile File a Script Run During starting, The First Shell Script, The read command, Positional Parameters, The \$? Variable , The Exit command, Branching Control Structures, Loop Control Structures, The Continue and Break Statement- Real Arithmetic in Shell Programs

**UNIT-III: Files** - Introduction, file descriptors, open, creat, read, write, close, lseek, dup2, file status information-stat family, file and record locking- fcntl function, file permissions - chmod, fchmod, file ownership-chown, lchown, link, unlink.

**UNIT-IV: Directories**-Creating, removing and changing Directories-mkdir, rmdir, chdir, obtaining current working directory-getcwd, Directory contents, Scanning Directories-opendir, readdir, closedir, rewinddir functions.

**UNIT-V: Process Control:** process identifiers, fork function, vfork function, exit function, wait and waitpid functions, exec functions, user identification. **Signals:** signal handling using signal function, kill and raise, alarm, pause, abort and

sleep functions. **Shared memory**-system calls of shared memory, semaphore structure in kernel, client server example.

**Text Books:**

1. Unix the ultimate guide, 3<sup>rd</sup> edition, Sumitabha Das, TMH.
2. Advanced programming in the unix environment by W. Richard Stevens.
3. Unix network programming by W. Richard Stevens.

**Reference Books:**

1. Introduction to Unix and shell programming, Venkateshmurthy
2. Unix and shell programming by B.M. Harwani, OXFORD university press.

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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Computer Organization and Architecture (Open Elective-I)</b>					

**Course Objectives:**

- The purpose of the course is to introduce principles of computer organization and the basic architectural concepts.
- It provides an in depth understanding of basic organization, design, programming of a simple digital computer, computer arithmetic, instruction set design, micro programmed control unit, pipelining and vector processing, memory organization and I/O systems

**Course Outcomes:** By the end of the course student will be able to

- Demonstrate an understanding of the different number systems, codes and Relate Postulates of Boolean algebra and minimize combinational functions
- Evaluate and learn different combinational circuits, sequential circuits and able to design them
- Organize, Determine and learns basic structure of components register through language, micro operations and able to write micro programs
- Determine and able to write data transfer and manipulators program and students able to learn micro programme control and central processing unit
- Able to learns the internal organization of computers and able to evaluate performance of them.

**UNIT I: Number System and Data Representation:** Introduction, Numbering Systems, Decimal to Binary Conversion, Binary Coded Decimal Numbers, Error Detecting Codes, Error Correcting Codes, Hamming Code for Error Correction.

**Boolean algebra and Logic gates :** Karnaugh map representation and minimization of Boolean functions using K-maps up to 4-variable; Don't care conditions, Digital Logic gates, Two-level realizations using gates -- AND-OR, OR-AND, NAND-NAND and NOR-NOR

**UNIT II: Combinational logic circuits-I:** Design of Half adder, full adder, half subtractor, full subtractor, Design of decoder, De-multiplexer, encoder, multiplexer. **Sequential circuits I:** Classification of sequential circuits (synchronous and asynchronous): basic flip-flops, truth tables and excitation tables (NAND RS latch, NOR RS latch, RS flip-flop. JK flip-flop, T flip-flop, D flip-flop with reset and clear terminals).

**Unit-III: Basic Structure Of Computers:** Computer Types, Functional unit, Basic Operational concepts, Bus structures, Software, Performance, multiprocessors and multi computers.

**Register Transfer Language And Micro-operations:** Register Transfer language. Register Transfer Bus and memory transfers, Arithmetic Micro-operations, Logic micro operations, shift micro operations. Instruction codes. Computer Registers, Computer instructions, Instruction cycle.

**UNIT IV: Micro Programmed Control:** Control memory, Address sequencing, micro program example, design of control unit.

**Central Processing Unit:** General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control.

**UNIT V: Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory, Virtual memories Introduction to Shift registers and RAID **Input –Output Organization** Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupts, DMA, Input Output Processor, Serial Communication.

**Text Books:**

1. Digital Logic and Computer Design, Moriss Mano, 11th Edition, Pearson Education.
2. Computer Organization, 5<sup>th</sup>ed., Hamacher, Vranesic and Zaky, TMH, 2002
3. Computer System Architecture, 3/e, Moris Mano, Pearson/PHI.

**Reference Books:**

1. Computer System Organization & Architecture, John D. Carpinelli, Pearson, 2008
2. Computer System Organization, Naresh Jotwani, TMH, 2009
3. Computer Organization & Architecture: Designing for Performance, 7<sup>th</sup>ed., William Stallings, PHI, 2006
4. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.

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<b>Operating Systems (Open Elective-I)</b>					

**Course Objectives:**

- Study the basic concepts and functions of operating systems.
- Understand the structure and functions of OS.
- Learn about Processes, Threads and Scheduling algorithms.
- Understand the principles of concurrency and Deadlocks.
- Learn various memory management schemes.
- Study I/O management and File systems.
- Learn the basics of Linux system and perform administrative tasks on Linux Servers.

**Course Outcomes:**

By the end of the course, student will be able to

- Describe Computer Operating System Functions, Structures and System Calls.
- Demonstrate various Process Management Concepts and CPU Scheduling Algorithms and Process Synchronization Techniques.
- Illustrate Memory Management Techniques and Page Replacement Algorithms.
- Apply Deadlock Prevention and Avoidance Techniques
- Demonstrate File System Concepts and Mass Storage Structures

**UNIT-I: Introduction to Operating System Concept:** Types of operating systems, operating systems concepts, Evaluation of operating systems, operating systems services, structure of OS, Introduction to System call, System call types.

**UNIT-II: Process Management** – Process concept, The process, Process State Diagram , Process control block, Process Scheduling- Scheduling Queues, Schedulers, Operations on Processes, Interprocess Communication, Threading Issues, Scheduling-Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

**UNIT-III: Memory Management:** Swapping, Contiguous Memory Allocation, Paging, structure of the Page Table, **Virtual Memory Management:** Virtual Memory, Demand Paging, Page-Replacement Algorithms.

**UNIT-IV: Concurrency:** Process Synchronization, The Critical- Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples **Principles of deadlock:** System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock

**UNIT-V: File System Interface:** Concept of a file, Access Methods, Directory structure, File system mounting, file sharing, protection. **File System Implementation:** File system structure, allocation methods, Disk scheduling, **Case studies:** Android, UNIX, Windows

**Text Books:**

1. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne 9th Edition, John Wiley and Sons Inc., 2012.
2. Operating Systems – Internals and Design Principles, William Stallings, 7th Edition, Prentice Hall, 2011.

**Reference Books:**

1. Modern Operating Systems, Andrew S. Tanenbaum, Second Edition, Addison Wesley, 2001.
2. Operating Systems: A Design-Oriented Approach, Charles Crowley, Tata McGraw Hill Education, 1996.
3. Operating Systems: A Concept-Based Approach, D M Dhamdhare, Second Edition, Tata McGraw-Hill Education, 2007.
4. Operating Systems-S Halder, Alex A Aravind Pearson Education Second Edition 2016

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<b>Python Programming (Open Elective-II)</b>					

**Course Objectives:**

- Introduction to Scripting Language
  - Exposure to various problems solving approaches of computer science
- Syllabus

**Course Outcomes:**

By the end of the course, the student will be able to

- Describe comprehend the basics of python programming
- Demonstrate the principles of structured programming and be able to describe, design, implement, and test structured programs using currently accepted methodology
- Explain the use of the built-in data structures list, sets, tuples and dictionary.
- Make use of functions and its applications
- Identify real-world applications using oops, files and exception handling provided by python.

