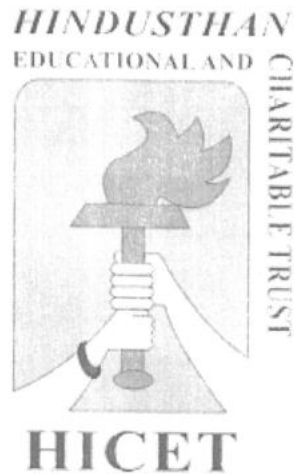


**HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY**  
(An Autonomous Institution Affiliated to Anna University, Chennai)  
(Approved by AICTE, New Delhi, Accredited by NAAC with 'A' Grade)  
Coimbatore - 641 032.

**B.TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**



**Common to all B.E. / B.Tech. Degree Programmes**  
**(CHOICE BASED CREDIT SYSTEM)**

**Curriculum & Syllabus**

**2022-2023**

## VISION AND MISSION OF THE INSTITUTION

### VISION

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

### MISSION

IM1: To provide academic excellence in technical education through novel teaching methods.

IM2: To empower students with creative skills and leadership qualities.

IM3: To produce dedicated professionals with social responsibility.



Chairman, Board Of Studies

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Dean-Academics

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**HiCET**

## VISION AND MISSION OF THE DEPARTMENT

### VISION

To impart quality education for students in the field of Artificial Intelligence and human-machine partnership in the technological-embedded world and create competent professionals who serve the greater cause of society.

### MISSION

DM1: To provide a student-centric learning environment to create competent professionals with knowledge in artificial intelligence, machine learning techniques, natural language processing, deep-learning and computer vision.

DM2: To facilitate the students to develop the necessary skills to sustain in today's globalised technological society, in pursuit of excellence by keeping high personal and professional values and ethics.

DM3: To nurture their skills in research and innovation that contributes to the development of society.



A handwritten signature in green ink, appearing to be "S. M. J.", written over a faint circular stamp.

Chairman, Board Of Studies

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A handwritten signature in green ink, appearing to be "S. M. J.", written over a faint circular stamp.

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## PROGRAM OUTCOMES (POs)

### **Engineering Graduates will be able to:**

PO1. **Engineering Knowledge** - Ability to apply knowledge of mathematics, science, mechanical engineering fundamentals and specialization to the solutions of complex engineering problems;

PO2. **Problem Analysis** - Ability to identify, formulate, conduct research literature and analyze complex engineering problems using principles of mathematics, natural sciences and mechanical engineering sciences;

PO3. **Design/Development of Solutions** - Ability to design mechanical solutions for complex engineering problems and systems, components or processes that meet specified needs;

PO4. **Investigation** - Ability to conduct investigation of complex problems using research based knowledge and research methods to provide valid conclusions;

PO5. **Modern Tool Usage** - Ability to develop and apply appropriate techniques, resources, and innovative engineering tools to complex mechanical engineering activities;

PO6. **The Engineer and Society** - Ability to apply contextual knowledge to assess societal, health, safety, legal and cultural issues with the awareness of the consequent responsibilities to professional mechanical engineering practice for the betterment of society;

PO7. **Environment and Sustainability** - Ability to understand the impact of professional mechanical engineering solutions in societal, economic and environmental contexts and demonstrate knowledge of and need for sustainable development;

PO8. **Ethics** - Ability to apply ethical principles and demonstrate commitment to professional ethics, responsibilities and norms of mechanical engineering practice;

PO9. **Communication** - Ability to communicate effectively on complex engineering activities with the engineering community and with society at large;



**PO10. Individual and Team Work** - Ability to demonstrate knowledge and understanding of mechanical engineering and management principles and apply these effectively as an individual, a member or a leader in diverse teams and in multidisciplinary settings.

**PO11. Life Long Learning** - Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change in mechanical engineering practice.

**PO12. Project Management and Finance** - Ability to demonstrate knowledge and understanding of project management, finance principles, business development within the scope of mechanical engineering practices.

### PROGRAM SPECIFIC OUTCOMES (PSOs)

<b>PSO1</b>	An ability to apply advanced core AI technologies, to extract information and provide knowledge to intelligent decision-making systems and human-AI collaboration
<b>PSO2</b>	An ability to develop a principled and thoughtful approach to the machine learning tools that can address complex cognitive tasks for the betterment of society.

### PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

**PEO1:** To acquire strong knowledge in the domain of artificial intelligence and machine learning theory and principles for identifying, analyzing and solving problems.

**PEO2:** To enable students to build intelligent machines, software, or applications with a cutting-edge combination of machine learning, analytics, and visualization technologies.

**PEO 3:** To improve students' ability to work effectively within a team and apply appropriate practices within a professional, legal and ethical framework for societal needs, and accomplish sustainable progress through lifelong learning and research.



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**DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS**

**CBCS PATTERN**

**UNDERGRADUATE PROGRAMMES**

**B.TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (UG)**

**REGULATION-2022**

**For the students admitted during the academic year 2022-2023 and onwards**

<b>SEMESTER I (Credit : 19)</b>											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
2	22HE1151	English for Engineers	HSC	2	0	2	3	4	50	50	100
3	22CY1151	Chemistry for Circuit Engineers	BSC	2	0	2	3	4	50	50	100
4	22CS1152	Object Oriented Programming using Python	ICC-1	2	0	2	3	4	50	50	100
5	22IT1152	Introduction to Web Application Development	ESC	2	0	2	3	4	50	50	100
<b>EEC COURSES (SE/AE)</b>											
6	22HE1071	Universal Human Values	AEC	2	0	0	2	3	40	60	100
7	22HE1072	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
<b>MANDATORY COURSES</b>											
8	22MC1091/ 22MC1092	அறிவியல் தமிழ்/ Indian Constitution	MC	2	0	0	0	2	100	0	100
<b>TOTAL</b>				<b>16</b>	<b>1</b>	<b>8</b>	<b>19</b>	<b>26</b>	<b>480</b>	<b>320</b>	<b>800</b>

**SEMESTER II (Credits – 22)**

S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
<b>THEORY</b>											
1	22MA2103	Differential Equations & Linear Algebra	BSC	3	1	0	4	4	40	60	100
2	22PH2101	Basics of Material Science	BSC	2	0	0	2	3	40	60	100
<b>THEORY WITH LAB COMPONENT</b>											
3	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
4	22PH2151	Physics For Circuit Engineering Programme	BSC	2	0	2	3	4	50	50	100
5	22CS2253	Java Fundamentals	ICC-2	2	0	2	3	4	50	50	100
6	22IT2253	Dynamic Web Design	PCC	2	0	1	2	3	50	50	100
<b>PRACTICAL</b>											
7	22ME2001	Engineering Practices	ESC	0	0	4	2	2	60	40	100
<b>EEC COURSES (SE/AE)</b>											
8	22HE2071	Design Thinking	AEC	1	0	2	2	2	100	0	100
9	22HE2072	SOFT SKILLS AND APTITUDE-1	SEC	1	0	0	1	1	100	0	100
<b>MANDATORY COURSES</b>											
10	22MC2091/ 22MC2092	தமிழர்மரபு/ <i>Heritage of Tamils</i>	MC	2	0	0	0	2	100	0	100
11	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							
<b>TOTAL</b>				<b>18</b>	<b>1</b>	<b>12</b>	<b>22</b>	<b>29</b>	<b>630</b>	<b>370</b>	<b>1000</b>

**For the students admitted during the academic year 2021-2022 and onwards**

**SEMESTER III -21 Credits**

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21AI3201	Data Structures and Algorithms	PC	3	0	0	3	40	60	100
2	21AI3202	Foundations of Artificial Intelligence	PC	3	0	0	3	40	60	100
<b>THEORY &amp; LAB COMPONENT</b>										
3	21MA3152	Probability and Applied Statistics	BS	3	0	2	4	50	50	100
4	21AI3251	Digital Principles and System Design	PC	3	0	2	4	50	50	100
5	21AI3252	Clean Coding and Devops	IC	3	0	2	4	50	50	100
<b>PRACTICAL</b>										
6	21AI3001	Data Structures and Algorithms Laboratory	PC	0	0	3	1.5	60	40	100
7	21AI3002	Artificial Intelligence Laboratory	PC	0	0	3	1.5	60	40	100
<b>MANDATORY</b>										
8	21MC3191	India Constitution	AC	2	0	0	0	0	0	0
9	21HE3072	Career Guidance- Level III	EEC	2	0	0	0	100	0	100
10	21HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
Total Credits				20	0	12	21	550	350	900

**SEMESTER IV -19 Credits**

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
<b>THEORY</b>										
1	21MA4105	Discrete Mathematical Structures	BS	2	1	0	3	40	60	100
2	21AI4201	Database Management System	PC	3	0	0	3	40	60	100
3	21AI4202	Data Visualization	IC	3	0	0	3	40	60	100
<b>THEORY &amp; LAB COMPONENT</b>										
4	21AI4251	Operating Systems	PC	2	0	2	3	50	50	100
5	21AI4252	Introduction to Machine Learning	PC	3	0	2	4	50	50	100

PRACTICAL										
6	21AI4001	Database Management System Laboratory	PC	0	0	3	1.5	60	40	100
7	21AI4002	Data Visualization Laboratory	IC	0	0	3	1.5	60	40	100
MANDATORY										
8	21MC4191	Value Education - Essence of Indian Traditional Knowledge	AC	2	0	0	0	0	0	0
9	21HE4072	Career Guidance- Level IV	EEC	2	0	0	0	100	0	100
10	21HE4073	Ideation Skills	EEC	1	0	0	0	100	0	100
Total Credits				18	1	10	19	540	360	900

For the students admitted during the academic year 2020-2021 and onwards  
SEMESTER V -24 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19AI5201	Computer Networks	PC	3	0	0	3	25	75	100
2	19AI5202	Data Analytics	PC	3	0	0	3	25	75	100
3	19HE5181	Management Information System	HS	3	0	0	3	25	75	100
4	19AI53**	Professional Elective- I	PE	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
5	19AI5251	Object Oriented Analysis and Design	PC	2	0	2	3	50	50	100
6	19AI5252	Introduction to Design Thinking	IC	2	0	2	3	50	50	100
PRACTICAL										
7	19AI5001	Networks Lab	PC	0	0	3	1.5	50	50	100
8	19AI5002	Data Analytics Lab	PC	0	0	3	1.5	50	50	100
9	19AI5701	MOOC / Industrial Training / Seminar	EEC	0	0	2	1	100	0	100
10	19HE5071	Soft Skills-I	EEC	1	0	0	1	100	0	100
11	19HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
Total Credits				18	0	12	24	600	500	1100

SEMESTER VI-24 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19AI6201	Theory of Computation	PC	3	0	0	3	25	75	100
2	19AI6202	Development of Machine Learning Models	IC	3	0	0	3	25	75	100
3	19AI6203	Natural Language Processing	PC	3	0	0	3	25	75	100
4	19AI63**	Professional Elective- II	PE	3	0	0	3	25	75	100
5	19**64**	Open Elective I	OE	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
6	19AI6251	Predictive Modeling	IC	3	0	2	4	50	50	100

PRACTICAL										
7	19AI6001	Natural Language Processing Lab	PC	0	0	3	1.5	50	50	100
8	19AI6801	Mini Project	EEC	0	0	3	1.5	50	50	100
9	19HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
10	19HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
Total Credits				20	0	8	24	475	525	1000

### PROFESSIONAL ELECTIVE I

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19AI5301	AI for Cyber Security	3	0	0	3	25	75	100
19AI5302	Internet of things	3	0	0	3	25	75	100
19AI5303	Advanced Machine Learning	3	0	0	3	25	75	100
19AI5304	Introduction to Robotics	3	0	0	3	25	75	100
19AI5305	Bioinformatics	3	0	0	3	25	75	100
19AI5306	Computer Architecture and Organization	3	0	0	3	25	75	100

### PROFESSIONAL ELECTIVE II

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19AI6301	Neural Networks	3	0	0	3	25	75	100
19AI6302	Big data Computing	3	0	0	3	25	75	100
19AI6303	AI in Blockchain	3	0	0	3	25	75	100
19AI6304	Human Machine Interaction	3	0	0	3	25	75	100
19AI6306	Foundations Of Data Science	3	0	0	3	25	75	100
19IT6308	Web Development - I	0	0	3	3	50	50	100

### OPEN ELECTIVE

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19AI6401	Cyber Security and Intelligence	3	0	0	3	25	75	100
19AI7401	Business Analytics	3	0	0	3	25	75	100

## CREDIT DISTRIBUTION

### R2019

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	24	24	20	14	165

### R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	19	22	25	23	22	24	20	10	165



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# SYLLABUS





Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22MA1101	<b>MATRICES AND CALCULUS</b> (Common to all Branches)	3	1	0	4
Course Objective	<p><b>The learner should be able to</b></p> <ol style="list-style-type: none"> <li>1. Construct the characteristic polynomial of a matrix and use it to identify eigenvalues and Eigenvectors</li> <li>2. Impart the knowledge of sequences and series.</li> <li>3. Analyse and discuss the maxima and minima of the functions of several variables.</li> <li>4. Evaluate the multiple integrals and apply in solving problems.</li> <li>5. Apply vector differential operator for vector function and theorems to solve engineering problems.</li> </ol>					
Unit	Description					Instructional Hours
I	<b>Matrices</b> Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) - Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.					12
II	<b>Single Variate Calculus</b> Rolle's Theorem–Lagrange's Mean Value Theorem–Maxima and Minima–Taylor's and Maclaurin's Series.					12
III	<b>Functions of Several Variables</b> Partial derivatives–Total derivative, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.					12
IV	<b>Integral Calculus</b> Double integrals in Cartesian coordinates–Area enclosed by plane curves (excluding surface area)– Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates.					12
V	<b>Vector Calculus</b> Gradient, divergence and curl; Green's theorem, Stoke's and Gauss divergence theorem (statement only) for cubes only.					12
<b>Total Instructional Hours</b>					<b>60</b>	
Course Outcome	<p>At the end of the course, the learner will be able to</p> <p>CO1: Compute Eigen values and Eigen vectors of the given matrix and transform given quadratic form into canonical form.</p> <p>CO2: Apply the concept of differentiation to identify the maximum and minimum values of curve.</p> <p>CO3: Compute partial derivatives of function of several variables and write Taylor's series for functions with two variables.</p> <p>CO4: Evaluate multiple integral and its applications in finding area, volume.</p> <p>CO5: Apply the concept of vector calculus in two and three dimensional spaces.</p>					
<b>TEXTBOOKS:</b>						
T1: G.B. Thomas and R.L. Finney, "Calculus and Analytical Geometry", 9 <sup>th</sup> Edition Addison Wesley Publishing Company, 2016.						
T2: Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2019.						
T3: K.P. Uma and S. Padma, "Engineering Mathematics I (Matrices and Calculus)", Pearson Ltd, 2022.						
<b>REFERENCEBOOKS:</b>						
R1- Jerrold E. Marsden, Anthony Tromba, "Vector Calculus", W.H. Freeman, 2003						
R2- Strauss M.J, G.L. Bradley and K.J. Smith, "Multivariable calculus", Prentice Hall, 2002.						
R3- Veerarajan T, "Engineering Mathematics", McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016.						

  
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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22HE1151	ENGLISH FOR ENGINEERS (Common to all Branches)	2	0	2	3
Course Objective	<p>The student should be able</p> <ol style="list-style-type: none"> <li>1. To improve the communicative proficiency of learners.</li> <li>2. To help learners use language effectively in professional writing.</li> <li>3. To advance the skills of maintaining the suitable one of communication.</li> <li>4. To introduce the professional life skills.</li> <li>5. To impart official communication etiquette.</li> </ol>					
Unit	Description					Instructional Hours
I	<b>Language Proficiency:</b> Types of Sentences, Functional Units, Framing question. <b>Writing:</b> process description, Writing Checklist. <b>Vocabulary</b> – words on environment. <b>Practical Component: Listening-</b> Watching short videos and answer the questions, <b>Speaking-</b> Self introduction ,formal & semi-formal					7+2
II	<b>Language Proficiency:</b> Tenses, Adjectives and adverbs. <b>Writing:</b> Formal letters (letters conveying positive and negative news), Formal and informal email writing (using emoticons, abbreviations & acronyms), reading comprehension. <b>Vocabulary</b> – words on entertainment. <b>Practical Component: Listening-</b> Comprehensions based on TED talks <b>Speaking-</b> Narrating a short story or an event happened in their life					7+2
III	<b>Language Proficiency:</b> Prepositions, phrasal verbs. <b>Writing:</b> Formal thanks giving, Congratulating, warning and apologizing letters, cloze test. <b>Vocabulary</b> – words on tools. <b>Practical Component: Listening-</b> Listening to songs and answering the questions <b>Speaking-</b> Just a minute					5+4
IV	<b>Language Proficiency:</b> Subject verb concord, Prefixes & suffixes. <b>Writing:</b> Preparing agenda & minutes, writing an event report. <b>Vocabulary</b> – words on engineering process. <b>Practical Component: Listening-</b> Comprehensions based on Talk of orators or interview shows <b>Speaking-</b> Presentation on a general topic with ppt.					5+4
V	<b>Language Proficiency:</b> Modal Auxiliaries, Active & passive voice, <b>Writing:</b> Project report (proposal & progress), sequencing of sentences <b>Vocabulary</b> – words on engineering material <b>Practical Component: Listening-</b> Listening- Comprehensions based on Nat Geo/Discovery channel videos <b>Speaking-</b> Preparing posters and presenting as a team.					6+3
<b>Total Instructional Hours</b>						<b>45</b>
Course Outcome	<p>After completion of the course the learner will be able</p> <p>CO1: To communicate in a professional forum</p> <p>CO2: To speak or write a content in the proficient language</p> <p>CO3: To maintain and use appropriate one of the communication.</p> <p>CO4: To read, write and present in a professional way.</p> <p>CO5: To follow the etiquettes in formal communication.</p>					
<b>TEXTBOOKS:</b>						
T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016. T2- Raymond Murphy, "Essential English Grammar". Cambridge University Press, 2019.						
<b>REFERENCEBOOKS:</b>						
R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice". Oxford University Press, 2009.						
R2- Raymond Murphy, "English Grammar in Use" - 4 <sup>th</sup> edition Cambridge University Press, 2004.						
R3- Kamallesh Sadanan "A Foundation Course for the Speakers of Tamil-Part-I&II", Orient Blackswan, 2010.						



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Programme /Sem	Course Code	Name of the Course	L	T	P	C
B.E/B.Tech/ I	22CY1151	Chemistry for Circuit Engineering (ECE, EEE, EIE, BME,CSE, IT, AIML)	2	0	2	3
Course Objective	<p><b>The learner should be able to</b></p> <ol style="list-style-type: none"> <li>1. Acquire knowledge on the concepts of chemistry involved in day today life.</li> <li>2. Identify the water related problems and water treatment techniques.</li> <li>3. Enhance the fundamental knowledge on electrochemistry and the mechanism of corrosion and its control.</li> <li>4. Gain knowledge on the nuclear energy source and batteries.</li> <li>5. Extend the knowledge on the concepts of spectroscopy and its applications.</li> </ol>					
Unit	Description					Instructional Hours
I	<p><b>CHEMISTRY IN EVERYDAY LIFE</b> Chemicals in food – Food colors – Artificial sweeteners – Food preservatives. Soaps and Detergents – Soaps – Types of Soap – Detergents – Types of detergents. Drugs – Classification of drugs - Therapeutic Action of Different Classes of Drugs. Chemicals in Cosmetics – Creams – Talcum powders- Deodorants – Perfumes. Plastics – Thermoplastics- Preparation, properties and uses of PVC, Teflon and Thermosetting plastics - Preparation, properties and uses of Polyester and Polyurethane.</p>					6
II	<p><b>WATER TECHNOLOGY</b> Impurities in Water, Hardness of Water, Boiler feed Water – Boiler troubles -Sludge and scale formation, Caustic embrittlement, priming and foaming, boiler corrosion- -Softening Methods (Zeolite &amp; Ion-Exchange Methods)- Desalination of Brackish Water - Reverse Osmosis, Potable water and treatment. <b>Estimation of total, permanent and temporary hardness of water by EDTA. Determination of Dissolved Oxygen in sewage water by Winkler's method. Estimation of alkalinity of water sample by indicator method.</b></p>					6+9
III	<p><b>ELECTROCHEMISTRY AND CORROSION</b> Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only) – Conductometric titrations. Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types –galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods. <b>Conductometric titration of strong acid vs strong base (HClvsNaOH). Estimation of Ferrous iron by Potentiometry.</b></p>					6+6
IV	<p><b>ENERGY SOURCES AND STORAGE DEVICES</b> Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor. Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery- lithium ion battery- fuel cell- H<sub>2</sub> -O<sub>2</sub> fuel cell applications.</p>					6
V	<p><b>SPECTROSCOPY</b> Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) – applications – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – Estimation of nickel by atomic absorption spectroscopy.</p>					6
<b>Total Instructional Hours</b>						<b>45</b>
Course Outcome	<p>At the end of the course, the learner will be able to            CO1: List out the chemicals used in food, soaps and detergents, drugs, cosmetics and plastics            CO2: Differentiate hard and soft water and solve the related problems on water purification in domestic as well as in industries.            CO3: Develop knowledge on the basic principles of electrochemistry and understand the causes of corrosion, its consequences to minimize corrosion to improve industrial design            CO4: Develop knowledge about the renewable energy resources and batteries along with the need of new materials to improve energy storage capabilities            CO5: List out the applications of spectroscopic techniques in various engineering fields.</p>					
<b>TEXT BOOKS</b>						
T1 - P.C.Jain& Monica Jain, "Engineering Chemistry" DhanpatRai Pub, Co., New Delhi (2018).						
T2 -O.G.Palanna. "Engineering chemistry" McGraw Hill Education India (2017).						
<b>REFERENCES</b>						
R1 - ShikhaAgarwal "Engineering Chemistry -Fundamentals and Applications, Cambridge University Press, Delhi, 2019						
R2 - S.S.Dara "A Text book of Engineering Chemistry" S.Chand& Co. Ltd., New Delhi (2018).						

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22CS1152	<b>OBJECT ORIENTED PROGRAMMING USING PYTHON</b> (Common to CSE, IT, ECE and AI&ML)	2	0	2	3
Course Objective	<p><b>The learner should be able</b></p> <ol style="list-style-type: none"> <li>To read and write simple Python programs.</li> <li>To develop Python programs with conditionals and loops.</li> <li>To define Python functions and call them.</li> <li>To understand OOP concepts and write programs using classes and objects.</li> <li>To do input/output with files in Python.</li> </ol>					
Unit	Description					Instructional Hours
I	<b>INTRODUCTION TO PYTHON</b> What is Python - Advantages and Disadvantages, Benefits and Limitation- Downloading and Python-installation-Python Versions-Running Python Scripts, Executing scripts with python launcher-Using interpreter interactively- Using variables-String types: normal, raw and Unicode-String operations and functions- Math operator and functions.Illustrative program: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.					7+2
II	<b>DATA TYPES, STATEMENTS, CONTROL FLOW</b> Data Types(List,Tuple,string,dictionary,set)-Operators and precedence of operators, expressions, statements, comments; Conditionals: Boolean values and operators, conditional (if), alternative (if - else), chained conditional (if -elif-else); Iteration: state, while, for, break, continue, pass. Illustrative programs:Find the square root of a number, To find the given number is Prime or not, Write a Python program which accepts a sequence of comma-separated numbers from user, generate a list and find the sum and average of the numbers.					5+4
III	<b>PYTHON FUNCTIONS</b> Introduction to functions-Global and local variable in python-Decorators in python-Python lambda functions-Exception handling in python. Illustrative programs:Square root, GCD,exponentiation, linear search, binary search, Write a menu driven program to perform the following task:a) A function Sum_DigN( ) to find the sum of the digits of a given number, b) A recursive function Sum_DigR( ) to find the same.					5+4
IV	<b>PYTHON OOPS</b> Introduction to oops concept-Python class and objects-Constructor in python-Inheritance-Types of inheritance-Encapsulation in python-Polymorphism in python. Illustrative programs:Write a Python program using class for the calculation of telephone bill..The charges for the calls are fixed as follows: Unit Call Cost/unit Below 100 calls No Charge, only rental amount Rs. 250 100-150 calls Rs. 1.00 151-300 calls Rs. 2.50 301-600 calls Rs. 4.50 Above 600 Rs. 6.00					5+4
V	<b>FILES, PACKAGES</b> File handling in python-Open a file in python-How to read from a file in python-writing to file in python-Python numpy-Python pandas. Illustrative programs:How to display the contents of text file in reverse order? Write the code for the same, not exceeding 10 lines of code, Creating Modules and Packages for arithmetic Operations.					5+4
<b>Total Instructional Hours</b>						45
Course Outcome	At the end of the course, the learner will be able to CO1: Understanding the basic concepts to read, write and execute simple python programs. CO2: Apply the conditional and looping concepts for solving problems. CO3: Apply functions to decompose larger complex programs. CO4: Understanding the OOPS concepts and writing programs using classes and objects CO5: Understand to read and write data from/to files in Python Programs.					
<b>TEXT BOOKS:</b>						
T1: Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.2. Network Theory Ltd., 2011.						
<b>REFERENCE BOOKS:</b>						
R1: Charles Dierbach. —Introduction to Computer Science using Python: A Computational Problem-Solving Focus. Wiley India Edition, 2013;						
R2: Timothy A. Budd. —Exploring Python!, Mc-Graw Hill Education (India) Private Ltd., 2015.						
R3: Robert Sedgewick, Kevin Wayne, Robert Dondero. —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd, 2016						

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Programme	Course Code	Name of the Course	L	T	P	C
B TECH	22IT1152	Introduction to Web Application Development	2	0	2	3
<b>Course Objective</b>	<ol style="list-style-type: none"> <li>To discuss the essence of software development methods</li> <li>To gain knowledge about basic HTML Tags.</li> <li>To create static websites using HTML.</li> <li>To impart knowledge about Cascading Style sheet.</li> <li>To design a front end web application using HTML and CSS</li> </ol>					
Unit	Description					Instructional Hours
<b>I</b>	<b>Unit-1 Software Development Life Cycle</b> Software Development Model -Waterfall Model- Incremental Process Models- Evolutionary Process Models- Spiral Model-Agile Software Development –Agile process-Agility principles-Introduction Github.					5
<b>II</b>	<b>Unit-2 Hyper Text Markup Language-1</b> Web Essentials: Clients, Servers, Basic Terminologies-HTML Basic Tags – Elements - Attributes - Basic Formatting, Fonts and Colors-Hyperlink-Images- Tables - cell spanning, cell spacing- Table contents, Border. List –ordered List-Unordered List-Definition List. <b>Illustrative problems:</b> Designing a web page using HTML basic tags, Developing web site with suitable contents and links, Designing web pages using lists and tables, Designing a web page using images and embed an image map in a web page					(6+4)
<b>III</b>	<b>Unit-3 Hyper Text Markup Language-II</b> Frames-HTML Forms - Single line text field, Text area, Check box, Radio buttons, Password fields, Pull-down menus, File selector dialog box–HTML 5 features. <b>Illustrative problems:</b> Designing the Login form with username, password and submit field, Designing a course registration form.					(6+4)
<b>IV</b>	<b>Unit-4 Cascading Style Sheet-I</b> Introduction - CSS Syntax -Type of CSS Selector-Simple Selectors, Universal Selector, ID Selector, Class selector and Pseudo Classes – Style Specification Formats-Inline Style-Embedded Style sheet-External Style sheet. <b>Illustrative problems:</b> Developing a web application using internal, external and embedded style sheet, Applying style specification in HTML page using CSS.					(6+4)
<b>V</b>	<b>Unit-5 Cascading Style Sheet-II</b> Font properties-List properties- Background properties-Colors RGB and RGBA, HSL and HSLA, Borders, Rounded Corners, Applying Shadows in border- Padding, Margin-CSS Layout- Normal Flow Layout-Relative positioning-Float positioning-Absolute positioning. <b>Illustrative problems:</b> Developing an web application using CSS Positioning.					(6+4)
<b>Total Instructional Hours</b>						<b>45</b>
<b>Course Outcome</b>	<ol style="list-style-type: none"> <li>Basic understanding of development of software life cycle.</li> <li>To understand basic HTML Tags.</li> <li>Designing a simple web application using HTML.</li> </ol>					

- |  |   |  |
|--|---|--|
|  | <ol style="list-style-type: none"><li>4. Understanding about the usage of Cascading Style Sheet.</li><li>5. Creating a front end Web application using HTML and CSS</li></ol> |  |
|--|---|--|

**TEXT BOOKS:**

T1 – Roger S.Pressman, Bruce R. Maxim, Software engineering- A practitioner's Approach, McGraw-Hill International Edition, 8th edition ( 2015). ISBN: 9789353165710

T2- Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.

T3- Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006.

**REFERENCE:**

R1 - Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education, 2007.

R2 - <https://www.w3schools.com/>

R3 - <https://www.tutorialspoint.com/>



  
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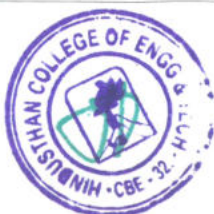
  
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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22HE1071	UNIVERSAL HUMAN VALUES (COMMON TO ALL BRANCHES)	2	0	0	2
<b>Course Objectives</b>	<p><b>The students should be made</b></p> <ol style="list-style-type: none"> <li>To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.</li> <li>To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.</li> <li>To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.</li> </ol>					
<b>Unit</b>	<b>Description</b>					<b>Instructional Hours</b>
I	<b>Introduction to Value Education</b> Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)-Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations					6
II	<b>Harmony in the Human Being and Harmony in the Family</b> Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self- Harmony of the Self with the Body - Programme to ensure self-regulation and Health					6
III	<b>Harmony in the Family and Society</b> Harmony in the Family – the Basic Unit of Human Interaction. Values in Human to Human Relationship 'Trust' – the Foundational Value in Relationship Values in Human to Human Relationship 'Respect' – as the Right Evaluation Understanding Harmony in the Society					6
IV	<b>Harmony in the Nature / Existence</b> Understanding Harmony in the Nature. Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature- Understanding Existence as Co-existence of mutually interacting units in all pervasivespace Realizing Existence as Co-existence at All Levels The Holistic Perception of Harmony in Existence. Vision for the Universal Human Order					6
V	<b>Implications of the Holistic Understanding –a Look at Professional Ethics</b> Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models- Typical Case Studies Strategies for Transition towards Value-based Life and Profession					6
<b>Total Instructional Hours</b>						<b>30</b>
<b>Course Outcome</b>	<p>At the end of the course, the learner will be able</p> <p>CO1: To become more aware of holistic vision of life - themselves and their surroundings.</p> <p>CO2: To become more responsible in life, in the Society and in handling problems with sustainable Solutions.</p> <p>CO3: To sensitive towards their commitment towards what they understood towards environment and Socially responsible behavior.</p> <p>CO4: To able to apply what have learnt to their own self in different day-to-day settings in real life and In handling problems with sustainable solutions.</p> <p>CO5: To develop competence and capabilities for maintaining Health and Hygiene.</p>					
<b>Reference Books:</b>						
R1. A Foundation Course in Human Values and Professional Ethics. R R Gaur, R Asthana, G P Bagaria, 2 <sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1						
R2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2 <sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-53-2						
R3. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.						
R4. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.						

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22HE1072	ENTREPRENEURSHIP & INNOVATION	1	0	0	1
<b>Course Objectives</b>	<b>The student should be made</b> <ol style="list-style-type: none"> <li>To acquire the knowledge and skills needed to manage the development of innovation.</li> <li>To recognize and evaluate potential opportunities to monetize these innovations.</li> <li>To plan specific and detailed method to exploit these opportunities.</li> <li>To acquire the resources necessary to implement these plans.</li> <li>To make students understand organizational performance and its importance.</li> </ol>					
<b>Module</b>	<b>Description</b>					
1	Entrepreneurial Thinking					
2	Innovation Management					
3	Design Thinking					
4	Opportunity Spotting/ Opportunity Evaluation					
5	Industry and Market Research					
6	Innovation Strategy and Business Models					
7	Financial Forecasting					
8	Business Plans/ Business Model Canvas					
9	Entrepreneurial Finance					
10	Pitching to Resources Providers / Pitch Deck					
11	Negotiating Deals					
12	New Venture Creation					
13	Lean Start-ups					
14	Entrepreneurial Ecosystem					
15	Velocity Venture					
<b>TOTAL INSTRUCTIONAL HOURS</b>						<b>15</b>
<b>Course Outcome</b>	At the end of the course, the learner will be able to CO1: Understand the nature of business opportunities ,resources, and industries in critical and creative aspects. CO2: Understand the processes by which innovation is fostered; managed ,and commercialized. CO3:Remember effectively and efficiently the potential of new business opportunities. CO4:Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness.. CO5:Develop a business model for a new venture ,including revenue, Margins, operations, Working capital ,and investment					
<b>TEXTBOOKS</b>						
T1:AryaKumar“Entrepreneurship–CreatingandleadinganEntrepreneurialOrganization”,Pearson,SecondEdition(2012).						
T2:EmrahYayici“DesignThinkingMethodology”, Artbiztech,FirstEdition(2016).						
<b>REFERENCEBOOKS</b>						
R1: Christopher Golis “Enterprise & Venture Capital”, Allen & Unwin Publication, Fourth Edition (2007).						
R2: Thomas Lock Wood & Edger Papke “Innovation by Design”, Career Press.com ,Second Edition (2017).						
R3: Jonathan Wilson “Essentials of Business Research”, Sage Publication, First Edition (2010).						
<b>WEBRESOURCES</b>						
W1: <a href="https://blof.forgeforward.in/tagged/startup-lessons">https://blof.forgeforward.in/tagged/startup-lessons</a>						
W2: <a href="https://blof.forgeforward.in/tagged/entrepreneurship">https://blof.forgeforward.in/tagged/entrepreneurship</a>						
W3: <a href="https://blof.forgeforward.in/tagged/minimum-viable-product">https://blof.forgeforward.in/tagged/minimum-viable-product</a>						
W4: <a href="https://blof.forgeforward.in/tagged/minimum-viable-product">https://blof.forgeforward.in/tagged/minimum-viable-product</a>						
W5: <a href="https://blof.forgeforward.in/tagged/innovation">https://blof.forgeforward.in/tagged/innovation</a>						

  
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Programme/ Sem	CourseCode	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22MC1091	INDIAN CONSTITUTION	2	0	0	0
<b>Course Objectives</b>	<b>The student should be made to</b> 1. Sensitization towards self, family (relationship), society and nature 2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals 3. Strengthening of self-reflection 4. Development of commitment and courage to act					
Unit	Description					Instructional Hours
I	<b>BASIC FEATURES AND FUNDAMENTAL PRINCIPLES</b> Meaning of the constitution law and constitutionalism–Historical perspective of the constitution of India– salient features and characteristic of the constitution of India.					6
II	<b>FUNDAMENTAL RIGHTS</b> Scheme of the fundamental rights–fundamental duties and its legislative status–The directive principles of state policy–its importance and implementation–Federal structure and distribution of legislative and financial powers between the union and states.					6
III	<b>PARLIAMENTARY FORM OF GOVERNMENT</b> The constitution powers and the status of the president in India.– Amendment of the constitutional Powers and procedures–The historical perspective of the constitutional amendment of India–Emergency provisions: National emergency, President rule, Financial emergency.					6
IV	<b>LOCAL GOVERNANCE</b> Local self-government–Rural Local Government–Panchayath Raj, Elections of Panchayat–State Election Commission–Urban Local Government–Amendment Act, Urban Local Government Structures in India					6
V	<b>INDIAN SOCIETY</b> Constitutional Remedies for citizens–Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.					6
<b>Total Instructional Hours</b>						<b>30</b>
<b>Course Outcome</b>	At the end of the course, the learner will be able to CO1: Understand the functions of the Indian government. CO2: Understand and abide the rules of the Indian Constitution					
<b>TEXTBOOKS:</b>						
T1: Durga Das Basu, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi, 1997.						
T2: Agarwal R.C., "Indian Political System", S.Chand and Company, New Delhi, 1997.						
T3: Maciver and Page, "Society: An Introduction Analysis", Mac Milan India Ltd., New Delhi.						
T4: Sharma K.L., "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi, 1997.						
<b>REFERENCEBOOKS:</b>						
R1-Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi.						
R2- Gahai U R., "Indian Political System", New Academic Publishing House, Jalaendhar.						
R3-Sharma R N., "Indian Social Problems", Media Promoters and Publishers Pvt. Ltd.						

  
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திட்டம்/ செம்	பாடநெறி குறியீடு	பாடத்தின் பெயர்	L	T	P	C
பி.இ/ க	22MC1091	அறிவியல் தமிழ் (முதலாம் ஆண்டு பி.இ பொது பாடப்பிரிவு)	2	0	0	0
பாடத்தின் நோக்கம்	<b>கற்றவர் இயல வேண்டும்</b> <ol style="list-style-type: none"> <li>சங்க காலத்தில் தொழில்துறை பற்றிய அறிவைப் பெறுதல்.</li> <li>சங்க காலத்தில் வீட்டின் பொருள் ,சிற்பங்கள் மற்றும் கோவில்கள் வடிவமைப்பு பற்றி கூட்டு கற்றல்</li> <li>வரலாறு மற்றும் தொல்லியல் சான்றுகளின் ஆதாரமாக உலோகவியல் ஆய்வுகளில் அறிவை வளர்த்துக் கொள்ளுங்கள்.</li> <li>வேளாண்மை மற்றும் வேளாண் செயலாக்கத்தில் பயன்படுத்தப்படும் பண்டைய நுட்பங்களைப் பற்றிய அறிவைப் பெறுதல்.</li> <li>தமிழ் மொழியின் மென்பொருள் பற்றி அறிதல்</li> </ol>					
அலகு	விளக்கம்					பயிற்சி நேரம்
I	<b>நெசவு மற்றும் பானைத் தொழில்நுட்பம்</b> சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம்- கருப்பு சிவப்பு பாண்டங்கள் -பாண்டங்களில் கீறல் குறியீடுகள்					3
II	<b>வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்</b> சங்க இலக்கியத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் மற்றும் சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு -சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும்- சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிப்பாடுத் தளங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டி நாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோச்செனிக் கட்டிடக் கலை.					3
III	<b>உற்பத்தி தொழில்நுட்பம்</b> கப்பல் கட்டும் கலை- உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருகுதல் எ.கு - வரலாற்றுசாலை சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள் , கண்ணாடிமணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் -					3

	தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.	
IV	<b>வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம்</b> அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்க பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.	3
V	<b>அறிவியல் தமிழ் மற்றும் கணித்தமிழ்</b> அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணைய கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.	3
<b>மொத்த பயிற்றுவிக்கும் நேரம்</b>		15
பாடத்தின் முடிவு	<b>பாடநெறியின் முடிவில் கற்றவர் கற்றபின்</b> பா மு1: பண்டைய தொழில்நுட்பத்தை அடையாளம் கொள்ள தெரியும் பா மு2: சங்க கால கட்டுமானப் பொருட்கள்- சிற்ப வகைகளை வேறுபடுத்த முடியும் பா மு3: வரலாறு மற்றும் தொல்லியல் சான்றுகளின் ஆதாரமாக உலோகவியல் ஆய்வுகளில் பட்டியலிட்டு அடையாளம் காண முடியும் பா மு4: விவசாயம் மற்றும் வேளாண் செயலாக்கத்தில் பயன்படுத்தப்படும் பழங்கால நுட்பங்களைப் பற்றி விளக்கத்துடன் நிரூபிக்க முடியும் பா மு5: தமிழ் மொழியின் புதிய மென்பொருள் பற்றி உருவாக்கக் கூடிய திறன் மேம்படுத்துதல்.	
<b>உரை புத்தகங்கள்</b>		
உ1- தமிழக வரலாறு - மக்களும் பண்பாடும் - கே .கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம் )		
உ2- எஸ்.கே. சிங், இடைக்கால இந்தியாவின் வரலாறு. புது தில்லி: ஆக்சிஸ் பக்ஸ் பிரைவேட் லிமிடெட், 2013.		
<b>குறிப்புகள்</b>		
கு1- கணித்தமிழ் -முனைவர் இல. சுந்தரம் .(விகடன் பிரசுரம் )		
கு2- கீழடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு.		

  
ஆய்வுவாரிய தலைவர்

  
டீன் கல்வியாளர் / முதல்வர்



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**SEMESTER II**

Programme	Course code	Name of the course	L	T	P	C

**The student should be able**

- Course Objective**
- 1 Describe some methods to solve different types of first order differential equations.
  - 2 Understand the various approach to find general solution of the ordinary differential equations
  - 3 Evaluate the various types of Partial differential equations and methods to find solution.
  - 4 Extend the knowledge of vector spaces
  - 5 Extend the knowledge of inner product spaces

Unit	Description	Instructional Hours
	<b>ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER</b>	
I	Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, Bernoulli equation.	12
	<b>LINEAR DIFFERENTIAL EQUATIONS OF SECOND ORDER</b>	
II	Second order linear differential equations with constant with RHS of the form $e^{ax}$ , $x^n$ , $\sin ax$ , $\cos ax$ – Cauchy’s linear equations– Method of variation of parameters.	12
	<b>PARTIAL DIFFERENTIAL EQUATIONS</b>	
III	Formation of partial differential equations by eliminating arbitrary constants and functions – Solution of first order partial differential equations of the form $f(p,q)=0$ , Clairaut’s equation – Lagrange’s equation.	12
IV	[REDACTED]	12
	<b>INNER PRODUCT SPACES</b>	
V	Complex matrices – Conjugate of the matrix – Hermitian and Skew Hermitian matrices – Properties (without proof) – Unitary matrix – Properties (without proof) - Inner product spaces – Gram – Schmidt orthogonalization	12

**Total Instructional Hours 60**

- Course Outcome**
- CO1 Apply few methods to solve different types of first order differential equations.
  - CO2 Evaluate the solutions of higher order ordinary differential equations and its properties.
  - CO3 Compute the solution of first order partial differential equations.
  - CO4 Infer the knowledge of vector space
  - CO5 Infer the knowledge of Inner product space space

**TEXT BOOK:**

- T1 Erwin Kreyszig, “Advanced Engineering Mathematics”, 10<sup>th</sup> Edition, Wiley India Private Ltd., New Delhi, 2019
- T2 Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence; Linear Algebra, Pearson 5<sup>th</sup> edition

**REFERENCES:**

- R1 Dennis Zill, Warren S. Wright, Michael R. Cullen, Advanced Engineering Mathematics, Jones & Bartlett Learning, 2011
- R2 Ian N. Sneddon, Elements of Partial Differential Equations, Courier Corporation, 2013.
- R3 David Lay, Steven Lay, Judi McDonald “Linear Algebra and Its Applications” 5th Edition, Pearson ,2019.