**UNIT I: Introduction:** History of Python, Python Language, Features of Python, Applications of Python, Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

**UNIT II: Types, Operators and Expressions:** Types - Integers, Strings, Booleans; Operators Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations, Control Flow- if, if-elif-else, for, while, break, continue.

**UNIT III:** Data Structures Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions.

**UNIT IV: Functions** - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions(Function Returning Values), Scope of the Variables in a Function - Global and Local Variables.

**UNIT V: Modules:** Creating modules, import statement, from.import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages Error and Exceptions: Difference between an error and



Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions

**Text Books:**

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Learning Python, Mark Lutz, Orielly

**Reference Books:**

1. Think Python, Allen Downey, Green Tea Press
2. Core Python Programming, W.Chun, Pearson.
3. Introduction to Python, Kenneth A. Lambert, Cengage

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<b>Web Technologies (Open Elective-II)</b>					

**Course Objectives:**

- To Learn the basics of Web Designing using HTML, DHTML, CSS, Client side scripts and Server side scripts

**Course Outcomes (COs):**

At the end of the course, student will be able to

- Describe basics of Web Designing using HTML, DHTML, and CSS
- Build real world applications using client side and server side scripting languages
- Design and develop applications using web servers
- Analyze the basics of PHP programming
- Apply Database connectivity with case study for student Information System and Health Management system

**UNIT I: HTML:** Introduction, HTML Formatting, Hyper-Links, Lists, Tables, Images, Forms, Frames, Cascading Style sheets, Types, XML, Document type definition, XML Schemas, Document Object model.

**UNIT II: Introduction to Client Side scripting** –JavaScript, Control statements, Functions, Arrays, Objects, Events, Dynamic HTML with Java Script, AJAX: Ajax Client Server Architecture, XML Http Request Object, Call Back Methods.

**UNIT III: Web Application-** Web servers, IIS(XAMPP) and Tomcat Servers, Server Side Scripting, Java Servlets, Java Server Pages, JSF Components, Cookies.

**UNIT IV: PHP Programming** -Basic Syntax, Defining variable and constant, PHP Data types, Operator and Expression, Operator Precedence, Decisions and Loop, Functions & Recursion, String Processing and Regular Expressions

**UNIT V: JDBC:** Database Connectivity with MySQL, Servlets, JSP, PHP, Case Studies - Student information system, Health Management System

**Text Books:**

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, “Internet & World Wide Web How to Program”, Fifth Edition, Deitel Series, 2012.
2. Jason Gilmore, “Beginning PHP and MySQL from Novice to Professional”, Fourth Edition, Apress Publications, 2010.

3. Brown, Ethan, "Web Development with Node and Express: Leveraging the JavaScript Stack", O'Reilly Media, 2019. CSE Dept. Flexible Curriculum NITTUGCSE19 95
4. Anthony, Accomazzo, Murray Nathaniel, Lerner Ari, "Fullstack React: The Complete Guide to React JS and Friends", Fullstack.io, 2017.
5. Kozlowski, Pawel, "Mastering Web Application Development with Angular JS", Packt Publishing Ltd., 2013.

**Reference Books:**

1. Robert W. Sebesta, "Programming with World Wide Web", Fourth Edition, Pearson, 2008.
2. David William Barron, "The World of Scripting Languages", Wiley Publications, 2000.
3. Dayley B., "Node.js, MongoDB, and AngularJS Web Development", Addison-Wesley Professional, 2014.
4. Vainikka J., "Full-Stack Web Development using Django REST Framework and React", 2018

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<b>Soft Computing (Open Elective-II)</b>					

**Course Objectives:** In the course the student will Learn soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world problems.

**Course Outcomes (COs):** At the end of the course, student will be able to

- Able to apply fuzzy logic and reasoning to handle uncertainty in engineering problems.
- Make use of genetic algorithms to combinatorial optimization problems
- Apply artificial intelligence techniques, including search heuristics, knowledge representation, planning and reasoning.
- Learn and apply the principles of self adopting and self organizing neuro fuzzy inference systems
- Evaluate and compare solutions by various soft computing approaches for a given problem

**UNIT I : FUZZY SET THEORY:** Introduction to Neuro – Fuzzy and Soft Computing, Fuzzy Sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations. Fuzzy Inference Systems, Mamdani Fuzzy Models, Sugeno Fuzzy Models.

**UNIT II: OPTIMIZATION:** Derivative based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton’s Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms.

**UNIT III : ARTIFICIAL INTELLIGENCE :** Introduction, Knowledge Representation, Reasoning, Issues and Acquisition: Propositional and Predicate Calculus Rule Based knowledge Representation Symbolic Reasoning, Heuristic Search: Techniques for Heuristic search Heuristic Classification.

**UNIT IV: NEURO FUZZY MODELING:** Adaptive Neuro-Fuzzy Inference Systems, Architecture – Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN –Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

**UNIT V: APPLICATIONS OF COMPUTATIONAL INTELLIGENCE :** Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Color Recipe Prediction.

**Text Books:**

1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004
2. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006.

**Reference Books:**

1. Elaine Rich & Kevin Knight, Artificial Intelligence, Second Edition, Tata Mcgraw Hill Publishing Comp., 2006, New Delhi.
2. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
4. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI,
5. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP Professional, Boston, 1996.
6. Amit Konar, "Artificial Intelligence and Soft Computing Behaviour and Cognitive model of the human brain", CRC Press, 2008

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<b>Distributed Computing (Open Elective-II)</b>					

**Course Objectives:**

To make understand the concepts of Distributed Operating System concepts and work with distributed environments

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

- Explain the fundamentals of Distributed Computing
- Identify an Message communication process
- Briefly explain uses of RPC Model in a system
- Design and Implementation issues of DSM
- Compare the relationship between Clock Synchronization, Algorithms

**UNIT I:** Fundamentals Evolution of Distributed Computing Systems, System models, issues in design of Distributed Systems, Distributed computing environment, web based distributed model, computer networks related to distributed systems and web based protocols.

**UNIT II:** Message Passing Inter process Communication, Desirable Features of Good Message-Passing Systems, Issues in IPC by Message, Synchronization, Buffering, Multidatagram Messages, Encoding and Decoding of Message Data.

**UNIT III:** Remote Procedure Calls The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Server Management, Communication Protocols for RPCs, Complicated RPCs, Client-Server Binding, Exception Handling, Security, Some Special Types of RPCs.

**UNIT IV:** Distributed Shared Memory Design and Implementation issues of DSM, Granularity, Structure of Shared memory Space, Consistency Models, Thrashing, Other Approaches to DSM, Advantages of DSM.

**UNIT V:** Synchronization Clock Synchronization, Event Ordering, Mutual Exclusion, Election Algorithms.

**Text Books:**

1. Distributed OS by Pradeep K. Sinha (PHI)
2. Tanenbaum S.: Distributed Operating Systems, Pearson Education

**Reference Books:**

1. Tanenbaum S. Maarten V.S.: Distributed Systems Principles and Paradigms, (Pearson Education)
2. George Coulouris, Jean Dollimore. Tim Kindberg: Distributed Systems

concepts and design.