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Programme	Course code	Name of the course	L	T	P	C
B.EECH	22PH2101	BASICS OF MATERIAL SCIENCE (Common to all branches of EEE) (MCT)	2	0	1	2

**The student should be able**

- Course Objective**
- 1 Gain knowledge about Crystal systems and crystal structures
  - 2 Understand the knowledge about electrical properties of materials
  - 3 Enhance the fundamental knowledge in semiconducting materials.
  - 4 Gain knowledge about magnetic materials
  - 5 Acquire fundamental knowledge new engineering materials which is related to the engineering program

Unit	Description	Instructional Hours
<b>CRYSTAL PHYSICS</b>		
I	Crystal systems - Bravais lattice - Lattice planes - Miller indices - Inter planar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures.	6
II	[REDACTED]	6
<b>SEMICONDUCTING MATERIALS</b>		
III	Introduction - Compound and elemental semiconductor - direct and indirect band gap of semiconductors. Intrinsic semiconductor - electrical conductivity - band gap determination. - Extrinsic semiconductor - n type and p type semiconductor - Light Emitting Diode.	6
<b>MAGNETIC MATERIALS</b>		
IV	Origin of magnetic moment - Bohr magnetron - comparison of Dia, Para and Ferro magnetism - Domain theory - Hysteresis - soft and hard magnetic materials - anti ferromagnetic materials - Ferrites and its applications.	6
V	[REDACTED]	6
<b>Total Instructional Hours</b>		<b>30</b>

- Course Outcome**
- CO1 Understand the Crystal systems and crystal structures in the field of Engineering
  - CO2 Illustrate the fundamental of electrical properties of materials
  - CO3 Discuss concept of acceptor or donor levels and the band gap of a semiconducting materials
  - CO4 Develop the technology of the magnetic materials and its applications in engineering field
  - CO5 Understand the advanced technology of new engineering materials in the field of Engineering

**TEXT BOOK:**

- T1 Rajendran V, "Materials Science", Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.  
T2 M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New

**REFERENCES:**

- R1 Charles Kittel "Introduction to Solid State Physics". Wiley., New Delhi 2017  
R2 Dr. M.Arumugam "Materials Science" Anuradha publications., 2019

*J.M.V.*

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	20BE2151	EFFICIENT TECHNICAL COMMUNICATION (Common to all Branches)	2	1	2	3

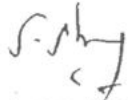
Unit	Description	Instructional Hours
	<b>The student should be able</b>	
<b>Course Objective</b>	1 To improve essential business communication skills. 2 To enrich employability knowledge. 3 To acquire the crucial organizing ability in official forum. 4 To impart important business writings. 5 To make effective presentation with essential etiquette.	
<b>I</b>	Language Proficiency: Types of sentences in English according to structure Writing: writing definitions, Describing product, work place and service (purpose, appearance, function) <b>Practical Component: Listening- Watching and interpreting advertisements/short films Speaking-</b>	9
<b>II</b>	Language Proficiency: Direct and Indirect speech. Writing: Formal memos, Job application and resume preparation <b>Practical Component: Listening- Comprehensions based on telephonic conversation Speaking-</b>	9
<b>III</b>	Language Proficiency: Homophones and Homonyms, Writing: Preparing a detail plan for an official visit, schedule and Itinerary, reading comprehension, <b>Practical Component: Listening- Listening- paraphrasing the listened content Speaking- Group Discussion with preparation</b>	9
<b>IV</b>	Language Proficiency: Idioms Writing: Report writing (marketing, investigating) <b>Practical Component: Listening- Watching technical discussions and preparing MoM Speaking- On the spot Group Discussion</b>	9
<b>V</b>	Language Proficiency: spotting errors Writing: making /interpreting chart, sequencing of sentences <b>Practical Component: Listening- Comprehensions based on announcements Speaking-</b>	9
	<b>Total Instructional Hours</b>	<b>45</b>
<b>Course Outcome</b>	CO1 To the business procedure and promotion skills. CO2 To make oral and written presentation in corporate forum. CO3 To schedule official events and participate in official discussions without reluctance. CO4 To take an effective role and manage in an organizational sector. CO5 To prepare and demonstrate a professional presentation	

**TEXT BOOK:**

- T1 Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.  
T2 Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2015.  
T3

**REFERENCES:**

- R1 Michael Mc Carthy, "Grammar for Business", Cambridge University Press, 2009.  
R2 Bill Mascull, "Business Vocabulary in use: Advanced 2<sup>nd</sup> Edition", Cambridge University Press, 2009.  
R3 Frederick T. Wood, "Remedial English Grammar For Foreign Students", Macmillan publishers, 2001.

  
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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22PH2151	PHYSICS FOR CIRCUIT ENGINEERING PROGRAMME (AIML, CSE, ECE, EEE, EIE, IT & BME)	2	0	2	3

**The student should be able**

- Course Objective**
- 1 Gain knowledge about laser, their applications, become conversant with principles of optical fiber and its applications
  - 2 Enhance his fundamental knowledge about properties of matter
  - 3 Understand the concept of wave optics
  - 4 Gain knowledge about quantum mechanics to explore the behavior of sub atomic particles
  - 5 Acquire fundamental knowledge of Ultrasonics and their applications.

Unit	Description	Instructional Hours
	<b>LASER AND FIBER OPTICS</b>	
I	Spontaneous emission and stimulated emission –Type of lasers – Nd:YAG laser - Laser Applications – Holography – Construction and reconstruction of images. Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index and modes) – Fiber optical communication link. <b>Determination of Wavelength and particle size using Laser</b>	6
	<b>PROPERTIES OF MATTER</b>	
II	Elasticity – Hooke's law – Poisson's ratio – Bending moment – Depression of a cantilever – Determination of Young's modulus of the material of the beam by Uniform bending theory and experiment. Twisting couple - torsion pendulum: theory and experiment <b>Determination of Young's modulus by uniform bending method</b> <b>Determination of Rigidity modulus – Torsion pendulum</b>	6
	<b>WAVE OPTICS</b>	
III	Interference of light – air wedge –Thickness of thin paper (Testing of thickness of surface) -Michelson interferometer - Diffraction of light –Fraunhofer diffraction at single slit – Diffraction grating - Plane Diffraction grating – Rayleigh's criterion of resolution power - resolving power of grating. <b>Determination of wavelength of mercury spectrum – spectrometer grating</b> <b>Determination of thickness of a thin wire – Air wedge method</b>	6
	<b>QUANTUM PHYSICS</b>	
IV	Black body radiation –Compton effect: theory and experimental verification – wave particle duality –concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box.	6
	<b>ULTRASONICS</b>	
V	Production – Piezoelectric generator – Properties of Ultrasonic waves. Determination of velocity using acoustic grating – Cavitation. Industrial applications – Drilling and welding – Nondestructive testing (pulse echo system). Medical applications – Ultrasound Scanner – A – mode – B- mode and C –mode.	6
	<b>Total Instructional Hours</b>	30
	<b>Total Lab Instructional Hours</b>	30

Course Outcome	CO1	CO2	CO3	CO4	CO5
	Understand the advanced technology of LASER and optical communication in the field of engineering	Illustrate the fundamental properties of matter	Discuss the Oscillatory motions of particles	Understand the dual nature of matter and the Necessity of quantum mechanics.	Develop the Ultrasonics technology and its applications in NDT.

**TEXT BOOK:**

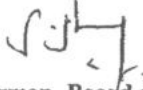
T1 Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.

T2 Gaur R.K. and Gupta S.L., Engineering Physics, 8<sup>th</sup> edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

**REFERENCES:**

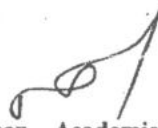
R1 M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S.Chand and Company ltd., New Delhi 2016

R2 Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2021



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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22IT2251	Python Programming and Practices (Common to IT, CSE & AIML)	2	0	2	3

**The student should be able**

- |                         |   |   |
|-------------------------|---|---|
| <b>Course Objective</b> | 1 | To know the basics of algorithmic problem solving   |
|                         | 2 | To read and write simple Python programs  |
|                         | 3 | To develop Python programs with conditionals and loops and to define Python functions and call them |
|                         | 4 | To use Python data structures — lists, tuples, dictionaries   |
|                         | 5 | To do input/output with files in Python   |

Unit	Description	Instructional Hours
	<b>ALGORITHMIC PROBLEM SOLVING</b>	
I	Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).	(5+2)
	<b>DATA, STATEMENTS, CONTROL FLOW</b>	
II	Data Types, Operators and precedence of operators, expressions, statements, comments; Conditionals: Boolean values and operators, conditional (if), alternative (if -else), chained conditional (if -elif-else); Iteration: state, while, for, break, continue, pass;	(6+4)
	<b>FUNCTIONS, STRINGS</b>	
III	Functions, parameters and arguments; Fruitful functions: return values, local and global scope, function composition, recursive functions. Strings: string slices, immutability, string functions and methods, string module.	(6+4)
	<b>LISTS, TUPLES, DICTIONARIES</b>	
IV	Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension.	(6+4)
	<b>FILES, MODULES, PACKAGES</b>	
V	Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages	(6+2)
<b>Total Instructional Hours</b>		<b>45</b>

S.No

**List of Experiments**

- 1 Read NAME, REG NO, PHYSICS, CHEMISTRY, MATHS MARKS and calculate cutoff marks out of 200 print the cutoff marks of the student
- 2 Take two numbers of int data type, two numbers of float data type as input. Print the sum and difference of two int variable on a new line Print the sum and difference of two-float variable rounded to one decimal place on a new line.
- 3 Get two integer inputs from user as dividend named as x and y. Find out Greatest Common Divisor Between both of the above two dividends
- 4 Tony's Maths teacher ask him to solve an exponential problem but he don't know how to solve. Teacher gives two values as named base and exponent value ask tony to find the factor. Help him to do his task.
- 5 Read four inputs from the user named X1, X2, Y1, Y2 and compute to find a distance between two points.
- 6 Read the five different subject marks of the student, calculate total marks and print the total marks, grade.
- 7 Given the age input as N from the user and check whether user is eligible for voting or not using if condition and print Eligible or Not Eligible. Hint: The minimum age to vote is 18 years.
- 8 Write a program that reads a integer value as N from the user and then produces n lines of output The first line contains 1 star,the second line contains 2 stars and so on until the last line which

should have N stars.can you Write this using single loop? Hint: remember what the expression '+' \*5 does.

9 A year is a leap year if it is divisible by 4, unless it is divisible by 100 and not by 400. Write a function that takes an integer value representing a year, and returns a Boolean result indicating whether or not the year is a leap year

10 sheela wants to convert time into minutes but she have no idea about it. Create a function named time() and get the input from the user as two integers hours, minutes and print the minutes as output. Help sheela to do this conversion

11 Get the two different matrix elements for (2x2) matrix. Perform addition operation and subtraction operation and print the result in matrix format using nested loop in python.

12 Read the input from the user for no of elements as N and then append it into the list. Write a python program to find the maximum element in the list.

13 Read the N no of elements from the user and append it into the list, perform linear search operations using python programming List operations

14 Read the List of Numbers from the user with N elements and perform Selection sorting operation using python programming.

15 Write a python program to take input as filename with extension, perform reading and writing operations in the file.

CO1 Develop algorithmic solutions to simple computational problems

CO2 Read, write, execute by hand simple Python programs

Course Outcome CO3 Structure simple Python programs for solving problems and Decompose a Python program into functions

CO4 Represent compound data using Python lists, tuples, dictionaries

CO5 Read and write data from/to files in Python Programs.

#### TEXT BOOK:

T1 Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.6.2, Shroff Publishers, First edition (2017).

T2 S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, Fundamentals of Python Programming, Mc-Graw Hill Education (India) Private Ltd, 2019

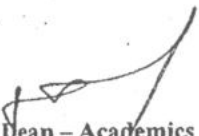
#### REFERENCES:

R1 Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

R2 Timothy A. Budd, —Exploring Python!, Mc-Graw Hill Education (India) Private Ltd., 2015

R3 Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Interdisciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

  
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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22IT2253	DYNAMIC WEB DESIGN (Common to IT, CSE & AIML)	2	0	2	2

- The student should be able**
- Course Objective**
- 1 To get Introduction to Java Script
  - 2 To understand about Dialog box and functions in Java Script
  - 3 To learn about Control statements in Java script
  - 4 To study about Arrays and objects in Java Script
  - 5 To have a knowledge in Event handling in JavaScript

Unit	Description	Instructional Hours
I	<b>INTRODUCTION TO JAVASCRIPT</b> Introduction-History of JavaScript -Simple Program: Displaying a dynamic Line of Text in a Web Page - Modifying Our First Program Obtaining – Data Types- Identifiers - Operators. <i>Conversion of Celsius to Fahrenheit using JavaScript. Java Script to perform Arithmetic Operations-Calculation of diameter, circumference and area of the circle.</i>	7+2
	<b>DIALOG BOX AND FUNCTIONS</b> User Input with prompt Dialogs (alert, prompt, confirm) - Arithmetic operations using prompt (Detail) - Display Date and Time with Greeting - Functions-Function Expression - Arrow Function. <i>Input two Integers from user and displays the sum, product, difference and quotient of the two numbers using functions and alert box. Input three integers from user and display sum, average in alert dialog using functions.</i>	7+2
III	<b>CONTROL STATEMENTS</b> If statement - if else statement-else - if statement-Switch statement-repetition statements - while repetition statement - do-while repetition statement -for repetition statement – break and continue statements. <i>Check for eligibility to drive a vehicle - Rate the student performance 5 to 1 using switch- loop that will iterate from 0 to 15. For each iteration, it will check if the current number is odd or even, and display a message to the screen.</i>	7+2
IV	<b>ARRAYS AND OBJECT</b> Arrays - Declaring and Allocation Arrays - Array Methods - Built in Object - Math - String-Date – Boolean – documents – window - using cookies. <i>Random Image Generator Using Arrays - Display current Date and Time in a Web page.</i>	7+2
V	<b>EVENT HANDLING AND REGULAR EXPRESSION</b> Document Object Model - Element Access in JavaScripts - Events and Event Handling - Basic Concepts of Event Handling - Events, Attributes, and Tag - Event Handler Attributes - Handling Events from Form Elements - Regular Expression. <i>Form validation - Design Job Skills web page-what happens for a failing applicant and a successful applicant.</i>	7+2
<b>Total Instructional Hours</b>		<b>45</b>

- Course Outcome**
- CO1 Design simple dynamic web pages
  - CO2 Develop a web page using prompt and using functions.
  - CO3 Creation of dynamic web page using Control Statements
  - CO4 Creating an interactive webpage using Arrays and Objects
  - CO5 Design a web page that handles Events.

**TEXT BOOK:**

- T1 Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Fourth Edition, Pearson Education, 2006.
- T2 Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education, 2007.

**REFERENCES:**

- R1 Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.
- R2 John Dean "WEB PROGRAMMING with HTML5, CSS, and JavaScript", Bartlett Learning, LLC 2019.

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22ME2001	ENGINEERING PRACTICES (Common to all branches)	0	0	4	2

**Course Objective** To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical and Electrical Engineering.

**Unit Description of the Experiments**  
**GROUP A (CIVIL AND MECHANICAL)**

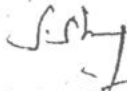
- 1 Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.
- 2 Arrangement of bricks using English Bond for one brick thick wall for right angle corner junction and T- junction
- 3 Arrangement of bricks using English Bond for one and a half brick thick wall for right angle corner and T- junction
- 4 Preparation of arc welding of Butt joints, Lap joints and Tee joints.
- 5 Practice on sheet metal Models— Trays and funnels
- 6 Hands-on-exercise in wood work, joints by sawing, planing and cutting.
- 7 Practice on simple step turning, taper turning and drilling.
- 8 Demonstration on Smithy operation.
- 9 Demonstration on Foundry operation.
- 10 Demonstration on Power tools.

**GROUP B (ELECTRICAL ENGINEERING)**

- 1 Residential house wiring using switches, fuse, indicator, lamp and energy meter.
- 2 Fluorescent lamp wiring.
- 3 Stair case wiring.
- 4 Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.
- 5 Measurement of energy using single phase energy meter.
- 6 Soldering practice using general purpose PCB.
- 7 Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.
- 8 Study of Energy Efficient Equipment's and Measuring Instruments.

**Total Instructional Hours 45**

**Course Outcome**  
 CO1 Fabricate wooden components and pipe connections including plumbing works.  
 CO2 Fabricate simple weld joints.  
 CO3 Fabricate different electrical wiring circuits and understand the AC Circuits.

  
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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22HE2071	DESIGN THINKING	2	0	0	2


Course Objective	The student should be able
	1 To expose students to the design process
	2 To develop and test innovative ideas through a rapid iteration cycle.
	3 To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
	<b>DESIGN ABILITY</b>	
I	Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	6
	<b>DESIGNING TO WIN</b>	
II	Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	5
	<b>DESIGN TO PLEASE AND DESIGNING TOGETHER</b>	
III	Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	6
	<b>DESIGN EXPERTISE</b>	
IV	Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert. Critical Thinking – Case studies: Brief history of Albert Einstein, Isaac Newton and Nikola Tesla	6
	<b>DESIGN THINKING TOOLS AND METHODS</b>	
V	Purposeful Use of Tools and Alignment with Process - Journey Mapping - Value Chain Analysis - Mind Mapping – Brainstorming - Design Thinking Application: Design Thinking Applied to Product Development	7
	<b>Total Instructional Hours</b>	<b>30</b>

Course Outcome	CO1	CO2	CO3
	Develop a strong understanding of the Design Process	Learn to develop and test innovative ideas through a rapid iteration cycle.	Develop teamwork and leadership skills

**TEXT BOOK:**  
T1 Nigel Cross, "Design Thinking", Kindle Edition

**REFERENCES:**  
R1 Tom Kelley, "Creative Confidence", 2013.  
R2 Tim Brown, "Change by Design", 2009



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Programme Course code Name of the course L T P C

B.TECH. 22HE2072 SOFT SKILLS AND APTITUDE I 0 0 0 1

**The student should be able**

- Course Objective**
- 1 To develop and nurture the soft skills of the students through instruction, knowledge acquisition, demonstration and practice.
  - 2 To enhance the students ability to deal with numerical and quantitative skills.
  - 3 To identify the core skills associated with critical thinking.
  - 4 To develop and integrate the use of English language skills

Unit	Description	Instructional Hours
I	<b>Lessons on excellence</b> Skill introspection, Skill acquisition, consistent practice	2
II	<b>Logical Reasoning</b> Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles - Attention to detail	11
III	<b>Quantitative Aptitude</b> Addition and Subtraction of bigger numbers - Square and square roots - Cubes and cube roots - Vedic maths techniques - Multiplication Shortcuts - Multiplication of 3 and higher digit numbers – Simplifications - Comparing fractions - Shortcuts to find HCF and LCM - Divisibility tests shortcuts - Algebra and functions	11
IV	<b>Recruitment Essentials</b> Resume Building - Impression Management	4
V	<b>Verbal Ability</b> Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement - Punctuations	4
<b>Total Instructional Hours</b>		<b>30</b>

- Course Outcome**
- CO1 Students will analyze interpersonal communication skills, public speaking skills.
  - CO2 Students will exemplify tautology, contradiction and contingency by logical thinking.
  - CO3 Students will be able to develop an appropriate integral form to solve all sorts of quantitative problems.
  - CO4 Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity
  - CO5 Students will be developed to acquire the ability to use English language with an error while making optimum use of grammar

**REFERENCES:**

- R1 Quantitative Aptitude – Dr. R S Agarwal
- R2 Speed Mathematics: Secret Skills for Quick Calculation - Bill Handley
- R3 Verbal and Non – Verbal Reasoning – Dr. R S Agarwal
- R4 Objective General English – S.P.Bakshi

  
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**அலகு I மொழி மற்றும் இலக்கியம்:**

3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி

இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

**அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை.**

3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளூர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

**அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்.**

3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின்

விளையாட்டுகள்.

**அலகு IV தமிழர்களின் திணைக்கோட்பாடுகள்:**

3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

**அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு.**

3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிக்கள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) - Reference Book.

  
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Programme	Course code	Name of the course	L	T	P	C
B-TECH	22MC2092	HERITAGE OF TAMIL	2	0	0	0

The student should be able		
<b>Course Objective</b>	1 Introduce students to the great History of Tamil literature.	
	2 Establish the heritage of various forms of Rock art and Sculpture art.	
	3 To study and understand the various folk and Martial arts of Tamil culture	
	4 Introduce students to Ancient Tamil concepts to understand the richness of Tamil literature.	
	5 To learn about the various influences or impacts of Tamil language in Indian culture.	
Unit	Description	Instructional Hours
	<b>Language and Literature</b>	
I	Language families in India – Dravidian Languages – Tamil as a classical language – Classical Literature in Tamil- Secular nature of Sangam Literature – Distributive justice in Sangam Literature – Management principles in Thirukural – Tamil epics and impacts of Buddhism & Jainism in Tamil and Bakthi literature of Azhwars and Nayanmars – Forms of minor poetry _ Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidasan.	6
	<b>Heritage _ Rock Art Paintings to Modern Art – Sculpture</b>	
II	Hero Stone to Modern Sculpture – Bronze icons – Tribes and their handcrafts - Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar statue at Kanyakumari, Making of musical instruments – Mridangam, Parai, Yazh and Nadhaswaram - Role of Temples in social and economic life of Tamils.	6
	<b>Folk and Martial Arts</b>	
III	Therukoothu, Karagattam, Villupattu, Kaniyan koothu, Oyilattam, Leather puppetry, Silambattam., Valari Tiger dance – Sports and Games of Tamils.	6
	<b>Thinai Concept of Tamils</b>	
IV	Flora and Fauna of Tamils – Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram concept of Tamils – Education and Literacy during Sangam Age - Ancient cities and ports of Sangam age – Export and Import during Sangam age – Overseas conquest of Cholas.	6
	<b>Contribution of Tamils to Indian National Movement and Indian Culture</b>	
V	Contribution of Tamils to Indian freedom struggle – The cultural influence of Tamils over the other parts of India – Self respect movement – Role of Siddha Medicine in indigenous systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil books.	6
	<b>Total Instructional Hours</b>	<b>30</b>
<b>Course Outcome</b>	CO1 Learn about the works pertaining to Sangam age	
	CO2 Aware of our Heritage in art from Stone sculpture to Modern Sculpture.	
	CO3 Appreciate the role of Folk arts in preserving, sustaining and evolution of Tamil culture.	
	CO4 Appreciate the intricacies of Tamil literature that had existed in the past.	
	CO5 Understand the contribution of Tamil Literature to Indian Culture	

#### TEXTBOOKS:

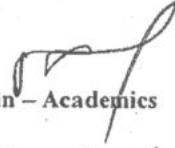
- T1 Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
- T2 Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
- T3 Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).

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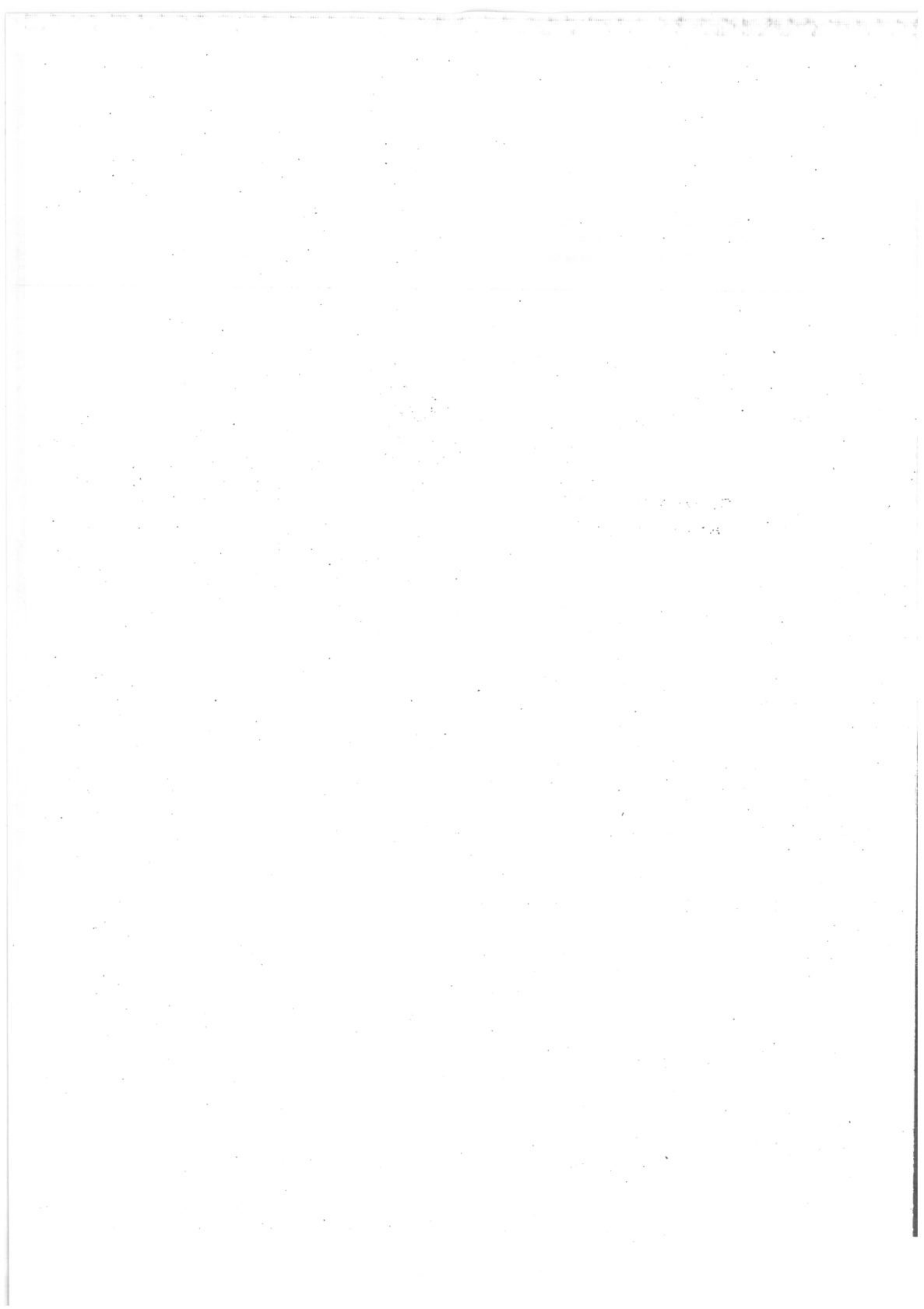
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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21AI3201	DATA STRUCTURES AND ALGORITHMS	3	0	0	3
<b>Course Objective</b>	1. To impart the basic concepts of data structures, algorithms and recursive methods 2. To understand Linked List and perform various operations on it 3. To implement operations on Stack and Queues 4. To implement traversal operations of trees and graphs 5. To understand concepts about various algorithm design techniques, searching and sorting techniques					

Unit	Description	Instructional Hours
	<b>INTRODUCTION TO ALGORITHMS</b>	
I	Introduction to Data vs Information - Data Structures - Classification - Abstraction - Abstract data types (ADT) - Array - characteristics - Storage Representations. Array Order Reversal - Recursion- Array operations, Algorithm complexity - Time and Space trade off	9
	<b>BASIC DATA STRUCTURES-LINKED LIST</b>	
II	Array Vs Linked List – Singly linked list - Representation of a linked list in memory - Operations on a singly linked list - Merging two singly linked lists into one list - Reversing a singly linked list - Polynomial Manipulation using List - Advantages and disadvantages of singly linked list - Circular linked list - Doubly linked list - Circular Doubly Linked List	9
	<b>BASIC DATA STRUCTURES-STACKS &amp; QUEUES</b>	
III	Introduction - Array Representation of a Stack - Linked List Representation of a Stack - Stack Operations - Algorithm for Stack Operations - Stack Applications: Tower of Hanoi - Infix to postfix Transformation - Evaluating Arithmetic Expressions. Queue - Introduction - Array Representation of Queue - Linked List Representation of Queue - Queue Operations - Algorithm for Queue Operations -Queue Applications: Priority Queue	9
	<b>TREES AND GRAPHS</b>	
IV	Preliminaries of Tree ADT - Binary Trees - The Search Tree ADT - Binary Search Trees - AVL Trees - Tree Traversals - B-Trees - Heap Tree - Preliminaries of Graph ADT - Representation of Graph - Graph Traversal - BFS - DFS - Applications of Graph - Shortest - Path Algorithms - Dijkstra’s Algorithm Minimum Spanning Tree - Prims Algorithm	9
	<b>ALGORITHM DESIGN TECHNIQUES &amp; SEARCHING AND SORTING TECHNIQUES</b>	
V	Divide and Conquer Strategy - Greedy Algorithm - Dynamic Programming - Backtracking Strategy - List Searches using Linear Search - Binary Search - Fibonacci Search - Sorting Techniques - Insertion sort - Heap sort – Bubble sort - Quick sort - Merge sort - Analysis of sorting techniques	9
<b>Total Instructional Hours</b>		<b>45</b>

<b>Course Outcome</b>	CO1: Understand the concept of data structures and recursive algorithms
	CO2: Able to perform various operations on linked lists
	CO3: Able to perform various operations on trees and graphs
	CO4: Able to perform traversal operations of trees and graphs
	CO5: Understand and implement the various algorithm design techniques, searching and sorting techniques.

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**TEXT BOOKS:**

- T1: Jean-Paul Tremblay, Paul G. Sorenson, "An Introduction to Data Structures with Application", TMH, 2017.  
T2: Richard F, Gilberg, Forouzan, "Data Structures", Cengage, 2nd Edition, 2004.

**REFERENCE BOOKS:**

- R1: Larry R. Nyhoff, "ADTs, Data Structures, and Problem Solving with C++", Prentice Hall Edition, 2004.  
R2: Thomas H. Cormen, Charles E. Leiserson, "Introduction to Algorithms", 3rd Edition, MIT Press, 2010.



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<b>Programme</b> B.Tech	<b>Course Code</b> 21AI3202	<b>Name of the Course</b> <b>FOUNDATIONS OF ARTIFICIAL INTELLIGENCE</b>	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To understand concepts of Artificial Intelligence and characteristics of intelligent agents</li> <li>2. To learn the different search strategies in AI</li> <li>3. To understand various knowledge representation techniques</li> <li>4. To understand the concepts of Planning and uncertainty</li> <li>5. To learn the concepts of learning in AI</li> </ol>
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Unit	Description	Instructional Hours
I	<b>INTRODUCTION</b> Introduction - Foundations of AI - History of AI - Intelligent agent - Types of agents - Structure - Problem solving agents - AI programming languages - Introduction to LISP and PROLOG - Uninformed search strategies - Breadth first search - Uniform cost search - Depth first search - Depth limited search - Bidirectional search - Searching with partial Information.	9
II	<b>SEARCHING TECHNIQUES</b> Informed search - Strategies - A* Heuristic function - Hill Climbing - Simulated Annealing - Constraint satisfaction problem - Local Search in continuous space - Genetic algorithm - Optimal decisions in games - Pruning - Imperfect decisions - Alpha - Beta pruning - Games that include an element of chance.	9
III	<b>KNOWLEDGE REPRESENTATION</b> Knowledge based agent - The Wumpus world environment - Propositional logic - Inference rules - First-order logic - Syntax and semantics - Situation calculus - Building a knowledge base - Electronic circuit domain - Ontological Engineering - Forward and backward chaining - Resolution - Truth maintenance system.	9
IV	<b>PLANNING AND UNCERTAINTY</b> Planning - Representation of planning - Partial order planning - Planning and acting in real world - Acting under uncertainty - Bayes's rules - Semantics of Belief networks - Inference in Belief networks.	9
V	<b>LEARNING</b> Learning from observation - Inductive learning - Decision trees - Explanation based learning - Statistical Learning methods - Reinforcement Learning Case Study: Chat bot System.	9
<b>Total Instructional Hours</b>		<b>45</b>

<b>Course Outcome</b>	CO1: Understand the characteristics of intelligent agents CO2: Understand and implement the Informed search strategies CO3: Able to Represent a problem using first order logic. CO4: Apply the Baye's rule to solve the problem CO5: Analyze the different learning systems to solve a given problem.
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**TEXT BOOKS:**

- T1: Stuart J.Russel, Peter Norvig, "Artificial Intelligence A Modern Approach ", 3<sup>rd</sup> Edition, Pearson Education, 2009.
- T2: Elaine Rich, Kevin Knight, "Artificial Intelligence", 3<sup>rd</sup> Edition, Tata McGraw Hill, 2009.

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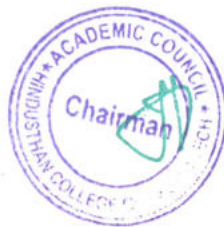
**REFERENCE BOOKS:**

- R1: M.Tim Jones, “Artificial Intelligence: A Systems Approach (Computer Science)”, Jones and Bartlett Publishers, Inc., 1<sup>st</sup> Edition, 2008.  
R2: David L. Poole and Alan K. Mackworth, “Artificial Intelligence: Foundations of Computational Agents”, 2<sup>nd</sup> Edition, Cambridge University Press, 2010.  
R3: Wolfgang Ertel, “Introduction to Artificial Intelligence”, 1<sup>st</sup> Edition, Springer, 2017.



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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21MA3152	PROBABILITY AND APPLIED STATISTICS	3	0	2	4

- Course Objective**
1. Provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like computer networks.
  2. Explain the concept of two-dimensional random variables and determine covariance.
  3. Introduce the concepts of correlation and regression to understand the relation between two random variables and illustrate the applications of descriptive statistics along with R studio
  4. Design and develop R programs for testing of hypothesis with real time applications
  5. Analyze the design of experiment techniques to solve various engineering problems

Unit	Description	Instructional Hours
	<b>PROBABILITY AND RANDOM VARIABLE</b>	
	Axioms of probability - Conditional probability - Total probability – Baye’s theorem.	
I	Random variable –Discrete and continuous random variables – Probability mass function - Binomial, Poisson distributions - Probability density function – Uniform, exponential, normal distributions - Moment generating functions – Mean and variance	9+3
	<b>TWO DIMENSIONAL RANDOM VARIABLES</b>	
	Joint probability mass function - Joint probability density function – Marginal	
II	Probability mass function – Marginal probability density function - Conditional Probability mass function - Conditional Probability density function – Independent random variables.	9
	<b>DESCRIPTIVE STATISTICS</b>	
	Measures of central Tendency - Measures of Dispersion – Skewness and Kurtosis. Correlation and Regression: Types of Correlation – Karl Pearson’s Coefficient of	
III	Correlation and Spearman’s Rank Correlation - Method of Least Squares – Linear Regression.	9+6
	<b>Introduction to R programming - Application of descriptive statistics – Mean, Median, Mode, variance. Applications of Correlation and Regression</b>	
	<b>HYPOTHESIS TESTING</b>	
	Test of significance of large samples - Test of significance for single mean - Test of significance for difference of means – Test of significance of small samples - Test for	
IV	means– t test for single mean and difference of means - Chi – Square test – independence of attributes – goodness of fit.	9+6
	<b>Application of Student t- test for Single mean &amp; difference of means, Application of Chi – square test</b>	
	<b>THE ANALYSIS OF VARIANCE</b>	
V	Applications of F distributions - One way classification and two-way classifications– Completely Randomized Design -Randomized Block Design – Latin square Design.	9
	<b>Total Instructional Hours</b>	<b>60</b>

- Course Outcome**
- CO1: Understand the axiomatic formulation of Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena
  - CO2: Express the phenomenon of two dimensional random variables
  - CO3: Compute and interpret the descriptive statistics, correlation coefficient and rank correlation coefficient, use simple linear regression model to engineering data.
  - CO4: Understand the concepts of statistical methods for testing of hypothesis with R studio.
  - CO5: Apply design of experiment techniques to solve various engineering problems.

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**TEXT BOOKS:**

- T1: Gupta, S.C. & Kapoor, V.K. (2014). Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
- T2: Douglas C. Montgomery and George C. Runger. Applied Statistics and Probability for Engineers, (7th Edition), John Wiley and Sons, Inc., New York, January 2018.

**REFERENCE BOOKS:**

- R1: Richard A. Johnson and C. B. Gupta, Probability and Statistics for Engineers, (7th Edn.), Pearson Education, Indian Impression 2007.
- R2: Walpole R. E., Myers S.L. & Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education Inc, 9th edition, 2012.



  
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<b>Programme</b> B.Tech	<b>Course Code</b> 21AI3251	<b>Name of the Course</b> DIGITAL PRINCIPLES AND SYSTEM DESIGN	<b>L</b> 3	<b>T</b> 0	<b>P</b> 2	<b>C</b> 4
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- Course Objective**
1. To understand different methods used for the simplification of Boolean functions
  2. To study combinational circuits
  3. To learn synchronous sequential circuits
  4. To understand asynchronous sequential circuits
  5. To study the fundamentals of HDL

Unit	Description	Instructional Hours
	<b>MINIMIZATION TECHNIQUES</b> Number systems: Decimal, Binary, Octal, Hexadecimal - Number - Base conversion - Complements of Numbers: 1's and 2's complements - Boolean algebra and laws-De - Morgan's Theorem - Principle of Duality - Minimization of Boolean expressions - Minterm - Maxterm - Sum of Products (SOP) - Product of Sums (POS) - Karnaugh map Minimization - Don't care conditions (2variable, 3variable & 4variable) - Tabulation method.	10
II	<b>COMBINATIONAL CIRCUITS</b> Circuits for arithmetic operations: adder: Half adder, Full adder, subtractor: Half subtractor, Fullsubtractor - BCD adder - Magnitude comparator - Encoders, Decoders - Multiplexers, Demultiplexers, Code converters: Binary to Gray, Gray to Binary. <i>1. Experimental Design and implementation of Half Adder &amp; Half Subtractor.</i> <i>2. Experimental Design and implementation of Binary to Gray and Gray to Binary Conversion.</i> <i>3. Experimental Design and implementation of Multiplexers and Demultiplexers</i>	9+6(P)
III	<b>SYNCHRONOUS SEQUENTIAL CIRCUITS</b> Flip flops: SR, JK, D, T - Design of synchronous sequential circuits: State diagram - State table - State minimization - State assignment. Shift registers: SISO, SIPO, PIPO, PISO - Counters: BCD, Up down counter. <i>Experimental Design and implementation of Synchronous and Asynchronous Counters</i>	9+4(P)
IV	<b>ASYNCHRONOUS SEQUENTIAL CIRCUITS</b> Analysis and design of asynchronous sequential circuits - Reduction of state and flow tables - Race - free state assignment - Hazards.	9
V	<b>HARDWARE DESCRIPTION LANGUAGE</b> Introduction to Hardware Description Language (HDL) - HDL for combinational circuits - Half adder, Full adder, Multiplexer, De-multiplexer, HDL for Sequential Circuits - Flip flops, Synchronous and Asynchronous Counters, Registers. <i>Coding Combinational/Sequential circuits using HDL</i>	9+4(P)
<b>Total Instructional Hours</b>		<b>60</b>

**TEXT BOOKS:**

T1: Morris Mano M. and Michael D. Ciletti, "Digital Design with an Introduction to the Verilog HDL", 5<sup>th</sup> Edition, Pearson Education, 2013.

**REFERENCE BOOKS:**

R1: S. Salivahanan and S. Arivazhagan, "Digital Circuits and Design", 4<sup>th</sup> Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.

R2: Thomas L. Floyd, "Digital Fundamentals", Pearson Education, New Delhi, 2013.

  
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<b>Programme</b> B.Tech	<b>Course Code</b> 21AI3252	<b>Name of the Course</b> CLEAN CODING AND DEVOPS	<b>L</b> 3	<b>T</b> 0	<b>P</b> 2	<b>C</b> 4
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- Course Objective**
1. Understand about the clean code
  2. Explain the importance of naming conventions
  3. Understand the importance of comments in the applications
  4. Understand and install different tools used in DevOps stack
  5. Explain the benefits of DevOps and how various industries are benefitting
  6. Explain how to automatically rollback a release if it is failed

Unit	Description	Instructional Hours
	<b>INTRODUCTION TO CLEANCODING</b>	
I	Coding principles introduction-Bad and Good code-marshalling and unmarshalling-Names and Functions-distinct names-Defining meaningful context-Usage of domain and function names-Usage of exceptions and its error code names/descriptions. Lab Exercises- Write a Fibonacci Program using Clean coding, Exporting multiple variables, Assigning a value to the same thing conditionally using ternary operators, Declaring and assigning variables from array indexes.	9+3(P)
	<b>COMMENTS, FORMATTING AND OBJECTS</b>	
II	Right comments and types of formatting- Clean and bad comments-Vertical and horizontal formatting-Objects and data structures-Data abstraction-Data and object antisymmetric-Data transfer objects Lab Exercises- Structural Formatting the code, Eligible to vote using comments, Arithmetic Operator using Horizontal openness and density..	8+2(P)
	<b>INTRODUCTION TO DEV-OPS</b>	
III	An overview about DevOps - Why it is needed? How it is different from traditional IT and Agile - DevOps Principles - DevOps Lifecycle - An overview about CI/CD pipeline and various tools - setup a complete CI/CD pipeline from scratch using DevOps tools - How DevOps is used in various technologies/industries. Lab Exercises- Set up of Devops, Create a build and release agent	9+4(P)
	<b>ADVANCED DEV-OPS</b>	
IV	An overview of advanced DevOps concepts - Automatic Rollback and Provisioning, Scalability, Clustering and Infrastructure as Code. Lab Exercises- Import code and create Devops build pipeline, Create the Devops release pipeline	9+4(P)
	<b>INTRODUCTION TO DEV-OPS ON CLOUD</b>	
V	An overview of Cloud computing - Introduction to IBM Cloud - Why DevOps on cloud - IBM Cloud services - Setup a CI/CD pipeline in IBM Cloud. Lab Exercises- Continuously deliver to Production, Track functional changes throughout the CI/CD pipeline	9+3(P)
<b>Total Instructional Hours</b>		<b>(44 + 16) 60</b>

- Course Outcome**
- CO1: Understand the importance of comments in the applications
  - CO2: Understand the data and object antisymmetric
  - CO3: Understand Cloud computing concepts
  - CO4: Explain why DevOps on cloud and various DevOps services available on IBM Cloud

**TEXT BOOKS:**

T1: IBM Course Ware.