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<b>AI and ML for Robotics (Open Elective-II)</b>					

**Course Objectives :**

- To learn the concepts of searching for AI problems
- To learn about agents and knowledge representation
- To understand the various factors involved in inferences
- To get introduced to fundamentals of machine learning
- To learn about the possibilities of Supervised and Unsupervised learning

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

- Explain the History of AI - Agents - Structure of Intelligent agents
- Design agents for any given problem
- Describe Represent real world knowledge using first order or propositional logic
- To make use of Solve problems by appropriated using the supervised or unsupervised machine learning algorithms
- Develop appropriate clustering algorithm for solving real-world problems

**UNIT I:** AI, History of AI, Agents, Structure of Intelligent agents, Environments, Problem solving methods, Problem solving agents, Formulating problems, search strategies, Breadth-first, Uniform cost, Depth-first, Depth limited, Bidirectional, Informed Search, Best-first Heuristic Functions, Memory bounded search, A\*, SMA\*, Iterative Improvement algorithms, Hill Climbing, Simulated annealing, Measure of performance and analysis of search algorithms.

**UNIT II:** Game playing, Perfect Decisions, Imperfect Decisions, Alpha-beta pruning, Knowledge based agent, Wumpus World Environment, Propositional logic, agent for wumpus world, First order logic, syntax, semantics, extensions, Using First order logic, Representation change in the world, Goal based agents.

**UNIT III:** Knowledge Base, Knowledge representation, Production based system, Frame based system, Inference, Backward chaining, Forward chaining.

**UNIT IV:** Learning from agents, inductive learning, Types of Machine learning, Supervised learning, learning decision trees, support vector machines, Neural and Belief networks, Perceptron, Multi-layer feed forward networks, Bayesian belief networks.

**UNIT V:** Unsupervised learning, K-means clustering, hierarchical clustering, Agglomerative and Divisive clustering, Fuzzy clustering.

**Text Books:**

1. Stuart Russel, Peter Norvig, "AI – A Modern Approach", Second Edition, Pearson Education, 2007.
2. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill, 2008.

**Reference Books:**

1. Vinod Chandra SS, Anand Hareendran S, "Artificial and Machine Learning", First Edition, PHI Learning, 2014.
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007
3. G. Luger, W. A. Stubblefield, "Artificial Intelligence", Third Edition, Addison-Wesley Longman, 1998.
4. N. J. Nilson, "Principles of Artificial Intelligence", Narosa Publishing House, 1980.
5. Tom Mitchell, "Machine Learning", First Edition, Tata McGraw Hill India, 2017.

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<b>Computer Networks (Open Elective-II)</b>					

**Course Objectives:**

- To provide insight about networks, topologies, and the key concepts.
- To gain comprehensive knowledge about the layered communication architectures (OSI and TCP/IP) and its functionalities.
- To understand the principles, key protocols, design issues, and significance of each layers in ISO and TCP/IP.
- To know the basic concepts of network services and various network applications.

**Course Outcomes:**

By the end of the course, the student will be able to

- Demonstrate different network models for networking links OSI, TCP/IP, B-ISDN, N-BISDN and get knowledge about various communication techniques, methods and protocol standards.
- Discuss different transmission media and different switching networks.
- Analyze data link layer services, functions and protocols like HDLC and PPP.
- Compare and Classify medium access control protocols like ALOHA, CSMA, CSMA/CD, CSMA/CA, Polling, Token passing, FDMA, TDMA, CDMA protocols
- Determine application layer services and client server protocols working with the client server paradigms like WWW, HTTP, FTP, e-mail and SNMP etc.

**UNIT I:**

**Introduction:** Network Types, LAN, MAN, WAN, Network Topologies Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, OSI Vs TCP/IP, Lack of OSI models success, Internet History.

**Physical Layer** –Introduction to Guided Media- Twisted-pair cable, Coaxial cable and Fiber optic cable and unguided media: Wireless-Radio waves, microwaves, infrared.

**UNIT II:**

**Data link layer:** Design issues, **Framing:** fixed size framing, variable size framing, flow control, error control, error detection and correction codes, CRC, Checksum: idea, one's complement internet checksum, services provided to Network Layer, **Elementary Data Link Layer protocols:** simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel.

**Sliding window protocol:** One bit, Go back N, Selective repeat-Stop and wait protocol, Data link layer in HDLC: configuration and transfer modes, frames,

control field, point to point protocol (PPP): framing transition phase, multiplexing, multi link PPP.

### **UNIT – III:**

**Media Access Control: Random Access:** ALOHA, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance, **Controlled Access:** Reservation, Polling, Token Passing, **Channelization:** frequency division multiple Access(FDMA), time division multiple access(TDMA), code division multiple access(CDMA).

**Wired LANs:** Ethernet, Ethernet Protocol, Standard Ethernet, Fast Ethernet(100 Mbps), Gigabit Ethernet, 10 Gigabit Ethernet.

### **UNIT – IV:**

**The Network Layer Design Issues** – Store and Forward Packet Switching- Services Provided to the Transport layer- Implementation of Connectionless Service-Implementation of Connection Oriented Service- Comparison of Virtual Circuit and Datagram Networks, Routing Algorithms-The Optimality principle- Shortest path, Flooding, Distance vector, Link state, Hierarchical, Congestion Control algorithms-General principles of congestion control, Congestion prevention polices, Approaches to Congestion Control-Traffic Aware Routing- Admission Control-Traffic Throttling-Load Shedding. Traffic Control Algorithm- Leaky bucket & Token bucket.

**Internet Working:** How networks differ- How networks can be connected- Tunnelling, internetwork routing-, Fragmentation, network layer in the internet – IP protocols-IP Version 4 protocol-IPV4 Header Format, IP addresses, Class full Addressing, CIDR, NAT-, Subnets-IP Version 6-The main IPV6 header, Transition from IPV4 to IPV6, Comparison of IPV4 & IPV6- Internet control protocols- ICMP-ARP-DHCP

### **UNIT –V:**

**The Transport Layer:** Transport layer protocols: Introduction-services- port number-User data gram protocol-User datagram-UDP services-UDP applications-Transmission control protocol: TCP services- TCP features- Segment- A TCP connection- windows in TCP- flow control-Error control, Congestion control in TCP.

**Application Layer** -- World Wide Web: HTTP, Electronic mail-Architecture- web based mail- email security- TELENET-local versus remote Logging-Domain Name System: Name Space, DNS in Internet , - Resolution-Caching- Resource Records- DNS messages- Registrars-security of DNS Name Servers, SNMP.

### **Text Books:**

1. Computer Networks, Andrew S Tanenbaum, Fifth Edition. Pearson Education/PHI
2. Data Communications and Networks, Behrouz A. Forouzan, Fifth Edition TMH.

**References Books:**

1. Data Communications and Networks- Achut S Godbole, AtulKahate
2. Computer Networks, Mayank Dave, CENGAGE

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<b>Big Data Analytics (Open Elective-II)</b>					

**Course Objectives:**

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

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

- Understand how to leverage the insights from big data analytics
- Analyze data by utilizing various statistical and data mining approaches
- Perform analytics on real-time streaming data
- Understand the various NoSql alternative database models

**UNIT I: INTRODUCTION TO BIG DATA:** Big Data, Definition, Characteristic Features, Big Data Applications, Big Data vs Traditional Data, Risks of Big Data, Structure of Big Data, Challenges of Conventional Systems, Web Data, Evolution of Analytic Scalability.

**UNIT II: HADOOP FRAMEWORK:** Distributed File Systems, Large-Scale File System Organization, HDFS concepts, MapReduce Execution, Algorithms using MapReduce, Hadoop YARN.

**UNIT III: DATA ANALYSIS-** Statistical Methods: Regression modelling, Multivariate Analysis, Classification: SVM & Kernel Methods, Rule Mining, Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Predictive Analytics, Data analysis using R.

**UNIT IV: MINING DATA STREAMS:** Streams: Concepts, Stream Data Model and Architecture, Sampling data in a stream, Mining Data Streams and Mining Time-series data, Real Time Analytics Platform (RTAP) Applications, Case Studies, Real Time Sentiment Analysis.

**UNIT V: BIG DATA FRAMEWORKS:** Introduction to NoSQL, Aggregate Data Models, Hbase: Data Model and Implementations, Hbase Clients, Examples, Cassandra: Data Model, Examples, Cassandra Clients, Hadoop Integration.

**Software Links:**

1. Hadoop: <http://hadoop.apache.org/>

2. Hive: <https://cwiki.apache.org/confluence/display/Hive/Home>
3. Pig latin: <http://pig.apache.org/docs/r0.7.0/tutorial.html>

**Text Books:**

1. Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC
2. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly
3. Hadoop in Action by Chuck Lam, MANNING Publ.

**Reference Books:**

1. Hadoop in Practice by Alex Holmes, MANNING Publ.
2. Hadoop MapReduce Cookbook, Srinath Perera, Thilina Gunarathne
3. Michael Berthold, David J. Hand, —Intelligent Data Analysis, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley

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<b>Computational Tools (Open Elective-II)</b>					

**Course Objective:**

- The subject is aimed at students with little or no programming experience.
- It aims to provide students with an understanding of the role computation can play in solving problems.
- It also aims to help students, regardless of their major, to feel justifiably confident of their ability to write small programs that allow them to accomplish useful goals.

**Course Outcomes:**

After studying this course, Student should be able to:

1. Describe the skills that are involved in computational thinking
2. Demonstrate the concepts of Boolean Logic and Software Development.
3. Analyze the concepts of algorithmic thinking as modeling and abstraction as encapsulation.
4. Illustrate the distinctive nature of data organization, White box and Black box testing.
5. Student will be aware of a range of applications of computational thinking in different disciplines, Authentication and authorization.

**UNIT I:**

**Introduction:** Computers, Computational Thinking, Abacus to Machine, The First Software, The First Modern Computer, Moore's Law, **Real-World Information Becomes Computable Data**, Information and Data, Converting Information into Data, Data Capacity, Data Compression

**UNIT II:**

**Logic:** Boolean Logic, Applications of Propositional Logic, **Solving Problems**, Logical Reasoning, Decomposition: Software Design, Decomposition: Other Uses, Abstraction: Class Diagrams, Abstraction: Use Case Diagrams

**UNIT III:**

**Algorithmic Thinking:** Algorithms, Software and Programming, Languages, Actions, **Modeling Solutions:** Activity Diagrams, Selection in Activity Diagrams,



Repetition in Activity Diagrams, Control Abstraction in Activity Diagrams, States and State Diagrams, Behavior in State Diagrams,

**UNIT IV:**

**Data Organization:** Names, Lists, Graphs, Hierarchies, **Algorithmic Thinking:** Von Neumann Architecture, Spreadsheets, Text Processing, Patterns, Computer Errors, Software Correctness, Verification, Software Testing, White Box Testing, Black Box Testing with Equivalence Partitioning, Boundary Value Analysis

**UNIT V:**

**Concurrent Activity:** Parallelism or Concurrency, Scheduling, Sorting Networks, **Information Security:** Security, Foundations, Common Forms of Cybercrime, Secure- Step 1: Authenticate, Secure- Step 2: Authorization, All a Matter of Risk

**Text Book:**

1. David Riley, Kenny A. Hunt, Computational Thinking for the Modern Problem Solver, 2014.
2. G Venkatesh, Madhavan Mukund, Computational Thinking: A Primer for Programmers and Data Scientists, 2021.

**Reference Books:**

1. Paolo Ferragina, Fabrizio Luccio, Computational Thinking: First Algorithms, then coding, Springer, 2018.
2. Karl Beecher, computational thinking: A beginner's guide to problem-solving and programming, 2017.

**NPTEL Link:** Physics through Computational Thinking:  
[https://onlinecourses.nptel.ac.in/noc22\\_ph12/preview](https://onlinecourses.nptel.ac.in/noc22_ph12/preview)

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<b>AI Tools &amp; Techniques (Open Elective-III)</b>					

**Course Objectives:**

- To learn the basic concepts and techniques of AI and machine learning
- To explore the various mechanism of Knowledge and Reasoning used for building expert system.
- To become familiar with supervised and unsupervised learning models
- To design and develop AI and machine learning solution using modern tools.

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

- Explain the fundamentals of AI and machine learning
- Identify an appropriate AI problem solving method and knowledge representation technique
- Identify appropriate machine learning models for problem solving
- Design and develop the AI applications in real world scenario
- Compare the relationship between AI, ML, and Deep Learning

**UNIT- I: Introduction to AI-** Definition, Problem, State space representation. Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Applications of AI, Current trends in AI, Intelligent Agents: Anatomy, structure, Types.

**UNIT- II: Problem solving-**Solving problem by Searching: Problem Solving Agent, Formulating Problems. Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods- Greedy best first Search, A\* Search, Memory bounded heuristic Search. Local Search Algorithms and Optimization Problems- Hill climbing search Simulated annealing and local beam search.

**UNIT - III: Knowledge and Reasoning-**Knowledge based Agents, The Wumpus World, and Propositional logic. **First Order Logic-** Syntax and Semantic, Inference in FOL, Forward chaining, backward Chaining, Knowledge Engineering in First-Order Logic, Unification and Resolution.

**UNIT - IV: Concepts of Machine learning** -Supervised, unsupervised, semi-supervised, Rote learning, Reinforcement learning, Issues, steps and applications, Designing a learning System. Case study- hand written digit recognition, stock price prediction. Learning Models- Decision tree learning. Probabilistic Models, Deterministic Models, Hidden Markov Model, Reinforcement Learning-Model based learning, Temporal Difference Learning, Generalization, Partially Observable States.

**UNIT – V: Artificial Neural Network:** Introduction, neural network representation, Problems for neural network learning, perception, multilayer network & Back propagation Algorithm. Deep learning- Definition, relationship between AI, ML, and Deep Learning, Trends in Deep Learning.