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**REFERENCE BOOKS:**

R1: Robert C Martin, "Clean Code: A Hand Book of Agile Software Craftsmanship", 2008.

R2: Ingo M. Weber, Len Bass, and Liming Zhu, "DevOps: A Software Architect's Perspective", 2015.



A handwritten signature in green ink, appearing to be "A. Singh".

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Programme B.Tech	Course Code 21AI3001	Name of the Course DATA STRUCTURES AND ALGORITHMS LABORATORY	L 0	T 0	P 3	C 1.5
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- Course Objective**
1. To learn the methodical way of solving problem.
  2. To comprehend the different methods of organizing large amount of data.
  3. To efficiently implement the different data structures.

**S. No. Description of the Experiments**

**1 Singly Linked List and Doubly Linked List**

- a) Create and display Singly Linked List.
- b) Given a singly linked list with head node root, write a function to split the linked list into k consecutive linked list "parts".
- c) Find k<sup>th</sup> node from the end of linked list
- d) Reverse a doubly linked list.
- e) Merge two sorted singly Linked Lists without creating new nodes.

**2 a) Implementation of Stack**

Arun reads lot of story books and he keeps all the story books piled as a single stack. He wants to write a program to keep the order of the books in the pile. The program must implement the following functionalities.

Add a book to the top of the pile when 1 is followed by the name of the book.

Remove a book from the top of the pile when -1 is given as the input (provided the pile has at least one book).

Print the name of the book on the top of the pile when 2 is given as the input (provided the pile has at least one book).

The program must exit when 0 is given as the input.

**b) Implementation of Queue**

Riyaz has a book of tickets and wants to store ticket numbers in a data structure. New tickets are added to the end of the booklet. Ticket at the top of the stack is issued to the customer. Implement the data structure should Riyaz use to represent the ticket booklet?

- 3 a) Given an Infix expression convert it into its postfix Equivalent using stack data structure.  
b) Write a program to implement deque using linked lists

**4 Binary search tree and traversal**

a) Insertion, Deletion, Searching in a BST

b) Find k<sup>th</sup> smallest and k<sup>th</sup> largest element in a BST

Check if a given sequence represents the in-order, pre-order and post-order traversal of a BST.

**5 Write a program for AVL tree having functions for the following operations:**

a) Insert an element (no duplicates are allowed),

b) Delete an existing element,

Traverse the AVL (in-order, pre-order, and post-order)

**6 Heaps using priority queue**

Geek hosted a contest and N students participated in it. The score of each student is given by an integer array arr. The task is to print the number of each student (indexes) in the order they appear in the scoreboard. A student with a maximum score appears first. If two people have the same score then higher indexed student appears first.

- 7 Write a C program to Implement Hash Tables with Quadratic Probing.



- 8     **a) Merge Sort**  
Write a function that takes two list, each of which is sorted in increasing order, and merges the two into one list, which is in descending order, and returns it. In other words, merge two sorted linked list from their end.
- b) Quick Sort**  
Given an array arr[], its starting position low and its ending position high. Implement the partition() and quickSort() functions to sort the array.
- 9     Implementation of the following graph traversal algorithms:  
a) Depth first traversal  
b) Breadth first traversal
- 10    **Minimum spanning tree using prim's and kruskal's algorithm.**  
Given a graph which consists of several edges connecting its nodes, find a subgraph of the given graph with the following properties: The subgraph contains all the nodes present in the original graph. The subgraph is of minimum overall weight (sum of all edges) among all such subgraphs. It is also required that there is exactly one, exclusive path between any two nodes of the subgraph. One specific node S is fixed as the starting point of finding the subgraph using Prim's Algorithm. Find the total weight or the sum of all edges in the subgraph.
- 11    **Time Complexity**  
a) Write a C program to print the time complexity of merge sort algorithm  
b) C program to store time taken by bubble sort, insertion sort and selection sort

**Total Practical Hours: 45**

<b>Course Outcome</b>	CO1: Apply good programming design methods for program development.
	CO2: Apply the different data structures for implementing solutions to practical problems. Develop recursive programs using trees and graphs.
	CO3: Develop recursive programs using trees and graphs.



  
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<b>Programme</b> B.Tech	<b>Course Code</b> 21AI3002	<b>Name of the Course</b> ARTIFICIAL INTELLIGENCE LABORATORY	<b>L</b> 0	<b>T</b> 0	<b>P</b> 3	<b>C</b> 1.5
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- Course Objective**
1. To learn Prolog
  2. To understand and learn LISP
  3. To learn the methodical way of solving problem

S. No.	Description of the Experiments
1	Installation of gnu-prolog, Study of Prolog (gnu-prolog), its facts, and rules
2	Write simple fact for the statements using PROLOG
3	Write a program to solve the Monkey Banana problem
4	Write a program to implement factorial, fibonacci of a given number
5	Write a program to solve 4-Queen problem
6	Write a program to solve traveling salesman problem
7	Write a program to solve water jug problem using LISP
8	Write a program which behaves a small expert for medical Diagnosis

**Total Practical Hours: 45**

- Course Outcome**
- CO1: Able to implement facts and rules in Prolog  
CO2: Able to solve problems using LISP  
CO3: Apply good programming design methods for program development

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<b>Programme</b> B.Tech	<b>Course Code</b> 21MC3191	<b>Name of the Course</b> INDIAN CONSTITUTION	<b>L</b> 2	<b>T</b> 0	<b>P</b> 0	<b>C</b> 0
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- Course Objective**
1. Sensitization of student towards self, family (relationship), society and nature.
  2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
  3. Strengthening of self-reflection.
  4. Development of commitment and courage to act.

<b>Unit</b>	<b>Description</b>	<b>Instructional Hours</b>
I	<b>BASIC FEATURES AND FUNDAMENTALE PRINCIPLES</b> Meaning of the constitution law and constitutionalism - Historical perspective of the constitution of India - salient features and characteristics of the constitution of India.	4
II	<b>FUNDAMENTAL RIGHTS</b> Scheme of the fundamental rights - fundamental duties and its legislative status - The directive principles of state policy - its importance and implementation - Federal structure and distribution of legislative and financial powers between the union and states.	4
III	<b>PARLIAMENTARY FORM OF GOVERNMENT</b> The constitution powers and the status of the president in India - Amendments of the constitutional powers and procedures - The historical perspective of the constitutional amendment of India - Emergency provisions: National emergency, President rule, Financial emergency.	4
IV	<b>LOCAL GOVERNANCE</b> Local self-government -constitutional scheme of India - Scheme of fundamental right to equality - scheme of fundamental right to certain freedom under article 19 - scope of the right to life and personal liberty under article 21.	4
V	<b>INDIAN SOCIETY</b> Constitutional Remedies for citizens - Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	4
<b>Total Instructional Hours</b>		<b>20</b>

**Course Outcome** CO1: Understand the functions of the Indian government.  
CO2: Understand and abide the rules of the Indian constitution.

**TEXT BOOKS:**

- T1: Durga Das Basu, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi, 2011.  
T2: R.C.Agarwal, "Indian Political System", S.Chand and Company, New Delhi, 1997.  
T3: Maciver and Page, "Society: An Introduction Analysis", Mac Milan India Ltd., New Delhi, 1997.  
T4: K.L.Sharma, "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi, 1997.

**REFERENCE BOOKS:**

- R1: Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi, 2017.  
R2: U.R.Gahai, "Indian Political System", New Academic Publishing House, Jalaendhar.  
R3: R.N. Sharma, "Indian Social Problems", Media Promoters and Publishers Pvt. Ltd.

  
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<b>Programme</b> B.Tech	<b>Course Code</b> 21MA4105	<b>Name of the Course</b> DISCRETE MATHEMATICAL STRUCTURES	<b>L</b> 2	<b>T</b> 1	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. Understand the concepts of Logics and rules of inference
  2. Learn the basic concepts of Relations and Functions
  3. Generate counting problems using mathematical induction and recurrence relations
  4. Examine the Boolean algebra which is used in the Boolean logics and circuits
  5. Describe the basic knowledge of graph theory and trees which are applied in Computer networks

Unit	Description	Instructional Hours
	<b>LOGICS AND PROOFS</b>	
I	Basic Connectives – Truth Tables – Logical Equivalence – Normal forms - Principal normal forms -Rules of Inference.	9
	<b>RELATION AND FUNCTION</b>	
II	Relations- Types of relations - Equivalence Relation –Closure of relations - Partial Order Relation – Functions – Types of functions - Injective, surjective and bijective functions – composition of functions - Inverse functions.	9
	<b>COMBINATORICS</b>	
III	Mathematical induction – Recurrence relations – Solving linear recurrence relations-generating functions.	9
	<b>LATTICES AND BOOLEAN ALGEBRA</b>	
IV	Lattices – Properties of lattices – Lattices as algebraic system – Sub lattices - some special lattices – Boolean algebra – Definition and simple properties.	9
	<b>GRAPHS AND TREES</b>	
V	Graphs and their properties –Sub Graph – Isomorphism – Eulerian and Hamiltonian Walks – Trees - spanning tree – minimum spanning tree – Rooted Trees.	9
<b>Total Instructional Hours</b>		<b>45</b>

- Course Outcome**
- CO1: Explain and apply basic notions of symbolic logic  
 CO2: Identify the differences between a relation and a function  
 CO3: Solve problems using counting techniques and recurrence relations  
 CO4: Understand the knowledge about Lattices and Boolean Algebra  
 CO5: Apply the properties of graphs and trees in computer networks.

**TEXT BOOKS:**

- T1: Trembly J.P and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw–Hill Pub. Co. Ltd, New Delhi, Re-print (2017).  
 T2: Ralph. P. Grimaldi, “Discrete and Combinatorial Mathematics: An Applied Introduction”, Fifth Edition, Pearson Education Asia, Delhi, 2016.

**REFERENCE BOOKS:**

- R1: T. Veerarajan, “Discrete Mathematics with Graph Theory and Combinatorics”, Tata. McGraw-Hill Education, 15th reprint, 2012.  
 R2: Kenneth H. Rosen, “Discrete Mathematics and its Applications”, seventh Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 2013.  
 R3: Thomas Koshy, “Discrete Mathematics with Applications”, Elsevier Publications, 2010.

  
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<b>Programme</b> B.Tech	<b>Course Code</b> 21AI4201	<b>Name of the Course</b> DATABASE MANAGEMENT SYSTEMS	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. To understand the role of data, files and databases in information systems and learn the fundamentals of data models
  2. To study SQL and relational database design
  3. To represent ER diagram for any customized applications
  4. To understand various normal forms
  5. To understand the fundamental concepts of transaction processing, concurrency control techniques and recovery procedures

<b>Unit</b>	<b>Description</b>	<b>Instructional Hours</b>
	<b>INTRODUCTION TO DATABASE SYSTEMS</b>	
I	Introduction to database system - Characteristics of the Database Approach - Advantages of using the DBMS Approach - History of Database Applications. Data Models - Schemas, and Instances - Three-Schema Architecture and Data Independence - Database Languages.	8
	<b>RELATIONAL DATABASE</b>	
II	Structure of Relational Databases - Database Schema, Keys - Relational Query Languages - The Relational Algebra. Introduction to SQL: Overview of the SQL Query Language - SQL Data Definition - Basic Structure of SQL Queries - Additional Basic Operations - Set Operations - Null Values - Aggregate Functions - Nested Subqueries Join - Views - Integrity Constraints - Triggers.	10
	<b>CONCEPTUAL DATA MODELING</b>	
III	Using High - Level Conceptual Data Models for Database Design - Entity Types - Entity Sets - Attributes, and Keys - Relationship Types - Relationship Sets - Roles-Weak Entity Types - ER Diagrams - Naming Conventions - and Design Issues - The Enhanced Entity - Relationship (EER) Model.	9
	<b>NORMALIZATION THEORY</b>	
IV	Functional Dependencies - Normal Forms Based on Primary Keys - Boyce-Codd Normal Form - Multivalued Dependency and Fourth Normal Form - Join Dependencies and Fifth Normal Form.	9
	<b>TRANSACTION MANAGEMENT</b>	
V	Transactions: Transaction Concept - A Simple Transaction Model - Transaction Atomicity and Durability - Transaction Isolation - Serializability - Transaction Isolation and Atomicity. Concurrency Control: Lock-Based Protocols - Deadlock Handling - Multiple Granularity Recovery System: Failure Classification - Recovery Algorithm.	9
	<b>Total Instructional Hours</b>	<b>45</b>

- Course Outcome**
- CO1: Understand the functional components of DBMS and data models
- CO2: Able to write SQL queries
- CO3: Analyze a system and design ER diagram and Relational Schema
- CO4: Able to perform normalization and write queries using normalization criteria
- CO5: Illustrate the concepts for transaction processing, concurrency control and recovery procedures for RDBMS.

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**TEXT BOOKS:**

- T1: Ramez Elmasri and Shamkant B.Navathe, "Fundamentals of Database Systems", Pearson Education, 7th edition, 2013. (UNIT I, III & IV).  
T2: Abraham Silberschatz, Henry F.Korth and S.Sudarshan, "Database System Concepts", Mc Graw Hill, 7th edition, 2019. (UNIT II, V)

**REFERENCE BOOKS:**

- R1: Raghu Rama Krishnan, "Database Management Systems", Tata Mcgraw Hill, 6th edition, 2010.  
R2: Carlos Coronel and Steven Morris, "Database System Design and Implementation", Cengage Learning, 11th edition, 2013.



  
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<b>Programme</b> B. Tech.	<b>Course Code</b> 21AI4202	<b>Name of the Course</b> DATA VISULIZATION	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. Design and create data visualization.
  2. Conduct exploratory data analysis using visualization.
  3. Craft visual presentation of data for effective communication.
  4. Design and evaluate color palettes for visualization design alternative.
  5. Apply data transformation such as aggregation and filtering for visualization.
  6. Identify opportunities for application of data visualization in various domains

Unit	Description	Instructional Hours
	<b>INTRODUCTION TO STATISTICS</b>	
I	Data collection methods, Descriptive Statistics Mean, Median, Mode, Inferential Statistics, Random Variables, Probability Distributions, Normal Distribution, Sampling and Sampling Distribution.	9
	<b>VISUALIZATION USING R</b>	
II	Overview of R, Descriptive data analysis using R, Data manipulation with R Data visualization with R, R studio installation, Data manipulation with R (dplyr, data. table, reshape2package, tidyr package, Lubricate package), Data Visualization with R (working with Graphics, ggplot2).	7+2(P)
	<b>WATSON STUDIO</b>	
III	Data visualization in Watson studio, Adding data to data refiner, Visualization of data in Watson studio.	5+4(P)
	<b>DATA ANALYSIS USING PYTHON</b>	
IV	Introduction to python, Python scripting basics, Data types - Introduction to Jupyter notebook, Numpy and Pandas, Python and Anaconda installation, Pandas (text data, date time columns, indexing and selecting data, group by Merge/join datasets).	3+6(P)
	<b>VISUALIZATION USING PYTHON</b>	
V	Data Visualization tools in python, Basic plots using Matplotlib, Specialized Visualization tools using Matplotlib, Advanced Visualization tools using Matplotlib-Seaborn functionalities, Spatial visualization and analysis in python in folium, Usage of Seaborn functionalities, Case studies.	5+4(P)
<b>Total Instructional Hours</b>		<b>(29 + 16) 45</b>

- Course Outcome**
- CO1: Know the history of data visualization and its connection with computer graphics.
  - CO2: Students understand the foundations and characteristics of data, which forms the beginning of the visualization pipeline.
  - CO3: Understand the role of user interaction within visualizations, understand the visualization design process.
  - CO4: Students know some commercial data visualization packages with functionality.

**TEXT BOOKS:**

T1 :IBM CE-Data visualization.

**REFERENCE BOOKS:**

- R1: Information Dashboard Design: Displaying Data for At-a-glance Monitoring
- R2: The Big Book of dash board by Steve Wexler.
- R3: Mastering python data Visualization.

  
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HICET – Department of Artificial Intelligence and Machine Learning

<b>Programme</b> B.Tech	<b>Course Code</b> 21AI4251	<b>Name of the Course</b> OPERATING SYSTEMS	<b>L</b> 2	<b>T</b> 0	<b>P</b> 2	<b>C</b> 3
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- Course Objective**
1. To learn the basic concepts and understand the structure of operating systems
  2. To learn and implement the concept of process management.
  3. To learn and understand synchronization and deadlock concepts
  4. To learn various memory management schemes
  5. To understand the concept of I/O and file systems and learn the basics of Linux Programming

Unit	Description	Instructional Hours
	<b>OPERATING SYSTEMS OVERVIEW</b>	
I	Computer System Overview - Basic Elements, Instruction Execution, Interrupts operating systems overview - Evolution of Operating System - Computer System Organization - Operating System Structure and Operations - System Calls - System Programs - OS Generation and System Boot.	7
	<b>PROCESS MANAGEMENT</b>	
II	Processes - Process concepts - Process scheduling - Operations on processes - Cooperating processes - CPU scheduling - Basic concepts - Scheduling criteria - Scheduling algorithms - Preemptive strategies - Non-preemptive strategies. <i>Illustrative Programs: Implementation of process scheduling mechanism (Round Robin, SJF, FCFS).</i>	5+4(P)
	<b>SYNCHRONIZATION AND DEADLOCKS</b>	
III	The critical section problem - Semaphores - Classic problems of synchronization - Critical regions - Monitors-Dead locks - Deadlock characterization - Prevention - Avoidance - Detection - Recovery. <i>Illustrative Programs: Producer Consumer Problem using Semaphores, Bankers Algorithm.</i>	5+4(P)
	<b>MEMORY MANAGEMENT</b>	
IV	Storage Management Strategies - Contiguous Vs. Non-Contiguous Storage Allocation - Fixed & Variable Partition Multiprogramming - Paging - Segmentation - Paging/Segmentation Systems - Page Replacement Strategies - Demand & Anticipatory Paging - File Concepts - Access Methods - Directory Structure - File Sharing - Protection - File - System Structure - Implementation. <i>Illustrative Programs: Simulate Paging Technique of Memory Management, Simulate Page Replacement Algorithms (FIFO, LRU, LFU).</i>	6+4(P)
	<b>I/O SYSTEM, LINUX &amp; SHELL PROGRAMMING</b>	
V	Mass Storage Structure - Disk Structure- Disk Scheduling - Disk Management - Swap Space Management - RAID Structure - Shell Operation Commands - File Management Operation - Internet Service - Telnet - FTP - Filters & Regular Expressions - <i>Case Study (Linux) - Shell Programming - Variable, Arithmetic Operations, Control Structures, Handling Date, Time &amp; System Information.</i>	6+4(P)
<b>Total Instructional Hours</b>		<b>45(29+16)</b>

- Course Outcome**
- CO1: Understand the fundamental components of a computer operating system and how computing resources are managed by the operating system
  - CO2: Apply the concepts of various CPU scheduling algorithms
  - CO3: Describe and solve Synchronization, Deadlock Problem
  - CO4: Demonstrate the different memory management techniques used in Operating Systems.
  - CO5: Implement the basic services and functionalities of the operating system using System Calls in Linux.

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**TEXT BOOKS:**

- T1: Abraham Silberschatz, Peter Galvin and Gagne, "Operating System Concepts", 10th Edition, Addison Wesley, 2018.  
T2: Tom Adelstein, Bill Lubanovic, "Linux System Administration Solve Real-life Linux Problems Quickly", O'Reilly Media, 2007.

**REFERENCE BOOKS:**

- R1: Andrew S. Tanenbaum, "Modern Operating Systems", 4<sup>th</sup> Edition, Pearson Publications, 2019.  
R2: D M Dhamdhare, "Operating Systems: A Concept-Based Approach", 3<sup>rd</sup> Edition, Tata McGrawHill Education, 2017.  
R3: Harvey M.Deitel, "Operating System", 3rd Edition, Addison Wesley, 2003.  
R4: William Stallings, "Operating Systems - Internals and Design Principles", 9<sup>th</sup> Edition, Pearson Publications, 2018.