**Text Books:**

1. Artificial Intelligence and Machine Learning, 1<sup>st</sup> Edition, Vinod Chandra S.S., Anand Hareendran S, 2014
2. Artificial Intelligence: A Modern Approach, 2<sup>nd</sup> Edition, Pearson Education, Stuart J. Russell, Peter Norvig, 2002

**Reference Books:**

1. PROLOG Programming for Artificial Intelligence", 3<sup>rd</sup> Edition, Pearson Education, Ivan Bratko, 2002
2. Artificial Intelligence, Third Edition, McGraw Hill Education, Elaine Rich and Kevin Knight, 2017
3. Data Mining Concepts and Techniques, Morgan Kaufmann Publishers, Han Kamber, 2011
4. Machine learning with R, 2<sup>nd</sup> Edition, Brett Lantz, 2015
5. Genetic Algorithms: Search, Optimization and Machine Learning, 1<sup>st</sup> ed, Davis E. Goldberg, Addison Wesley, N.Y., 1989

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<b>Image Processing (Open Elective-III)</b>					

**Course Objectives:**

- Describe and explain basic principles of digital image processing.
- Design and implement algorithms that perform basic image processing (e.g. noise removal and image enhancement).
- Design and implement algorithms for advanced image analysis (e.g. image compression, image segmentation).
- Assess the performance of image processing algorithms and systems.

**Course Outcomes:**

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

- Demonstrate the components of image processing
- Explain various filtration techniques.
- Apply image compression techniques.
- Discuss the concepts of wavelet transforms.
- Analyze the concept of morphological image processing

**UNIT I: Introduction:** Fundamental steps in Image Processing System, Components of Image Processing System, Elements of Visual Perception, Image Sensing and acquisition, Image sampling & Quantization, Basic Relationship between pixels.

**UNIT II: Image Enhancement Techniques:** Spatial Domain Methods: Basic grey level transformation, Histogram equalization, Image subtraction, image averaging. **Spatial filtering:** Smoothing, sharpening filters, Laplacian filters.

**UNIT III: Image Compression:** Redundancies- Coding, Inter pixel, Psycho visual; Fidelity, Source and Channel Encoding, **Elements of Information Theory;** Loss Less and Lossy Compression; Run length coding, Differential encoding, DCT, Image Compression Standards-JPEG, JPEG 2000, MPEG; Video compression.

**UNIT IV: Wavelet Based Image Compression:** Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous, Wavelet Transform.

**UNIT V: Image Segmentation:** Discontinuities, Edge Linking and boundary detection, Thresholding, Region Based Segmentation, basic gray-scale morphology operations; Feature extraction; Classification; Object recognition.

**Digital Image Watermarking:** Introduction, need of Digital Image Watermarking, applications of watermarking.

**Text Books:**

1. Digital Image Processing. 2nd ed. Gonzalez, R.C. and Woods, R.E. India: Person Education,2009

**Reference Books:**

1. Digital Image Processing. John Wiley, Pratt, W. K, Fourth Edition-2001
2. Digital Image Processing, Jayaraman, S., Veerakumar, T. and Esakkiranjana, S.,Tata McGraw-Hill,Edition-3,2009

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<b>Information Security (Open Elective-III)</b>					

**Course Objectives:**

- Introduces the basic concepts of Information System.
- To understand The Management Control Framework and The Application Control Framework.

**Course Outcomes:**

After finishing this course student will be able to:

- Understands the function of Information Systems Audit and Management
- Evaluates the major phases in the System Development Process
- Understand the concept of operations management control and quality assurance management
- Plan the concurrent auditing techniques and audit software
- Acquire skills on Evidence Collection & Evaluation

**UNIT I:** Overview of Information System Auditing, conducting an Information Systems Audit, Overview and steps in an Audit.

**UNIT II: The Management Control Framework-I:** Introduction, Systems Development Management Controls, Security Management Controls, Operations management Controls, Quality assurance Management Controls.

**UNIT III: The Application Control Framework-I:** Boundary Controls, Input Controls, Processing Controls, Database Controls, output Controls.

**UNIT IV: Evidence Collection & Evaluation:** Audit Software, Code Review, Test Data, and Code Comparison, Concurrent Auditing techniques, Interviews, Questionnaires and Control Flowcharts. Performance Management tools. Evaluating Asset Safeguarding and Data Integrity,

**UNIT V: Information Systems Audit and Management:** Managing the Information Systems Audit Function, Introduction, Planning Function, Organizing Function, Staffing Function, Leading Function, Controlling Function, Some Features of Information Systems Auditing.

**Text Books:**

1. Ron Weber: Information Systems Control and Audit, Pearson, 2006.

**Reference Books:**

1. James A.Hall: Information Technology Auditing and Assurance, Cengage, 2008.
2. Davis: IT Auditing, TMH, 2007
3. David Ricchiute: Auditing and Assurance Services, 7<sup>th</sup>edition, Cengage, 2008.
4. Cannon, Bergmann, Pamplin: CICA- Certified Information Systems Auditor, Study Guide, 1/e, Sybex, WILEY- India, 2006.
5. Ronald, Russel: The CISSP prep Guide, 2<sup>th</sup>edition. Wiley, Dreamtech, 2006.

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<b>Mobile Application Development (Open Elective-III)</b>					

**Course Objectives:**

The main objectives of the course are:

- To facilitate students to understand android SDK
- To help students to gain a basic understanding of Android application development
- To inculcate working knowledge of Android Studio development tool

**Course Outcomes:** After finishing this course student will be able to:

- Install and configure Android application development tools.
- Design and develop user Interfaces for the Android platform.
- Save state information across important operating system events
- Apply Java programming concepts to Android application development.
- Design and Implement Packaging and Deploying, Performance Best Practices

**UNIT I: Introduction to Mobile Computing-** Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development, Android User.

**UNIT II: Intents on UIs VUIs and Mobile Apps:** Android Intents and Services, Characteristics of Mobile Applications, Successful Mobile Development- Storing and Retrieving Data-Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider

**UNIT III: Communications Via Network and the Web-** State Machine, Correct Communications Model, Android Networking and Web, Telephony- Deciding Scope of an App, **Notifications and Alarms-** Performance, Performance and Memory Management, Android Notifications and Alarms

**UNIT IV: Graphics-**Performance and Multithreading, Graphics and UI Performance, Android Graphics and Multimedia, Mobile Agents and Peer-to-Peer Architecture, Android Multimedia Location, Mobility and Location Based Services, Android,

**UNIT V:**Packaging and Deploying, Performance Best Practices, Android Field Service App, Security and Hacking - Active Transactions, More on Security, Hacking Android, **Platforms and Additional Issues** - Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing



**Text Books:**

1. Professional Mobile Application Development 11 October 2012 by Jeff Mcherter and Scott Gowell

**Reference Book:**

1. Android Programming: The Big Nerd Ranch Guide (3rd Edition)
2. iOS Programming: The Big Nerd Ranch Guide (6th Edition)
3. Mastering Xamarin UI Development: Build robust and a maintainable cross-platform mobile UI with Xamarin and C# 7, 2nd Edition

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<b>Data Science (Open Elective-III)</b>					

### **Course Objectives:**

From the course the student will learn

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science;
- Produce Python code to statistically analyze a dataset;
- Critically evaluate data visualizations based on their design and use for communicating stories from data

### **Course Outcomes:**

By the end of the course, student will be able to

- Acquire the knowledge and expertise to become a proficient data scientist
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
- Explain how data is collected, managed and stored for data science
- Interpret the key concepts in data science, including their real-world applications and the toolkit used by data scientists
- Illustrate data collection and management scripts using MongoDB

**UNIT-I: Introduction to Core Concepts and Technologies-** Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

**UNIT-II: Data Collection and Management-** Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

**UNIT -III: Data Analysis-** Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

### **UNIT-IV:**

**Data Visualization-** Introduction, Types of data visualization, **Data for visualization-** Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

**UNIT-V: Applications of Data Science-** Technologies for visualization, Bokeh (Python), recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

**Text Books:**

1. “The Art of Data Science”, 1<sup>st</sup> edition, Roger D. Peng and Elizabeth matsui, Lean Publications, 2015
2. “Algorithms for Data Science”, 1<sup>st</sup> edition, Steele, Brian, Chandler, John, Reddy, Swarna, springers Publications, 2016

**Reference Books:**

1. Doing Data Science: Straight Talk From The Frontline, 1<sup>st</sup> edition, Cathy O’Neil and Rachel Schutt, O’Reilly, 2013
2. Mining of Massive Datasets, 2<sup>nd</sup> edition, Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, v2.1, Cambridge University Press, 2014

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<b>Cyber Security (Open Elective-III)</b>					

**Course Objectives:**

The Cyber security Course will provide the students with foundational Cyber Security principles, Security architecture, risk management, attacks, incidents, and emerging IT and IS technologies. Students will gain insight into the importance of Cyber Security and the integral role of Cyber Security professionals.

**Course Outcomes:**

By the end of the course, student will be able to

- Understand Cyber Security architecture principles
- Identifying System and application security threats and vulnerabilities
- Identifying different classes of attacks
- Cyber Security incidents to apply appropriate response
- Describing risk management processes and practices
- Evaluation of decision making outcomes of Cyber Security scenarios

**UNIT-I: Introduction To Cybercrime:** Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens

**UNIT-II: Cyber Offenses:** Planning of Offenses by Cyber Criminals–Introduction, Planning attacks by criminals, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector Cloud Computing.

**UNIT-III: Cybercrime Mobile And Wireless Devices:** Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

**UNIT-IV: Tools And Methods Used In Cybercrime:** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and

DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft)

**UNIT-V: Cybercrimes And Cyber Security:** Need for Cyber laws: The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Information Security Planning and Governance, Information Security Policy Standards, Practices, The information Security Blueprint, Security education, Training and awareness program, Continuing Strategies.

**UNIT-VI: Understanding Computer Forensics:** Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics

**Text Books:**

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole, Sunit Belapure, Wiley.

**Reference Books:**

1. Principles of Information Security, Micheal E. Whitman and Herbert J. Mattord, Cengage Learning.  
2. Information Security, Mark Rhodes, Ousley, MGH.

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<b>Introduction to Internet of Things (Open Elective-III)</b>					

**Course Objectives:**

From the course the student will learn

- the application areas of IOT
- the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- building blocks of Internet of Things and characteristics

**Course Outcomes:**

By the end of the course, student will be able to

- Review Internet of Things (IoT).
- Demonstrate various business models relevant to IoT.
- Construct designs for web connectivity
- Organize sources of data acquisition related to IoT, integrate to enterprise systems.
- Describe IoT with Cloud technologies.

**UNIT-I:**

**The Internet of Things-** An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, Examples OF IoTs, Design Principles For Connected Devices, Internet connectivity, **Application Layer Protocols-** HTTP, HTTPS, FTP

**UNIT-II:** Business Models for Business Processes in the Internet of Things, IoT/M2M systems LAYERS AND designs standardizations, Modified OSI Stack for the IoT/M2M Systems ,ETSI M2M domains and High-level capabilities, Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability.

**UNIT-III:** Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.

**UNIT-IV:** Data Acquiring, Organizing and Analytics in IoT/M2M, Applications/Services/Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

**UNIT-V:** Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-

based services using the Xively (Pachube/COSM), Nimbits and other platforms  
Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and  
Wireless, Sensor Network Technology, Sensors Technology, Sensing the World.

**Text Books:**

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
2. Internet of Things, A.Bahgya and V.Madisetti, Univesity Press, 2015

**Reference Books:**

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley
2. Getting Started with the Internet of Things, CunoPfister , Oreilly

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<b>MEAN Stack Technologies (Open Elective-IV)</b>					

**Course Objectives:**

- To Learn the basics of Web Designing using HTML, DHTML, and CSS
- To learn the basics about Client side scripts and Server side scripts

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

- Describe basics of Web Designing using HTML, DHTML, and CSS
- Build real world applications using client side and server side scripting languages
- Design and develop applications using web servers
- Analyze the basics of PHP programming
- Apply Database connectivity with case study for student Information System and Health Management system

**UNIT I: HTML & DHTML :-** Introduction, HTML Formatting, Hyper-Links, Lists, Tables, Images, Forms, Frames, Cascading Style sheets, Types, XML, Document type definition, XML Schemas, Document Object model, HTML and Scripting Access, Rollover Buttons, Moving objects with DHTML, Ramifications of DHTML.

**UNIT II: Introduction to Client Side scripting:** JavaScript, Control statements, Functions, Arrays, Objects, Events, Dynamic HTML with Java Script, AJAX: Ajax Client Server Architecture, XML Http Request Object, Call Back Methods.

**UNIT III: Web Application-** Web servers, IIS (XAMPP, LAMPP) and Tomcat Servers, Server Side Scripting, Java Servlets, Java Server Pages, Java Server Faces, JSF Components, Session Tracking, Cookies.

**UNIT- IV: PHP Programming:** Basic Syntax, Defining variable and constant, PHP Data types, Operator and Expression, Operator Precedence, Decisions and Loop, Functions & Recursion, String Processing and Regular Expressions, Form Processing, Working with file and Directories, Cookies.

**UNIT- V: JDBC:** Database Connectivity with MySQL, Servlets, JSP, PHP, MongoDB, NOSQL Database, Fundamentals of JQuery and Bootstrap. Case Studies - Student information system, Health Management System

**Text Books:**

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, "Internet & World Wide Web How to Program", Fifth Edition, Deitel Series, 2012.
2. Jason Gilmore, "Beginning PHP and MySQL from Novice to Professional",



Fourth Edition, Apress Publications, 2010.

**Reference Books:**

1. Brown, Ethan, “Web Development with Node and Express: Leveraging the JavaScript Stack”, O'Reilly Media, 2019. CSE Dept. Flexible Curriculum NITTUGCSE19 95.
2. Anthony, Accomazzo, Murray Nathaniel, Lerner Ari, “Fullstack React: The Complete Guide to React JS and Friends”, Fullstack.io, 2017.
3. Kozlowski, Pawel, “Mastering Web Application Development with Angular JS”, Packt Publishing Ltd., 2013.
4. Robert W. Sebesta, “Programming with World Wide Web”, Fourth Edition, Pearson, 2008.
5. David William Barron, “The World of Scripting Languages”, Wiley Publications, 2000.
6. Dayley B., “Node.js, MongoDB, and AngularJS Web Development”, Addison-Wesley Professional, 2014.
7. Vainikka J., “Full-Stack Web Development using Django REST Framework and React”, 2018

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<b>Deep Learning Techniques (Open Elective-IV)</b>					

**Course Objectives:** At the end of the course, the students will be expected to:

- Learn deep learning methods for working with sequential data,
- Learn deep recurrent and memory networks,
- Learn deep Turing machines,
- Apply such deep learning mechanisms to various learning problems.
- Know the open issues in deep learning, and have a grasp of the current research directions.