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HICET – Department of Artificial Intelligence and Machine Learning

Programme	Course Code	Name of the Course	L	T	P	C
B. Tech	21AI4252	INTRODUCTION TO MACHINE LEARNING	3	0	2	4
Course Objective	1. Identify the scope and necessity of Data Mining & Warehousing for the society 2. To introduce students to the basic concepts and techniques of Machine Learning 3. To learn and understand the concept of neural networks 4. To understand classification and clustering techniques 5. To understand evolutionary models					
Unit	Description					Instructional Hours
I	<b>DATA MINING AND DATA WAREHOUSING</b> Introduction - Steps in KDD - System Architecture - Types of data - Data mining functionalities - Classification of data mining systems - Integration of a data mining system with a data warehouse - Issues - Data Preprocessing - Data Mining Application Data warehousing components - Building a data warehouse - Multi Dimensional Data Model - OLAP Vs OLTP, Case Study: Modernizing a Data Warehouse for Machine Learning <i>Perform the basic pre-processing operations on data relation such as removing an attribute and filter attribute bank data</i>					10+2(P)
II	<b>INTRODUCTION TO MACHINE LEARNING</b> Learning - Types of Machine Learning - Supervised Learning - The Brain and the Neuron - Design a Learning System - Perspectives and Issues in Machine Learning - Concept Learning Task - Concept Learning as Search - Finding a Maximally Specific Hypothesis - Version Spaces and the Candidate Elimination Algorithm - Linear Discriminants - Perceptron - Linear Separability - Linear Regression. Case Study: Personal Smart Assistants, Predictive Analytics using Machine Learning <i>Illustrative Examples: 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.</i> <i>For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm. Output a description of the set of all hypotheses consistent with the training examples.</i>					9+4(P)
III	<b>NEURAL NETWORKS</b> Neural Networks - threshold logic units - linear machines - networks of threshold learning units - Training of feed forward networks by back propagations - neural networks vs. knowledge - based systems. Case Study: text translation, credit card fraud detection, medical diagnosis and solutions using neural networks <i>Illustrative Examples: Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.</i>					9+4(P)
IV	<b>CLASSIFICATION AND CLUSTERING TECHNIQUES</b> Support vector Machine - Decision Tree - Naïve Bayes - Random Forest – Density - Based Clustering Methods Hierarchical Based clustering methods - Partitioning methods - Grid based methods - K means clustering - pattern based with deep learning. Using classification and clustering in Retail marketing and Sports science. <i>Illustrative Examples: 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.</i> <i>Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.</i>					9+4(P)
V	<b>EVOLUTIONARY MODELS</b> Evolutionary Learning - Genetic algorithms - Genetic Offspring: - Genetic Operators - Using Genetic Algorithms - Reinforcement Learning - Overview - Getting Lost Example - Markov Decision Process. Case Study: Applying Genetic algorithm in Wireless Sensor Networks and Vehicle Routing problems <i>Illustrative Examples: Implement genetic algorithm for an example of your choice</i>					7+2(P)



Course  
Outcomes

- CO1: Understand Data Mining & Warehousing concepts
- CO2: Understand and Distinguish between types of learning
- CO3: Build neural networks using algorithms
- CO4: Implement applications with clustering and classification techniques
- CO5: Understand evolutionary models

**TEXT BOOKS:**

- T1: Stephen Marsland, "Machine Learning - An Algorithmic Perspective", 2<sup>nd</sup> Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
- T2: Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", 2<sup>nd</sup> Edition, Elsevier, 2007.
- T3: Nils J. Nilsson, "Introduction to Machine learning".

**REFERENCE BOOKS:**

- R1: Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 3<sup>rd</sup> Edition, 2014.
- R2: Y. S. Abu-Mostafa, M. Magdon-Ismael, and H.-T. Lin, "Learning from Data", AML Book Publishers, 2012.
- R3: Andreas, C. Muller & Sarah Guido, "Introduction to Machine Learning with Python A guide for data scientists".
- R4: Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1<sup>st</sup> Edition, Cambridge University Press, 2012.
- R5: Tom M Mitchell, "Machine Learning", 1<sup>st</sup> Edition, McGraw Hill Education, 2013.



  
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*HICET – Department of Artificial Intelligence and Machine Learning*

<b>Programme</b> B.Tech	<b>Course Code</b> 21AI4001	<b>Name of the Course</b> DATABASE MANAGEMENT SYSTEMS LABORATORY	<b>L</b> 0	<b>T</b> 0	<b>P</b> 3	<b>C</b> 1.5
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- Course Objective**
1. To understand data definitions and data manipulation commands
  2. To learn the use of nested and join queries
  3. To understand views and constraints
  4. To understand functions, procedures and procedural extensions of data bases
  5. To understand design and implementation of typical database applications

S. No.	Description of the Experiments
1	Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving tables
2	Data Control and Transaction Control statements
3	Database Querying – Simple queries, Nested queries, Sub queries and Joins
4	Integrity Constraints
5	Views, Sequences and Synonyms
6	Database Programming: Implicit and Explicit Cursors
7	Procedures and Functions
8	Triggers
9	Exception Handling
10	Development of mini-projects with front end of your choice.

**Total Practical Hours: 45**

**Scenario 1**

**Table 1: Busdiv**

Buscode	BusDesc
01	Super Delux
02	Delux
03	Super Fast
04	Normal

**Table 2: Busroute**

Route_id	Route_no	Buscode	Origin	Dest	Fare	Dist	Capacity
201	33	01	Chennai	Madurai	170	300	45
202	25	02	Trichy	Madurai	45	100	50
203	15	03	Nellai	Madurai	30	90	50
204	36	04	Chennai	Bangalore	150	250	55
205	40	01	Bangalore	Madurai	170	250	45
206	38	02	Madurai	Chennai	160	300	50
207	39	03	Hyderabad	Chennai	160	190	50
208	41	04	Chennai	Cochin	148	320	55
209	47	02	Chennai	Coimbatore	165	300	50
210	46	04	Coimbatore	Chennai	150	300	55

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Table 3: Busdepot

Place_id	Place	Address	Station
01	Chennai	12, Beach Rd	Broadway
02	Madurai	17, Bye Pass Rd	Ellis Nagar
03	Trichy	11, First Cross Road	Tollgate
04	Bangalore	15, Second St	Malleswaram
05	Hyderabad	115, Lakeview Rd	Charminar
06	Nellai	12, Temple Rd	Town

Table 4: Journey

J-Id	Date	Time	Route_id	Buscode
01	13-Jan-97	10:00:00	201	01
02	13-Jan-97	12:00:00	201	01
03	13-Jan-97	13:00:00	201	01
04	13-Apr-97	15:00:00	202	02
05	13-Apr-97	17:00:00	202	03
06	13-Apr-97	19:00:00	203	04

Table 5: Ticket

J-Id	Tick_no	Dob	Doj	Time	Station	Origin	Dest	Adults	Child	Totfare	Route_id
01	001	10-Dec-96	13-Jan-97	10:00:00	Broadway	Chennai	Madurai	1	1	225	201
02	002	12-Dec-96	13-Jan-97	12:00:00	Broadway	Chennai	Madurai	2	0	90	202
03	003	01-Jan-97	13-Jan-97	13:00:00	Broadway	Chennai	Madurai	1	1	255	201
04	004	02-Feb-97	13-Apr-97	15:00:00	Tollgate	Trichy	Madurai	3	0	90	203
05	005	05-Mar-97	13-Apr-97	17:00:00	Tollgate	Trichy	Madurai	1	0	150	204
06	006	18-Mar-97	13-Apr-97	19:00:00	Town	Nellai	Madurai	1	1	90	202

Table 6: Ticketdetail

Tick_no	Name	Sex	Age	Fare
001	Latha	F	24	170
001	Anand	M	10	85
002	Pradeep	M	30	45
002	Kuldeep	M	32	45
003	Rakesh	M	48	170
003	Brindhha	F	08	85
004	Radhika	F	22	30
004	Juliat	F	21	30

**Constraints**

1.

**Busdiv**

Buscode(primary key)  
Busdesc(Unique)

**Busroute**

Buscode(Foreign key)  
Route\_no(Unique)

2.

**Journey**

J\_Id(primary key)  
Day(Notnull)  
Time(Notnull)

**Ticket**

J\_Id(Foreign key)  
Time(Notnull)  
Origin(Notnull)  
Dest(Notnull)

3.

**Busroute**

Route\_id (primary key)

**Journey**

Route\_id (Foreign key)

4.

**Ticket**

Tick\_no (primary key)  
Sex (Check constraint for  
accepting either M of F)

**Ticketdetail**

Tick\_no (Foreign key)

5.

**Busdiv**

Buscode (primary key)

**Journey**

Buscode (Foreign key)

Create the above tables by applying the constraints specified and populate the tables. Perform various DML, TCL commands (Select, Insert, Update, Delete, Commit, Rollback, Savepoint, Grant, Revoke). Perform various operation involving arithmetic operators, logical operators, comparison operators, character, number, date functions. Create a view jview from the Journey table such that it contains Day, Time and route\_id as J\_day, J\_time, J\_r\_id as column headings. Update the jview such that the J\_day is "20-jan-98" where J\_r\_id is 201. Select the contents of corresponding table that jview is based and check whether update has occurred. Perform various join operations on the tables Busdiv and Busroute.

Create a synonym passenger for ticketdetail table. Select contents of passenger. Create a synonym busdetails for busroute table. Drop the passenger synonym. Create an index on route\_id column of busroute table. Drop the index. Create a sequence ticket where minimum value is 1 and maximum value is 20 with an increment of 2 and starting with 1. Insert the sequence ticket into the tick\_no column of ticket table. Alter the sequence such that the maximum value is 15. List only the sequences created by you. List only the views created by you. List all the indexes created by you. Drop all the database objects created by you. Create a procedure that will increment the selected records tofare in the ticket table by 100 update the table. Create a trigger that ensures no changes to the records on specified days.

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Scenario 2:

Table 1: Emp

EmpNo	Ename	Job	MGR	HireDate	Sal	Comm	Deptno
7369	SMITH	CLERK	7902	17-DEC-80	800		20
7499	ALLEN	SALESMAN	7698	20-FEB-81	1600	300	30
7521	WARD	SALESMAN	7698	22-FEB-81	1250	500	30
7566	JONES	MANAGER	7839	02-APR-81	2975		20
7654	MARTIN	SALESMAN	7698	28-SEP-81	1250	1400	30
7698	BLAKE	MANAGER	7839	01-MAY-81	2850		30
7782	CLARK	MANAGER	7839	09-JUN-81	2450		10
7788	SCOTT	ANALYST	7566	19-APR-87	3000		20
7839	KING	PRESIDENT		17-NOV-81	5000		10
7844	TURNER	SALESMAN	7698	08-SEP-81	1500	0	30
7876	ADAMS	CLERK	7788	23-MAY-87	1100		20
7900	JAMES	CLERK	7698	03-DEC-81	950		30
7902	FORD	ANALYST	7566	03-DEC-81	3000		20
7934	MILLER	CLERK	7782	23-JAN-82	1300		10

Table 2: Dept

DeptNo	Dname	Loc
10	Accounting	New York
20	Research	Dallas
30	Sales	Chicago
40	Operations	Boston

Table 3: Salgrade

Grade	LoSal	HiSal
1	700	1200
2	1201	1400
3	1401	2000
4	2001	3000
5	3001	9999

Create the above tables by applying the necessary constraints and populate the tables. Perform various DML, TCL commands (Select, Insert, Update, Delete, Commit, Rollback, Savepoint, Grant, Revoke). Perform various operation involving arithmetic operators, logical operators, comparison operators, character, number, date functions. Perform various join operations on the tables Emp and Dept. Create Sequence Next\_Empno Start with 8000 Increment By 1. Create view from emp table where job is salesman. Create a Procedure that lists all employees' numbers and names from the 'emp' table using a cursor. Create Procedure that selects an employee row given the employee number and displays certain columns. Create statement-level triggers that display a message after an insert, update, or deletion to the 'emp' table.

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**Scenario 3**

A new supermarket will be opened in 3 months. The owner wants to have a software to manage the supermarket data (inventory, customers, sales,..). Design a database to insert, retrieve, update data. ex. When a product is sold to a customer, the database changes may need to be done reducing the inventory. Real world need for creating views. Provide different Users different roles for separate DB.

**Scenario 4**

Design database for university which should include details about student, faculty, course, department. Create, populate the database, perform updates and retrieval. Create views and triggers that does not allow manipulation during holidays. Provide different privileges to different users.

**Course  
Outcome**

- CO1: Use typical data definitions and manipulation commands
- CO2: Design applications to test Nested and Join Queries
- CO3: Implement simple applications that use Views
- CO4: Critically analyze the use of Tables, Views, Functions and Procedures
- CO5: Implement applications that require a Front-end Tool



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HICET – Department of Artificial Intelligence and Machine Learning

Programme B. Tech.	Course Code 21AI4002	Name of the Course DATA VISULIZATION LABORATORY	L 0	T 0	P 3	C 1.5
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Course Objective

1. Design and create data visualization.
2. Conduct exploratory data analysis using visualization.
3. Craft visual presentation of data for effective communication.
4. Design and evaluate color palettes for visualization design alternative.
5. Apply data transformation such as aggregation and filtering for visualization.
6. Identify opportunities for application of data visualization in various domains

Description of the Experiments

1. Data manipulation using dplyr package in R programming
2. Data manipulation using tidyr package in R programming
3. Data analysis using data. table package in R programming
4. Data Visualization using R programming
5. Pandas – Indexing and selecting operations
6. Pandas -Merging operations
7. Exploratory data analysis for loan prediction dataset
8. Creating a data frame from dictionary and accessing the data using pandas packages
9. Data analysis and visualization for COVID19 dataset
10. Creating different types of visualizations using python (matplotlib package) programming

Total Practical Hours 45

Course Outcome

- Upon completion of this course, the students will be able to
- CO1: Know the history of data visualization and its connection with computer graphics
  - CO2: Students understand the foundations and characteristics of data, which forms the beginning of the visualization pipeline
  - CO3: Understand the role of user interaction within visualizations, understand the visualization design process
  - CO4: Students know some commercial data visualization packages with functionality



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<b>Programme</b> <b>B.Tech</b>	<b>Course Code</b> <b>21AC4191</b>	<b>Name of the Course</b> <b>VALUE EDUCATION - ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE</b>	<b>L</b> <b>2</b>	<b>T</b> <b>0</b>	<b>P</b> <b>0</b>	<b>C</b> <b>0</b>
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**Course Objective**

1. The course aims at imparting basic principles of thought process, reasoning and inferencing.
2. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
3. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
4. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system, Indian philosophical traditions, Indian linguistic tradition and Indian artistic tradition.

<b>Unit</b>	<b>Description</b>	<b>Instructional Hours</b>
I	Basic Structure of Indian Knowledge System	4
II	Modern Science and Indian Knowledge System	4
III	Yoga and Holistic Health care	4
IV	Philosophical tradition	4
V	Indian linguistic tradition (Phonology, Morphology, Syntax and semantics), Indian artistic tradition and Case Studies.	4
<b>Total Instructional Hours</b>		<b>20</b>

<b>Course Outcome</b>	CO1: Ability to understand the structure of Indian system of life
	CO2: Connect up and explain basics of Indian Traditional knowledge in modern scientific perspective.

**REFERENCE BOOKS:**

- R1: V. Sivaramakrishna (Ed.), "Cultural Heritage of India-Course Material", Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.
- R2: Swami Jitatmanand, "Modern Physics and Vedant", Bharatiya Vidya Bhavan.
- R3: Fritzof Capra, Tao of Physics.
- R4: Fritzof Capra, The wave of Life.
- R5: V N Jha (Eng. Trans.), "Tarkasangraha of Annam Bhatta", International Chinmay Foundation, Velliarnad, Amakuum.
- R6: "Yoga Sutra of Patanjali", Ramakrishna Mission, Kolkatta.
- R7: GN Jha (Eng. Trans) Ed. R N Jha, "Yoga-darshanam with Vyasa Bhashya", Vidyanidhi Prakasham, Delhi, 2016.
- R8: RN Jha, "Science of Consciousness Psychotherapy and Yoga Practices", Vidyanidhi Prakasham, Delhi, 2016.
- R9: P R Sharma (English translation), Shodashang Hridayam.



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<b>Programme</b>	<b>Course Code</b>	<b>Name of the Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
B.E./B.Tech.	21HE4073	IDEATION SKILLS	1	0	0	0

- Course Objective**
1. To study the importance of ideation.
  2. To learn about the various tools for Ideation.
  3. To provide an insight in Prototyping and its significance.

<b>Unit</b>	<b>Description</b>	<b>Instructional Hours</b>
	<b>IDEATION: INTRODUCTION TO DESIGN THINKING METHODOLOGY</b>	
I	Design Thinking Methodology and how it can be used as a powerful tool for developing new and innovative solutions - Inspiration – Implementation - Disruptive technology.	4
	<b>IDEATION: TOOLS FOR IDEATION</b>	
II	Various resources to kindle new ideas for innovation. Explore the types of ideas in the past – Effect of the ideas and innovation of past on the world – Innovation Thinking – Case studies.	4
	<b>IDEATION: INTRODUCTION TO CUSTOMER DISCOVERY</b>	
III	Intro to Customer Discovery - development of customer discovery plan that can lead to powerful business innovation - Customer Discovery Plan	4
	<b>PROTOTYPING AND PRODUCT IDEATION</b>	
IV	Introduction to Prototyping - minimum viable product - High fidelity prototype vs low fidelity prototype – Prototyping tools	3
	<b>Total Instructional Hours</b>	<b>15</b>

**Course Outcome**

Upon completion of the course, students will be able to

CO1: Develop a strong understanding and importance of ideation  
 CO2: Learn about the different kinds of tools for Ideation.  
 CO3: Learn the need and significance of prototyping and its significance.

**TEXT BOOKS:**

- T1 - Mark Baskinger and William Bardel, "Drawing Ideas: A Hand-Drawn Approach for Better Design", 2013  
 T2 - Nigel Cross, "Design Thinking", Kindle Edition

**REFERENCE BOOKS:**

- R1 - Kurt Hanks and Larry Belliston, "Rapid Viz : A New Method for the Rapid Visualization of Ideas", 2008.  
 R2 - Kathryn McElroy , "Prototyping for Designers: Developing the Best Digital and Physical Products", 2017.



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<b>Programme</b> B. Tech.	<b>Course Code</b> 19AI5201	<b>Name of the Course</b> COMPUTER NETWORKS	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. To study the Protocol Layering and Physical Level Communication.
  2. To understand the Data Communication System and the purpose of Layered Architecture.
  3. To analyze the concepts of Routing Methods and Sub-netting.
  4. To learn the functions of Network Layer and the various Routing Protocols.
  5. To familiarize the functions and Protocols of the Transport Layer.

Unit	Description	Instructional hours
I	<b>OVERVIEW &amp; PHYSICAL LAYER</b> Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission Media – Switching – Circuit-switched Networks – Packet Switching.	9
II	<b>DATA LINK LAYER</b> Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC– PPP - Media Access Control - Wired LANs: Ethernet - Wireless LANs – Introduction –IEEE 802.11, Bluetooth – Connecting Devices.	9
III	<b>NETWORK AND ROUTING</b> Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms –Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.	9
IV	<b>TRANSPORT LAYER</b> Process to process delivery, User datagram protocol (UDP), Transmission control protocol (TCP), Data traffic, Congestion, Congestion control, Quality of service, Techniques to improve QOS, Integrated services, Differentiated services, QOS in switched networks.	9
V	<b>APPLICATION LAYER</b> Client server model, Socket interface, Name space, Domain name space, Distribution of name space, DNS in the internet, Resolution, DNS messages, DDNS, Encapsulation, Electronic mail, File transfer, HTTP, World wide web (WWW), Digitizing audio and video, Audio and video compression, Streaming stored audio/video, Streaming live audio/video, Real time interactive audio/video, Voice over IP.	9
<b>Total Instructional</b>		<b>45</b>

**Hours**

- Course Outcome**
- Upon completion of this course, the Students will be able to
- CO1: Learn about the Protocol Layering and Physical Level Communication
  - CO2: Understand the Data Communication System and the purpose of Layered Architecture.
  - CO3: Analyze the concepts of Routing Methods and Subnetting.
  - CO4: Design protocols for various functions in the Network.
  - CO5: Understand the functions and Protocols of the Transport Layer.

**TEXT BOOK:**

- T1: Larry Peterson, Bruce Davie, “Computer Networks: A Systems Approach”, Elsevier, Online Edition, 2019.
- T2: Paul Goransson, Chuck Black and Timothy Culver, “Software Defined Networks - A Comprehensive Approach”, Elsevier, Second Edition, 2017.

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**REFERENCES:**

- R1: James F. Kurose, Keith W. Ross, “Computer Networking – A Top-Down Approach Featuring the Internet”, Pearson Education, Seventh Edition, 2017.  
R2: Nader. F. Mir, “Computer and Communication Networks”, Pearson Prentice Hall Publishers, Second Edition, 2015.  
R3: Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw – Hill, Fifth Edition, 2013.  
R4: Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open-Source Approach”, McGraw Hill Publishers, 2011.



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<b>Programme</b> B. Tech.	<b>Course Code</b> 19AI5202	<b>Name of the Course</b> DATA ANALYTICS	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. To explore the fundamental concepts of data analytics
  2. To learn different types of data and how to prepare data for analysis
  3. To learn different python packages for mathematical, scientific applications
  4. To understand Web Data Analysis
  5. To create meaningful data visualizations and predict future trends from data

Unit	Description	Instructional Hours
	<b>Introduction to Analytics</b>	
I	Analytics life cycle - Business analytics - lending analytics- recommendation analytics, Healthcare Analytics- financial analytics - sports analytics. Data Analytics: Introduction to Tools and Environment, Application of Modeling in Business, Databases & Types of Data and variables, Data Modeling Techniques	9
	<b>Introduction to Data Understanding and Preprocessing</b>	
II	Knowledge domains of Data Analysis, Understanding structured and unstructured data, Data Analysis process, Dataset generation, Importing Dataset: Importing and Exporting Data, Basic Insights from Datasets, Cleaning and Preparing the Data: Identify and Handle Missing Values.	10
	<b>Mathematical and Scientific applications for Data Analysis</b>	
III	Numpy and Scipy Package, Understanding and creating N-dimensional arrays, Basic indexing and slicing, Boolean indexing, Fancy indexing, Universal functions, Data processing using arrays, File input and output with arrays.	8
	<b>Analysing Web Data</b>	
IV	Data wrangling, Web scrapping, Combing and merging data sets, Reshaping and pivoting, Data transformation, String Manipulation, case study for web scrapping.	8
	<b>Model Development and Evaluation</b>	
V	Model development using Linear Regression, Model Visualization, Prediction and Decision Making, Model Evaluation: Over-fitting, Under-fitting and Model Selection	10
<b>Total Instructional Hours</b>		<b>45</b>

<b>Course Outcome</b>	CO1: Understand the fundamentals and impact of data analytics for business decisions and strategy
	CO2: Understanding the data, performing preprocessing, processing and data visualization to get insights from data
	CO3: Use different python packages for mathematical, scientific applications data analysis.
	CO4: Use different python packages for web data analysis
	CO5: Develop the model for data analysis and evaluate the model performance

**TEXT BOOKS:**

- T1: Wes Mckinney “Python for Data Analysis”, Publisher O’Reilly Media  
 T2: David Taieb, “Data Analysis with Python: A Modern Approach”, Packt Publishing 2018

**REFERENCE BOOKS:**

- R1: David Ascher and Mark Lutz, Learning Python, Publisher O’Reilly Media.  
 R2: Data Mining Analysis and Concepts, M. Zaki and W. Meira.  
 R3: Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. “Mining of Massive Datasets”. Cambridge University Press. 2014.  
 R4: Student’s Handbook for Associate Analytics – II, III.

  
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<b>Programme</b> B. Tech.	<b>Course Code</b> 19HE5181	<b>Name of the Course</b> MANAGEMENT INFORMATION SYSTEM	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. To describe the role of information technology and decision support systems in business and record the current issues with those of the firm to solve business problems.
  2. To introduce the fundamental principles of computer-based information systems analysis and design and develop an understanding of the principles and techniques used.
  3. To enable students understand the various knowledge representation methods and different expert system structures as strategic weapons to counter the threats to business and make business more competitive.
  4. To enable the students to use information to assess the impact of the Internet and Internet technology on electronic commerce and electronic business and understand the specific threats and vulnerabilities of computer systems.
  5. To provide the theoretical models used in database management systems to answer business questions.

<b>Unit</b>	<b>Description</b>	<b>Instructional hours</b>
I	<b>INTRODUCTION</b> Introduction, Concept, evolution and meaning of MIS, System View of Business, Process of MIS, Development of MIS within the organization, Management Process, Information Needs, System Approach in Planning Organizing and Controlling MIS, MIS function in an organization, MIS and the user.	9
II	<b>SYSTEM ANALYSIS AND DESIGN</b> System - Need for system analysis - System analysis of the existing system - System analysis of a new requirements - System Development Model - Structured System Analysis and Design - Object Oriented Analysis, Planning, Implementation and Controlling of Management Information System.	9
III	<b>INFORMATION SYSTEMS</b> Information Systems – Information systems and their role in Business systems, changing role of information systems, users of information systems; Types of information systems – transaction processing systems, MIS decision support systems, executive support system; Enterprise Resource Planning (ERP) system, Business expert system, E- Commerce, E-communication, Business Process Reengineering.	9
IV	<b>TECHNOLOGY OF INFORMATION SYSTEM</b> Data process- Transaction and application process- Information system process; Unified communication and network; Security challenges in E-enterprises; Security threats and vulnerability-Controlling security threat and vulnerability.	9
V	<b>TRANSACTION PROCESSING AND SUPPORT SYSTEM</b> Transaction processing system – Office automation systems – Decision support systems – Executive information systems – Artificial intelligence and Expert systems.	9
<b>Total Instructional Hours</b>		<b>45</b>

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Upon completion of this course, the Students will be able to

CO1: Relate the basic concepts and technologies used in the field of management information systems.

CO2: Compare the processes of developing and implementing information systems.

CO3: Outline the role of the ethical, social, and security issues of information systems.

CO4: Translate the role of information systems in organizations, the strategic management processes, with the implications for the management.

CO5: Apply the understanding of how various information systems like DBMS work together to accomplish the information objectives of an organization.

**Course  
Outcome**

**TEXT BOOK:**

T1: Jawadekar, W.S., "Management Information Systems", Tata McGraw Hill Private Limited, New Delhi, 2009.

T2: Kenneth C. Laudon and Jane P. Laudon: "Management Information Systems" 9/e, Pearson Education, New Delhi.

**REFERENCES:**

R1: Alex Leon and Mathew Leon: "Data Base Management Systems", Vikas Publishing House, New Delhi.

R2: Goyal, D.P.: "Management Information System", MACMILLAN India Limited, New Delhi, 2008.

R3: Mahadeo Jaiswal, Monika Mital: "Management Information System", Oxford University Press, New Delhi, 2008.

R4: Murthy C.S.V.: "Management Information System", Himalaya Publications, New Delhi, 2008.



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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	19AI5251	OBJECT ORIENTED ANALYSIS AND DESIGN	2	0	2	3

- Course Objective**
1. To express software design with UML diagrams
  2. To design software applications using OO concepts.
  3. To identify various scenarios based on software requirements
  4. To transform UML based software design into pattern-based design using design patterns
  5. To understand the various testing methodologies for OO software

Unit	Description	Instructional Hours
I	<p><b>UNIFIED PROCESS AND USE CASE DIAGRAMS</b> Introduction to OOAD with OO Basics - Unified Process – UML diagrams – Use Case – Case study – the Next Gen POS system, Inception -Use case Modelling –Relating Use cases – include, extends and generalization. <i>Experiments: Document the Software Requirements Specification (SRS) for the student information system.</i></p>	6+3
II	<p><b>STATIC UML DIAGRAMS</b> Class Diagram— Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition – Usage of Class diagrams. <i>Experiments: Identify use cases and develop the Use Case model for Student information system. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that for Recruitment system.</i></p>	6+3
III	<p><b>DYNAMIC AND IMPLEMENTATION UML DIAGRAMS</b> Dynamic Diagrams – UML interaction diagrams - System sequence diagram –Collaboration diagram – Usage of Communication Diagrams - State machine diagram and Modeling – usage of State Diagrams - Activity diagram – Usage of activity diagrams - Implementation Diagrams - Component and Deployment Diagrams – Usage of Component and Deployment diagrams. <i>Experiments: Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams for Airline/Railway reservation system. Draw relevant State Chart and Activity Diagrams for the same system for Exam registration.</i></p>	6+3
IV	<p><b>DESIGN PATTERNS</b> GRASP: Designing objects with responsibilities – Creator – Information expert – Low Coupling – High Cohesion – Controller- Design Patterns – creational – factory method– structural – Bridge – behavioural – Strategy – Applying GoF design patterns – Mapping design to code. <i>Experiments: Improve the reusability and maintainability of the software system by applying appropriate design pattern</i></p>	5+4
V	<p><b>TESTING</b> Object Oriented Methodologies – Software Quality Assurance – Impact of object orientation on Testing – Develop Test Cases and Test Plans <i>Experiments: Implement the modified system and test it for various scenarios</i></p>	6+3

**Total Instructional Hours (29 + 16) 45**

- Course Outcome**
- CO1: Express software design with UML diagrams
  - CO2: Design software applications using OO concepts.
  - CO3: Identify various scenarios based on software requirements.
  - CO4: Transform UML based software design into pattern-based design using design patterns
  - CO5: Understand the various testing methodologies for OO software

**TEXT BOOKS:**

- T1: Craig Larman, —Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative DevelopmentI, Third Edition, Pearson Education, 2005.
- T2: Ali Bahrami - Object Oriented Systems Development - McGraw Hill International Edition - 1999

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**REFERENCE BOOKS:**

- R1: Erich Gamma, a n d Richard Helm, Ralph Johnson, John Vlissides, —Design patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley, 1995
- R2: Erich Gamma, a n d Richard Helm, Ralph Johnson, John Vlissides, —Design patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley, 1995
- R3: Simon Bennett, Steve Mc Robb and Ray Farmer, “Object Oriented Systems Analysis and Design Using UML”, Fourth Edition, Mc-Graw Hill Education, 2010.
- R4: Paul C. Jorgensen, “Software Testing:- A Craftsman’s Approach”, Third Edition, Auerbach Publications, Taylor and Francis Group, 2008.



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<b>Programme</b> B.TECH	<b>Course Code</b> 19AI5251	<b>Name of the Course</b> INTRODUCTION TO DESIGN THINKING	<b>L</b> 2	<b>T</b> 0	<b>P</b> 2	<b>C</b> 3
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- Course Objective**
1. Expose students to the design process as a tool for innovation.
  2. Develop students' professional skills in client management and communication.
  3. Students develop a portfolio of work to set them apart in the job market.
  4. Provide an authentic opportunity for students to develop teamwork and leadership skills.
  5. Demonstrate the value of developing a local network and assist students in making
  6. lasting connections with the business community

Unit	Description	Instructional Hours
	<b>DESIGN THINKING HISTORY AND OVERVIEW</b>	
I	Understand what came before Design thinking-Identify who did what to bring it about-Learn how it built upon previous approaches-How design thinking is introduced in an organization-Understand the transformation required-What outcomes are possible-Understand the whole approach to design thinking-Determine what is most important. <i>Illustrative program: Listening and HMW</i>	9
	<b>KEY HABITS</b>	
II	Introduction to key habits-types-avoid common anti-patterns-Optimize for success with these habits-Introduction to loop-Importance of iteration-How to observe, Reflect & Make-Drill down. <i>Illustrative program: USER RESEARCH and PRACTICE MAPPING INSIGHTS FROM USER RESEARCH</i>	7+2(P)
	<b>USER RESEARCH AND MAKE</b>	
III	Importance of user research-Appreciate empathy through listening-Key methods of user research-How make fits into the loop-Leverage observe information-Ideation, storyboarding, & Prototyping. <i>Illustrative program: PRACTICE IDEATION AND PRIORITIZATION, COLLABORATIVELY CONSOLIDATE STORYBOARDS</i>	5+4(P)
	<b>USER FEEDBACK AND TEACHING</b>	
IV	User feedback and the loop-Different types of user feedback-How to carryout getting feedback-Understand the challenges of teaching EDT-Valuable hints and tips-Ready to teach the course. <i>Illustrative program: DEVELOP A SUMMARY HILL STATEMENT AND BUILD YOUR STORY BOARD AND HILL INTO A PROTOTYPE</i>	3+6(P)
	<b>LOGISTICS AND APPLICATIONS</b>	
V	Understand what type of room you need-Learn what materials and supplies you need-Learn how to setup the room-Domains that are applicable-Digital versus physical-Explore some technology specialization. <i>Illustrative program: PRACTICE TEACHING SELECTED SECTION AND USER FEEDBACK</i>	5+4(P)

**Total Instructional Hours (29 + 16) 45**

- Course Outcome**
- CO1: Students develop a strong understanding of the Design Process and how it can be applied in a variety of business settings
- CO2: Students learn to build empathy for target audiences from different "cultures"
- CO3: Students learn to research and understand the unique needs of a company around specific challenges
- CO4: Students learn to develop and test innovative ideas through a rapid iteration cycle
- CO5: Students learn how to map insights from user research.

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**TEXT BOOKS:**

T1 :IBM CourseWare

**REFERENCE BOOKS:**

R1:Creative Confidence-Tom Kelley.,2013

R2:Change by Design-Tim Brown.,2009

R3:Design Thinking-Nigel Cross.,Kindle Edition



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<b>Programme</b> B. Tech.	<b>Course Code</b> 19AI5001	<b>Name of the Course</b> NETWORKS LABORATORY	<b>L</b> 0	<b>T</b> 0	<b>P</b> 3	<b>C</b> 1.5
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- Course Objective**
1. Use simulation tools
  2. Implement the various protocols.
  3. Analyze the performance of the protocols in different layers.
  4. Analyze various routing algorithms.
  5. Analyze various real time problems for projects.

**S. No. Description of the Experiments**

1. Implementation of Stop and Wait Protocol and Sliding Window Protocol
2. Study of Socket Programming and Client – Server model
3. Write a code simulating ARP /RARP protocols.
4. Write a code simulating PING and TRACEROUTE commands
5. Write a code simulating PING and TRACEROUTE commands
6. Write a program to implement RPC (Remote Procedure Call)
7. Implementation of Subnetting
8. Applications using TCP Sockets like
  - a. Echo client and echo server
  - b. Chat c. File Transfer
9. Applications using TCP Sockets like
  - a. Echo client and echo server
  - b. Chat
  - c. File Transfer
10. Perform a case study about the different routing algorithms to select the network path with its optimum and economical during data transfer.
  - a. Link State routing
  - b. Flooding
  - c. Distance vector

**Total Practical Hours 45**

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

**Course Outcome**

CO1: To Use simulation tools  
 CO2: To Implement the various protocols  
 CO3: To Analyze the performance of the protocols in different layers  
 CO4: To Analyze various routing algorithms  
 CO5: To Learn about the network simulation.

  
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<b>Programme</b> B.Tech	<b>Course Code</b> 19AI5002	<b>Name of the Course</b> DATA ANALYTICS LABORATORY	<b>L</b> 0	<b>T</b> 0	<b>P</b> 3	<b>C</b> 1.5
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**Course Objective**

1. To understand dataset generation using python
2. To understand the preparation of Data using python
3. To understand Numpy and Scipy Package
4. To Apply statistical models to perform Regression Analysis
5. To perform text analytics

S. No.	Description of the Experiments
1	Dataset generation
2	Importing and Exporting Data Preparing Data
3	a. Data Cleaning b. Data imputation c. Data conversion
4	Indexing using Numpy and Scipy Package
5	Data processing using arrays
6	Combing and merging data sets
7	Correlation and N-Fold cross validation
8	Linear regression analysis
9	Forecasting - weather dataset
10	Text Analytics – Sentiment Analysis, Word cloud analysis

**Total Practical Hours: 45**

**Course Outcome**

CO1: Use python for dataset generation  
CO2: Perform various operations in data preparation  
CO3: Perform Indexing using Numpy and Scipy Package  
CO4: Implement statistical analysis techniques for solving  
CO5: Implement Text Analytics – Sentiment Analysis

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<b>Programme</b>	<b>Course Code</b>	<b>Name of the Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
B.E./B.Tech.	19HE5072	DESIGN THINKING	1	0	0	1

<b>Course Objective</b>	1. To expose students to the design process
	2. To develop and test innovative ideas through a rapid iteration cycle.
	3. To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
<b>DESIGN ABILITY</b>		
I	Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	4
<b>DESIGNING TO WIN</b>		
II	Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	4
<b>DESIGN TO PLEASE AND DESIGNING TOGETHER</b>		
III	Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	4
<b>DESIGN EXPERTISE</b>		
IV	Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert. Critical Thinking – Case studies: Brief history of Albert Einstein, Isaac Newton and Nikola Tesla	3
<b>Total Instructional Hours</b>		<b>15</b>

<b>Course Outcome</b>	Upon completion of the course, students will be able to
	CO1: Develop a strong understanding of the Design Process
	CO2: Learn to develop and test innovative ideas through a rapid iteration cycle.
	CO3: Develop teamwork and leadership skills

**TEXT BOOKS:**

T1 - 1. Nigel Cross, “Design Thinking”, Kindle Edition.

**REFERENCE BOOKS:**

R1 - Tom Kelley, “Creative Confidence”, 2013.

R2 - 3. Tim Brown, “Change by Design”, 2009.



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<b>Programme</b>	<b>Course Code</b>	<b>Name of the Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
B. Tech.	19AI5301	AI FOR CYBER SECURITY	3	0	0	3

- Course Objective**
1. To understand the basic concepts and various building blocks of cyber security
  2. To understand the machine learning systems security
  3. To apply AI methods to network attack detection
  4. To understand the cyber stacks in IOT and its applications
  5. To develop IoT infrastructure based on four-layer cyber security

<b>Unit</b>	<b>Description</b>	<b>Instructional Hours</b>
	<b>INTRODUCTION TO CYBER SECURITY</b>	
I	Introduction to Knowledge Engineering in Cybersecurity- Cybersecurity Taxonomies- A Core Reference Ontology for Cybersecurity- Upper Ontologies for Cybersecurity- Domain Ontologies for Cybersecurity- Networking Ontologies for Cybersecurity	9
	<b>MACHINE LEARNING SYSTEMS SECURITY</b>	
II	The Security of Machine Learning Systems- Machine Learning Algorithms Are Vulnerable- Threat Model- Data Poisoning- Attacks at Test Time- Evasion Attack Scenarios- Computing Evasion Attacks- Transferability of Evasion Attacks- Defense Against Evasion Attacks.	9
	<b>APPLYING AI METHODS TO NETWORK ATTACK DETECTION</b>	
III	Introduction- Binary Classifiers- Training the Binary Classifier for Detecting Network Attacks- Schemes for Combining the Binary Classifiers- Network Intrusion Detection Systems- Machine Learning in Network Intrusion Detection.	9
	<b>CYBER ATTACKS IN IOT ARCHITECTURE</b>	
IV	Cybersecurity in IoT Architecture- Cybersecurity at the Perception Layer- Cybersecurity at the Network Layer-Security Mechanisms for IoT Services- Lightweight Cryptography- Random Number Generator- Decision Trees- K-Nearest Neighbors- Support Vector Machines Artificial Neural Networks	9
	<b>BLOCKCHAIN-BASED CYBERSECURITY</b>	
V	Four-Layered Cybersecurity-Oriented IoT Architecture- Sensing Layer- Network Layer Network Layer- Middleware Layer- Application Layer- Security Threats in Industry 4.0- Denial-of-Service- Supply Chain and Extended Systems- Smart Security and Smart Factory- Advanced Persistent Threat.	9
<b>Total Instructional Hours</b>		<b>45</b>

- Course Outcome**
- CO1: Explain the concept of ontologies of cyber security
- CO2: Understand various data poisoning attacks architectures and working of state-of-the-art IoT systems
- CO3: Understand the Machine Learning in Network Intrusion Detection
- CO4: Apply Random Number Generator- Decision Trees for various applications
- CO5: Analyze applications of AI in cyber security in real time scenario

**TEXT BOOKS:**

T1: Leslie F. Sikos, "AI in Cyber Security", Springer Press, Intelligent Systems Reference Library 2019.




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T2: Ted Coombs, “Artificial Intelligence and Cyber Security for Dummies”, IBM Limited Edition, John Wiley & Sons, Inc, 2018.

**REFERENCE BOOKS:**

- R1: William Stallings, “Cryptography and Network Security: Principles and Practice”, Prentice Hall of India/Pearson Education, New Delhi, 2010.
- R2: Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill Publishing Company, New Delhi, 2007.
- R3: Nina Godbole, Sunit Belapure, Cyber Security Understanding cyber crimes, Computer Forensics and Legal Perspectives, Wiley & Sons, 2011.



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<b>Programme</b> B. Tech.	<b>Course Code</b> 19AI5302	<b>Name of the Course</b> INTERNET OF THINGS	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. To understand the basic concepts and various building blocks of Internet of Things
  2. To understand Smart Objects and IoT Architectures
  3. To build simple IoT Systems using Raspberry Pi
  4. To understand data analytics in the context of IoT and security issues in IoT
  5. To develop IoT infrastructure for popular applications

<b>Unit</b>	<b>Description</b>	<b>Instructional Hours</b>
I	<p><b>INTRODUCTION TO INTERNET OF THINGS</b> Definition &amp; Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, IoT Levels and Deployment Templates</p>	9
II	<p><b>IOT NETWORK ARCHITECTURE AND DESIGN</b> Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack, The “Things” in IoT</p>	9
III	<p><b>DEVELOPING INTERNET OF THINGS</b> IoT Design Methodology- COIP-IoT Physical Devices and Endpoints: Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python, Other IoT devices.</p>	9
IV	<p><b>DATA ANALYTICS AND SECURING IOT</b> DATA ANALYTICS: An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics. SECURING IOT: A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment</p>	9
V	<p><b>CASE STUDIES</b> Smart and Connected Cities: Smart City IoT Architecture, Street Lighting Architecture, Smart Parking Architecture and Smart Traffic Control Transportation: An IoT Architecture for Transportation, Connected Roadways Network Architecture, Connected Fleet Architecture, Connected Roadways Security Weather monitoring system, Air Pollution Monitoring</p>	9
<b>Total Instructional Hours</b>		<b>45</b>

- Course Outcome**
- CO1: Explain the concept of IoT and various building blocks
- CO2: Understand various architectures and working of state-of-the-art IoT systems
- CO3: Design IoT system using Rasperry Pi
- CO4: Apply data analytics related to IoT and evaluate security issues related to the Internet of Things
- CO5: Analyze applications of IoT in real time scenario

**TEXT BOOKS:**

- T1: Arshdeep Bahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities Press, 2015
- T2: David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, 2017.

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**REFERENCE BOOKS:**

- R1: Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
- R2: Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine -to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
- R3: Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) [Kindle Edition] by Cuno Pfister, 2011
- R4: Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things"- (Nov 2013).