**Course Outcomes:** After the completion of the course, student will be able to

- Demonstrate the fundamental concepts learning techniques of Artificial Intelligence, Machine Learning and Deep Learning.
- Discuss the Neural Network training, various random models.
- Explain the Techniques of Keras, TensorFlow, Theano and CNTK
- Classify the Concepts of CNN and RNN
- Implement Interactive Applications of Deep Learning.

#### **UNIT I:**

**Fundamentals of Deep Learning:** Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines,

**Fundamentals of Machine Learning:** Four Branches of Machine Learning, Evaluating Machine learning Models, Overfitting and Underfitting. **[Text Book 2]**

**UNIT II: Introducing Deep Learning:** Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks. **[Text Book3]**

**UNIT III: Neural Networks:** Anatomy of Neural Network, Introduction to Keras: Keras, TensorFlow, Theano and CNTK, Setting up Deep Learning Workstation, Classifying Movie Reviews: Binary Classification, Classifying newswires: Multiclass Classification. **[Text Book 2]**

#### **UNIT IV:**

**Convolutional Neural Networks:** Nerual Network and Representation Learning, Convolutional Layers, Multichannel Convolution Operation, **Recurrent Neural Networks:** Introduction to RNN, RNN Code, PyTorch Tensors: Deep Learning with PyTorch, CNN in PyTorch. **[Text Book 3]**

#### **UNIT V:**

**Interactive Applications of Deep Learning:** Machine Vision, Natural Language processing, Generative Adversarial Networks, Deep Reinforcement Learning. [**Text Book 1**]

**Deep Learning Research:** Autoencoders, Deep Generative Models: Boltzmann Machines Restricted Boltzmann Machines, Deep Belief Networks. [**Text Book 1**]

**Text Books:**

1. Deep Learning- Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, 2016
2. Deep Learning with Python - Francois Chollet, Released December 2017, Publisher(s): Manning Publications, ISBN: 9781617294433
3. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence - Jon Krohn, Grant Beyleveld, Aglaé Bassens, Released September 2019, Publisher(s): Addison-Wesley Professional, ISBN: 9780135116821
4. Deep Learning from Scratch - Seth Weidman, Released September 2019, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492041412

**Reference Books:**

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Matrix Computations, Golub, G.,H., and Van Loan,C.,F, JHU Press,2013.
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.

**Web Link:**

1. Swayam NPTEL: Deep Learning:  
[https://onlinecourses.nptel.ac.in/noc22\\_cs22/preview](https://onlinecourses.nptel.ac.in/noc22_cs22/preview)

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<b>Cloud computing with AWS (Open Elective-IV)</b>					

**Course Objectives:**

This course is intended to analyze the basics of cloud computing, and make aware students with diversified technologies working for cloud architecture. Course will be focusing on architecture, service models, privacy & security in cloud.

**Course Outcomes:**

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

- Understand and analyze the architecture of Cloud (Analyze).
- Identify and apply deployment and management options of AWS Cloud Architecture (Apply).
- Design architectures to decouple infrastructure and reduce interdependencies (Create).

**UNIT I:**

Introduction of Cloud Computing: What is Cloud Computing, How it works, Types of Cloud, Goals & Challenges, Leveraging Cloud Computing, Cloud Economics and Total Cost of Ownership

**UNIT II:**

Cloud Service Models Software as a Service (SaaS): Introduction, Challenges in SaaS Model, SaaS Integration Services, Advantages and Disadvantages. Infrastructure As a Services (IaaS): Introduction, Virtual Machines, VM Migration Services, Advantages and Disadvantages. Platform As a service (PaaS): Introduction, Integration of Private and Public Cloud, Advantages and Disadvantages.

**UNIT III:**

Virtualization and Abstraction: What is Virtualization and how abstraction is provided in cloud? Advantages and Disadvantages, Types of Hypervisor, and Load balancing.

**UNIT IV:**

Amazon Web Services Getting started with AWS, AWS Compute, Storage, and Networking, AWS Security, Identity, and Access Management, AWS Database Options, AWS Elasticity and Management Tools

**UNIT V:**

Architecting on AWS Introduction to System Design: AWS Essentials Review and

System Design for High Availability, Automation and Serverless Architectures: Event-Driven Scaling, Well-Architected Best Practices: Security, Reliability, Performance Efficiency, Cost Optimization and Deployment and Implementation: Design Patterns and Sample Architectures

**Text books:**

1. Judith Hurwitz, R Bloor, M.Kanfman, F.Halper “Cloud Computing for Dummies”, Wiley India Edition, First Edition
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, ”Cloud Computing: Principles and Paradigms”, Wiley Publication,2011

**Reference Books:**

1. Tim Mather, SubraKumara swamy, Shahed Latif, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance”, O’ReillyMedia Inc, 2009
2. Mickey Iqbal 2010, “ IT Virtualization Best Practices: A Lean, Green Virtualized Data Center Approach”, MC Press
3. Frank H. P. Fitzek, Marcos D. Katz, “Mobile Clouds: Exploiting Distributed Resources in Wireless, Mobile and Social Networks”, Wiley Publications, ISBN: 978-0-470- 97389-9, Jan 2014.

**e-Books:**

1. <https://www.manning.com/books/exploring-cloud-computing> (Paid Version)

**Supplementary Resources:**

1. NPTEL online course :  
[https://onlinecourses.nptel.ac.in/noc17\\_cs23/preview](https://onlinecourses.nptel.ac.in/noc17_cs23/preview)
2. MOOC : <https://www.edx.org/micromasters/cloud-computing>
3. Coursera: <https://www.coursera.org/specializations/cloud-computing>
4. AWS Academy: AWS Cloud Computing Architecture at  
<https://aws.amazon.com/training/awsacademy/cloud-computing-architecture/>

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<b>Block Chain Technologies (Open Elective-IV)</b>					

**Course Objectives:**

- To understand block chain technology and Cryptocurrency works

**Course Outcomes:** After the completion of the course, student will be able to

- Demonstrate the block chain basics, Crypto currency
- To compare and contrast the use of different private vs. public block chain and use cases
- Design an innovative Bit coin Block chain and scripts, Block chain Science on varies coins
- Classify Permission Block chain and use cases – Hyper ledger, Corda
- Make Use of Block-chain in E-Governance, Land Registration, Medical-Information Systems, and others

**UNIT I Introduction:** Introduction, basic ideas behind blockchain, how it is changing the landscape of digitalization, introduction to cryptographic concepts required, Block chain or distributed trust, Protocol, Currency, Cryptocurrency, How a Cryptocurrency works, Crowdfunding, contracts, Financial services, Bitcoin prediction markets, smart property, smart contracts

**UNIT II:** Hashing, public key cryptosystems, private vs public blockchain and use cases, Hash Puzzles, Extensibility of Block chain concepts, Digital Identity verification, Block chain Neutrality, Digital art, Block chain Environment

**UNIT III: Introduction to Bitcoin :** Bitcoin Block chain and scripts, Use cases of Bitcoin Blockchain scripting language in micropayment, escrow etc Downside of Bit coin-mining, Block chain Science: Grid coin, Folding coin, Block chain Genomics, Bit coin MOOCs, Alternative coins, Smart contracts,

**UNIT IV :** Ethereum continued, IOTA, The real need for mining, consensus, Byzantine Generals Problem, and Consensus as a distributed coordination problem, Coming to private or permissioned blockchains, Introduction to Hyper ledger, Currency, Token, Tokenizing, Campus coin, Coin drop as a strategy for Public adoption, Currency Multiplicity, Demurrage currency

**UNIT V:** Technical challenges, Business model challenges, Scandals and Public perception, Government Regulations, Uses of Block chain in E-Governance, Land Registration, Medical Information Systems.

**Text Book:**

1. Blockchain Blue print for Economy by Melanie Swan

**Reference Book:**

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps 1st Edition,  
by Daniel Drescher

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<b>Cryptography &amp; Network Security (Open Elective-IV)</b>					

**Course Objectives:**

The main objectives of this course are to explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, public key algorithms, design issues and working principles of various authentication protocols and various secure communication standards including Kerberos, IPsec, and SSL/TLS.

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

- Explain different security threats and countermeasures and foundation course of cryptography mathematics.
- Classify the basic principles of symmetric key algorithms and operations of some symmetric key algorithms and asymmetric key cryptography
- Revise the basic principles of Public key algorithms and Working operations of some Asymmetric key algorithms such as RSA, ECC and some more
- Design applications of hash algorithms, digital signatures and key management techniques
- Determine the knowledge of Application layer, Transport layer and Network layer security Protocols such as PGP, S/MIME, SSL,TSL, and IPsec .

**UNIT I:**

**Basic Principles :** Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography.

**UNIT II:**

**Symmetric Encryption:** Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.

**UNIT III:**

**Asymmetric Encryption:** Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography

**UNIT IV:**

**Data Integrity, Digital Signature Schemes & Key Management :** Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, Key Management.

**UNIT V:**



**Network Security-I:** Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, **Network Security-II :** Security at the Network Layer: IPSec, System Security

**Text Books:**

1. Cryptography and Network Security, 3<sup>rd</sup> Edition Behrouz A Forouzan, Debdeep Mukhopadhyay, McGraw Hill,2015
2. Cryptography and Network Security,4<sup>th</sup> Edition, William Stallings, (6e) Pearson,2006
3. Everyday Cryptography, 1<sup>st</sup> Edition, Keith M.Martin, Oxford,2016

**Reference Books:**

1. Network Security and Cryptography, 1<sup>st</sup> Edition, Bernard Meneges, Cengage Learning,2018

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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Introduction to Machine Learning (Open Elective-IV)</b>					

**Course Objectives:**

- Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
- Formalize a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).
- Implement basic AI algorithms (e.g., standard search algorithms or dynamic programming).
- Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports.

**Course Outcomes:**

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

- Explain the definition and usage of the term 'the internet of things' in different contexts
- Demonstrate on various network protocols used in IoT
- Analyze on various key wireless technologies used in IoT systems, such as WiFi, 6LoWPAN, Bluetooth and ZigBee.
- Illustrate on the role of big data, cloud computing and data analytics in IoT system
- Design a simple IoT system made up of sensors, wireless network connection, data analytics and display/actuators, and write the necessary control software

**Unit I: Introduction:** Towards Intelligent Machines Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured / Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

**Unit II: Supervised Learning:** Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Over fitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metris for assessing classification.

**Unit III: Statistical Learning:** Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning: A probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant

functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

#### **Unit IV:**

**Support Vector Machines (SVM):** Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for linearly separable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, and Regression by Support vector Machines. **Learning with Neural Networks:** Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule.

#### **Unit V:**

Multilayer Perceptron Networks and error back propagation algorithm, Radial Basis Functions Networks. **Decision Tree Learning:** Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.

#### **Text Books:**

1. Applied Machine Learning, 1<sup>st</sup> edition, M.Gopal, McGraw Hill Education, 2018
2. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis (CRC) 1<sup>st</sup> Edition-2014

#### **Reference Books:**

1. Machine Learning Methods in the Environmental Sciences, Neural Networks, William W. Hsieh, Cambridge Univ Press. 1 edition (August 31, 2009)
2. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2<sup>nd</sup> Edition-2001
3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995.
4. Machine Learning by Peter Flach , Cambridge-1<sup>st</sup> Edition 2012

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		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Machine Learning with Python (Open Elective-IV)</b>					

**Course Objectives:**

From the course the student will learn

- patterns and concepts from data without being explicitly programmed in various IOT nodes.
- to design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- to explore supervised and unsupervised learning paradigms of machine learning, Deep learning technique and various feature extraction strategies.

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

- Illustrate and comprehend the basics of Machine Learning with Python
- Demonstrate the algorithms of Supervised Learning and be able to differentiate linear and logistic regressions
- Demonstrate the algorithms of Unsupervised Learning and be able to understand the clustering algorithms
- Evaluate the concepts of binning, pipeline Interfaces with examples
- Apply the sentiment analysis for various case studies

**UNIT-I:**

**Introduction to Machine Learning with Python:** Introduction to Machine Learning, basic terminology, Types of Machine Learning and Applications, Using Python for Machine Learning: Installing Python and packages from the Python Package Index, Introduction to NumPy, SciPy, matplotlib and scikitlearn, Tiny application of Machine Learning.

**UNIT-II:**

**Supervised Learning:** Types of Supervised Learning, Supervised Machine Learning Algorithms: k-Nearest Neighbors, Linear Models, Naive Bayes Classifiers, Decision Trees, Ensembles of Decision Trees, Kernelized Support Vector Machines, Uncertainty Estimates from Classifiers.

**UNIT-III:**

**Unsupervised Learning:** Types of Unsupervised Learning, challenges, Preprocessing and scaling, Dimensionality Reduction, Feature Extraction, Manifold Learning, Clustering: K-Means Clustering, Agglomerative Clustering, DBSCAN, Comparing and Evaluating Clustering Algorithms.

**UNIT-IV:**

**Representing Data and Engineering Features:** Categorical Variables, Binning, Discretization, Linear Models, Trees, Interactions and Polynomials, Univariate Nonlinear Transformations, Automatic Feature Selection. Parameter Selection with Preprocessing, Building Pipelines, The General Pipeline Interface

**UNIT-V:**

**Working with Text Data (Data Visualization) :** Types of Data Represented as Strings, Example Application: Sentiment Analysis of Movie Reviews, Representing Text Data as a Bag of Words, Stop Words, Rescaling the Data with tf-idf, Investigating Model Coefficients, Approaching a Machine Learning Problem, Testing Production Systems, Ranking, Recommender Systems and Other kinds of Learning.

**Text Books:**

1. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Muller & Sarah Guido, Orielly Publications, 2019.
2. Python Machine Learning, Sebastian Raschka & Vahid Mirjalili, 3<sup>rd</sup> Edition, 2019.
3. Building Machine Learning Systems with Python, Luis Pedro Coelho, Willi Richert, 2nd Edition, 2015.

**Reference Books:**

1. Machine Learning, Tom M. Mitchell, Mc Graw-Hill Publication, 2017