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<b>Programme</b> B. Tech.	<b>Course Code</b> 19AI5303	<b>Name of the Course</b> ADVANCED MACHINE LEARNING	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
			3	0	0	3

<b>Course Objective</b>	<ol style="list-style-type: none"> <li>1. To understand pattern classification algorithms to classify multivariate data.</li> <li>2. To understand the Implementation of genetic algorithms</li> <li>3. To gain knowledge about Q-Learning</li> <li>4. To create new machine learning techniques.</li> <li>5. To understand reinforcement learning task.</li> </ol>
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Unit	Description	Instructional Hours
I	<b>INTRODUCTION</b> Learning Problems Perspectives and Issues Concept Learning Version Spaces and Candidate eEliminations – Inductive bias – Decision Tree learning – Representation – Algorithm –Heuristic Space Search	9
II	<b>NEURAL NETWORKS AND GENETIC ALGORITHMS</b> Neural Network Representation Problems-Perceptions Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms Hypothesis Space Search– Genetic Programming – Models of Evolutions and Learning.	9
III	<b>BAYESIAN AND COMPUTATIONAL LEARNING</b> Bayes Theorem Concept Learning Maximum-Likelihood Minimum Description Length Principle Bayes Optimal Classifier Gibbs Algorithm Naïve-Bayes Classifier Bayesian Belief Network EM Algorithm Probability Learning Sample Complexity-Finite and Infinite Hypothesis Spaces – Mistake Bound Model.	9
IV	<b>INSTANT BASED LEARNING</b> K- Nearest Neighbor Learning Locally weighted Regression Radial-Bases Functions – Case Based Learning.	9
V	<b>ADVANCED LEARNING</b> Learning Sets of Rules Sequential Covering Algorithm Learning Rule Set-First Order Rules Sets of First Order Rules Induction on Inverted Deduction Inverting Resolution-Analytical Learning Perfect Domain Theories Explanation Base Learning – FOCL Algorithm Reinforcement Learning Task Learning Temporal Difference Learning	9
<b>Total Instructional Hours</b>		<b>45</b>

<b>Course Outcome</b>	CO1: Develop and apply pattern classification algorithms to classify multivariate data. CO2: Develop and apply regression algorithms for finding relationships between data variables. CO3: Develop and apply reinforcement learning algorithms for learning to control complex systems. CO4: Write scientific reports on computational machine learning methods, results and conclusions. CO5: Develop and apply FOCL algorithm for machine learning.
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**TEXT BOOKS:**

- T1: Tom M. Mitchell, "Machine Learning", McGraw-Hill, 2010
- T2: Bishop, Christopher. *Neural Networks for Pattern Recognition*. New York, NY: Oxford University Press, 1995

**REFERENCE BOOKS:**

- R1: Ethem Alpaydin, (2004) "Introduction to Machine Learning (Adaptive Computation and Machine Learning)", The MIT Press
- R2: T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer(2nd ed.), 2009
- R3: Daniel Jurafsky and James H. Martin, "Speech and Language Processing", Pearson; 2nd edition, 2008



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<b>Programme</b> B. Tech.	<b>Course Code</b> 19AI5304	<b>Name of the Course</b> INTRODUCTION TO ROBOTICS	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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<b>Course Objective</b>	1. To understand the functions of the basic components of a Robot.
	2. To study the use of various types of End Effectors and Sensors.
	3. To impart knowledge in Robot Kinematics and Programming.
	4. To learn Robot safety issues and economics.
	5. To impart knowledge in Robot cell design.

<b>Unit</b>	<b>Description</b>	<b>Instructional Hours</b>
I	<b>INTRODUCTION AND ROBOT KINEMATICS</b> Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.	9
II	<b>ROBOT DRIVES AND CONTROL</b> Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.	9
III	<b>ROBOT SENSORS</b> Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.	9
IV	<b>ROBOT CELL DESIGN AND APPLICATION</b> Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.	9
V	<b>ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS</b> Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.	9
<b>Total Instructional Hours</b>		<b>45</b>

<b>Course Outcome</b>	CO1: Understand the functions of the basic components of a Robot.
	CO2: Study the use of various types of End Effectors and Sensors.
	CO3: Gain knowledge in Robot Kinematics and Programming.
	CO4: Impart knowledge on the use Robot safety issues and economics.
	CO5: Impart knowledge in Robot cell design



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**TEXT BOOKS:**


- T1: Fu.K.S., R.C. Gonzalez and C.S.G. Lee, "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill, 1987.  
T2: Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987.

**REFERENCE BOOKS:**

- R1: Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 1986.  
R2: Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.  
R3: Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.



  
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<b>Programme</b> B. Tech.	<b>Course Code</b> 19AI5305	<b>Name of the Course</b> BIOINFORMATICS	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. To understand the significance of string alignment To construct the phylogenetic tree
  2. To understand the fundamentals of protein structure prediction and microarray analysis
  3. Learn database search algorithms
  4. Know Molecular Phylogeny Analysis
  5. Understand structure prediction of proteins.

<b>Unit</b>	<b>Description</b>	<b>Instructional Hours</b>
I	<p><b>NETWORK PROTOCOLS AND BIOLOGICAL DATABASES</b> Operating systems: types, UNIX commands; Network Protocols: OSI, TCP/IP, ftp; Introduction to biological databases: Primary nucleotide databases (EMBL, Gene Bank and DDBJ), Primary protein databases (SwissProt, TrEMBL and PIR); EST Database; Genome annotation; Composite protein sequence database:OWL, NRDB; Secondary protein databases (PROSITE, BLOCKS and Profiles); Structural databases: SCOP and CATH</p>	9
II	<p><b>STRING MATCHING AND DYNAMIC PROGRAMMING</b> Introduction: strings, substrings, identity, similarity, INDEL; Gaps: biological significance, different types of gap penalties; Overview of basic algorithms:Naïve, Boyer – Moore; Algorithm of dot matrix analysis;Introduction to pairwise sequence alignment: global vs. local; Dynamic programming: Needleman –Wunsch algorithm, Smith – Waterman algorithm; Parametric and suboptimal alignments.</p>	9
III	<p><b>DATABASE SEARCH ALGORITHMS</b> Substitution matrices: PAM, BLOSUM; Position specific scoring matrices (PSSM); Database search algorithms and applications: FASTA, BLAST, PSI BLAST; Algorithm of multiple sequence alignments (msa): Sums of pairs method (SP), CLUSTAL W, PILEUP; Overview of iterative msa methods; SAGA; Expectation – Maximization (EM) algorithm; Machine learning – Hidden Markov models.</p>	9
IV	<p><b>MOLECULAR PHYLOGENY ANALYSIS AND GENE PREDICTION</b> Molecular Clock theory (old and new); Jukes-Cantor and Kimura’s models; Algorithm of distance matrix methods: Unweighted pair group method of arithmetic mean (UPGMA), Fitch-Margoliasch algorithm (FM), Neighbor – Joining method (NJ); Character based methods: Maximum parsimony, maximum likelihood; Bootstrapping technique; Comparative genomics; Prokaryotic and eukaryotic gene prediction methods: Feature and homology-based methods.</p>	9
V	<p><b>STRUCTURE PREDICTION OF PROTEINS</b> Microarray analysis: spotted and oligonucleotide arrays; Clustering gene expression profiles: hierarchical clustering, nearest neighboring clustering, unweighted pair group clustering; Algorithm of protein secondary structure prediction: Chow-Fasman method, GOR method, <i>ab initio</i> approach, threading method; Systems biology: Introduction to metabolic pathways; Introduction to computer aided drug design (CAD).</p>	9
<b>Total Instructional Hours</b>		<b>45</b>

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<b>Course Outcome</b>	CO1: Explain UNIX commands, various types of network protocols and architecture of biological databases
	CO2: Demonstrate and interpret the biological string matching by dot matrix and dynamic program algorithms
	CO3: Apply, solve, interpret and analyze the heuristics based pairwise sequence analysis of macromolecules through various algorithms
	CO4: Apply, solve, interpret and analyze the heuristics based multiple sequence analysis of macromolecules through various algorithms
	CO5: Construct, interpret and assess the different molecular phylogenetic tree prediction and gene prediction algorithms

**TEXT BOOKS:**

- T1: Bergeron, Bryan P. Bioinformatics computing. 2nd Edition, Prentice Hall Professional, ISBN: 0-13-100825-0, 2003.
- T2: Attwood, Teresa K., and David J. Parry-Smith. Introduction to bioinformatics. 1st Edition, Prentice Hall, ISBN: 13: 9780582327887, 2003.

**REFERENCE BOOKS:**

- R1: Rastogi, S. C., Parag Rastogi, and Namita Mendiratta. Bioinformatics Methods And Applications: Genomics Proteomics And Drug Discovery. 4th Edition, PHI Learning Pvt. Ltd., ISBN: 978-81-203-4785-4, 2013.
- R2: Mount, David W., and David W. Mount. Bioinformatics: sequence and genome analysis. 2<sup>nd</sup> Edition, , Cold Spring Harbor Lab (CHSL) press, USA, ISBN: 0-87969-687-7", 2004.
- R3: Gusfield, Dan. Algorithms on strings, trees and sequences: computer science and computational biology. Cambridge university press, 11th Print" (2008), Online publication (2010).(1997), Book DOI: <http://dx.doi.org/10.1017/CBO9780511574931>.



  
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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	19AI5306	COMPUTER ARCHITECTURE AND ORGANIZATION	3	0	0	3

- Course Objective**
1. To conceptualize the basic structure and operations of a digital computer.
  2. To study the design of arithmetic and logic unit and implementation of fixed-point and floating-point arithmetic operations.
  3. To understand the basic design principles of Pipelining for CPU performance improvement.
  4. To develop a deeper understanding of parallel processors and multi-core processors.
  5. To familiarize the concepts of hierarchical memory system, cache memories, virtual memories, I/O Communication, Interrupts and Standard Interfaces.

Unit	Description	Instructional Hours
	<b>BASIC STRUCTURE OF A COMPUTER SYSTEM</b>	
I	Functional Units –Basic Operational Concepts-Performance – Instructions: Language of the Computer – Operations, Operands – Representing Instructions– Logical operations – Decision making – MIPS Addressing.	9
	<b>ARITHMETIC FOR COMPUTERS</b>	
II	Addition and Subtraction – Multiplication – Division – Floating Point- Floating Point Representation – Floating Point Operations – Sub-word Parallelism	9
	<b>PROCESSOR AND CONTROL UNIT</b>	
III	Basic MIPS implementation – Building Datapath – Control Implementation Scheme – Pipelining –Pipelined Datapath and Control – Handling Data hazards & Control hazards – Exceptions	9
	<b>PARALLEL PROCESSORS</b>	
IV	The Difficulty of Creating Parallel Processing Programs – Flynn’s ClassificationSISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing	9
	<b>MEMORY AND I/O SYSTEMS</b>	
V	Memory Hierarchy - Memory Technologies – Cache Memory – Measuring and Improving Cache Performance – Virtual Memory, TLB’s – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus Structure – Bus Operation – Arbitration – Interface Circuits - USB	9
	<b>Total Instructional Hours</b>	<b>45</b>

- Course Outcome**
- CO1: Understand the basics structure of computers, operations and instructions
- CO2: Practice the arithmetic operations performed by ALU.
- CO3: Design and analyze pipeline for consistent execution of instructions with hazards.
- CO4: Explain the structure of parallel processing architectures
- CO5: Demonstrate knowledge about state-of-the-art I/O, memory , Interrupts and Interfaces

**TEXT BOOKS:**

- T1: David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014
- T2: Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, fifth Edition, Tata McGraw Hill, 2014

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**REFERENCE BOOKS:**

- R1: William Stallings, Computer Organization and Architecture – Designing for Performance, tenth Edition, Pearson Education, 2016.
- R2: John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2017 Paperback version.
- R3: John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach, Morgan Kaufmann / Elsevier Publishers, Sixth Edition, 2019 Paperback version.



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Programme B. Tech.	Course Code 19AI6201	Name of the Course THEORY OF COMPUTATION	L 3	T 0	P 0	C 3
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- Course Objective**
1. To understand the basic concepts, of automata theory and finite automaton
  2. To extend the concepts of automata theory in regular languages and expressions
  3. To learn about context free grammars and the normalizations of CFG
  4. To acquire the importance of push down automata with representations and various models of turing machines with its applications
  5. To discover the facts in decidability and tractability and to study the complexity classes

Unit	Description	Instructional Hours
I	<b>Introduction to Automata theory</b> Introduction-Need of automata theory-Formal proof- Additional Forms of Proof-Inductive Proofs-Central Concepts of Automata Theory-DFA and NDFA-Finite Automaton with $\epsilon$ - Transitions-Equivalence of DFA and NFA-Case Study: Finite Automata for Artificial Intelligence, Compilers, Probability	9
II	<b>Regular Expressions</b> Regular Languages-Regular Expressions-Equivalence of finite Automaton and regular expressions-Minimization of DFA-Closure Properties and Decision Properties of Regular Languages-Problems based on Pumping Lemma-Case Study: Regular Expressions for NLP, Pattern matching, Data extraction	9
III	<b>Context Free Grammars</b> Chomsky hierarchy of languages-Context-Free Grammar (CFG)-Parse Trees-Ambiguity in grammars and languages-Normal forms for CFG-Chomsky Normal Form (CNF)-Greibach Normal Form (GNF)-Pumping Lemma for Context Free Language (CFL)-Applications of Context Free Grammar. Case Study: Context Free Grammars in GCC compiler and in XML DTD	9
IV	<b>Pushdown Automata and Turing Machines</b> Definition of the Pushdown automata-Types of PDA-Languages of a Pushdown Automata - Equivalence of PDA and CFG-Definitions of Turing machines-Models-Computable languages and functions-Techniques - for Turing machine construction-Multi head and Multi tape Turing Machines. Turing machines for machine learning and high performance computing applications	9
V	<b>Undecidability</b> The Halting problem - Partial Solvability- Undecidability- Decidable and undecidable problems- Post correspondence problem and Undecidability of PCP-Basic Definition and properties of Recursive (RL) and Recursively enumerable (REL) languages. Intractable Problems- the Class P and NP-Introduction to NP-Hardness and NP-Completeness	9
<b>Total Instructional Hours</b>		<b>45</b>

**Course Outcome**

- CO1: Understand the theoretical concepts of automata and equivalence of automata  
 CO2: Remember the automata in applying to obtain regular expressions and languages  
 CO3: Apply the normalization in context free grammar to obtain optimized CFG  
 CO4: Understand PDA and turing machines and apply for making mathematical models  
 CO5: Understand the decidability and tractability problems and apply for developed models

**TEXT BOOKS:**

- T1: Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Third Edition, Pearson Education, 2016.  
 T2: John C. Martin, "Introduction to Languages and the Theory of Computation", Fourth Edition, Tata McGraw Hill Publishing Company, New Delhi, 2011.

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REFERENCE BOOKS:

- R1: Mishra K L P and Chandrasekaran N, "Theory of Computer Science - Automata, Languages and Computation", Third Edition, Prentice Hall of India, 2016
- R2: Harry R Lewis and Christos H Papadimitriou, "Elements of the Theory of Computation", Second Edition, Prentice Hall of India, Pearson Education, New Delhi, 2015.
- R3: Peter Linz, "An Introduction to Formal Language and Automata", Sixth Edition, Jones & Bartlett Learning, 2016



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Programme  
B.TECH

Course Code  
19AI6202

Name of the Course

DEVELOPMENT OF MACHINE LEARNING

L T P C  
3 0 0 3

MODULES

Course  
Objective

1. To understand the need for machine learning for various problem solving
2. To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning.
3. To learn the new approaches in machine learning.
4. Watson Studio provides you with the environment and tools to solve your business problems by collaboratively working with data.
5. You can choose the tools you need to analyze and visualize data, to cleanse and shape data, to ingest streaming data, or to create and train machine learning models.

Unit

Description

Instructional  
Hours

INTRODUCTION TO MACHINE LEARNING

I

Machine learning Introduction-Types of Machine learning -Supervised, Unsupervised and reinforcement-Over fitting and Regression-Classification-Clustering-Parametric, vs non-Parametric models-Linear model

9

INTRODUCTION TO IBM CLOUD

II

Introduction to IBM cloud- Resources-IBM Cloud Infrastructure- Security-IBM Cloud Foundry-Cloud Park for data- IBM cloud vs Amazon cloud - Cloud Native Storage and Data Service

9

INTRODUCTION TO WATSON STUDIO

III

Introduction to Watson studio- Project creation- Storage- Access control- Prebuilt Watson application- Watson Solutions- Catalog and govern data

9

MACHINE LEARNING IN WATSON

IV

Watson knowledge studio and Watson knowledge catalog-Watson Discovery Services-Watson Auto AI-Watson Open Scale- visual recognition- Watson API

9

NATURAL LANGUAGE PROCESSING

V

NLP Introduction-Natural language Understanding (NLU)-Conversational AI-Building blocks of chatbot-Watson Assistant-Speech to Text -Text to speech.

9

Total Instructional Hours

45

Course  
Outcome

- CO1: Analyze methods and theories in the field of machine learning
- CO2: Understand an introduction to the basic principles, techniques
- CO3: Watson studio helps enterprises simplify the process of experimentation to deployment, speed data exploration and model development and training
- CO4: Demonstrate AI model.
- CO5: Analyze AI model

**TEXT BOOKS:**

T1 :IBM CourseWare

**REFERENCE BOOKS:**

R1: Ethem Alpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning)I, The MIT Press 2004.

R2: Stephen Marsland, —Machine Learning: An Algorithmic PerspectiveI, CRC Press, 2009.



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<b>Programme</b> B.Tech.	<b>Course Code</b> 19AI6203	<b>Name of the Course</b> NATURAL LANGUAGE PROCESSING	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. To familiarize the concepts and techniques of Natural language Processing for analyzing words based on Morphology.
  2. Tolerate mathematical foundations, Probability theory with Linguistic essentials such as syntactic and semantic analysis of text.
  3. To apply the Statistical learning methods and cutting-edge research models from deep learning.
  4. To Create CORPUS linguistics based on digestive approach (Text Corpus method)
  5. To check the syntax and semantic used in NLP.

<b>Unit</b>	<b>Description</b>	<b>Instructional Hours</b>
I	<b>INTRODUCTION TO NLP</b> Introduction to NLP - Various stages of NLP –The Ambiguity of Language: Why NLP Is Difficult- Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Cross entropy	9
II	<b>TEXT PREPROCESSING AND MORPHOLOGY</b> Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.	9
III	<b>LANGUAGE MODELLING</b> Words: Collocations- Frequency-Mean and Variance –Hypothesis testing: The t test, Hypothesis testing of differences, Pearson's chi-square test, Likelihood ratios. Statistical Inference: n –gram Models over Sparse Data: Bins: Forming Equivalence Classes- N gram model - Statistical Estimators- Combining Estimators	9
IV	<b>WORD SENSE DISAMBIGUATION</b> Methodological Preliminaries, Supervised Disambiguation: Bayesian classification, An information- theoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus-based disambiguation, Disambiguation based on translations in a second-language corpus.	9
V	<b>SYNTAX AND SEMANTICS</b> Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information extraction, Text mining, Information Retrieval, NL interfaces, Sentimental Analysis, Question Answering Systems, Social network analysis.	9
<b>Total Instructional Hours</b>		<b>45</b>

- Course Outcome**
- CO1: Apply the principles and Process of Human Languages such as English and other Indian Languages using computers.
  - CO2: Realize semantics and pragmatics of English language for text processing
  - CO3: Create CORPUS linguistics based on digestive approach (Text Corpus method) and Check a current methods for statistical approaches to machine translation.
  - CO4: Develop a Statistical Methods for Real World Applications and explore deep learning based NLP.
  - CO5: Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology.



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**TEXT BOOKS:**

- T1: Christopher D. Manning and Hinrich Schütze, "Foundations of Natural Language Processing", 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003
- T2: Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd edition, Prentice Hall, 2009.

**REFERENCE BOOKS:**

- R1: Nitin Indurkha, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
- R2: James Allen "Natural Language Understanding", Pearson Publication 8th Edition, 2012.
- R3: Chris Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing", 2nd edition, MIT Press Cambridge, MA, 2003.
- R4: Hobson Lane, Cole Howard, Hannes Hapke, "Natural language processing in action" MANNING Publications, 2019.
- R5: Alexander Clark, Chris Fox, Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley-Blackwell, 2012
- R6: Rajesh Arunugam, Rajalingappa Shanmugam, "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application". PACKT publisher, 2018.



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Programme  
B.TECH

Course Code  
19AI6251

Name of the Course  
**PREDICTIVE MODELLING**

L T P C  
3 0 2 4

- Course Objective
1. To learn how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, decision trees, logistic regression, support vector machines and Bayesian network models.
  2. To know the use of the binary classifier and numeric predictor nodes to automate model selection.
  3. To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction

Unit	Description	Instructional Hours
	<b>INTRODUCTION TO PREDICTIVE MODELLING</b>	
I	What is Predictive Analytics? - What does a predictive model do? - Descriptive v/s Predictive v/s Prescriptive Analytics. - The need for a methodology CRISP-DM (Cross-Industry Standard Process for Data Mining). <i>Illustrative program: Collect and understand the data</i>	9+2(p)
	<b>INTRODUCTION TO SPSS MODELER</b>	
II	IBM SPSS Modeler (Nodes, Streams), Manager Pane and Project Pane-Collecting Initial Data-Understand data-Set the unit of Analysis (DISTINCT, AGGREGATE, SETTOFLAG) - Integrate data - (APPEND, MERGE), Relationship between a categorical and continuous field, Relationship between two continuous fields. <i>Illustrative program: Set the unit of analysis for the data</i> a) Remove duplicate records b) Aggregate transactional data c) Create flag fields and aggregate the data <i>Integrate data</i> a) Appending Report b) Merge field	9+4(p)
	<b>USING FUNCTIONS IN SPSS</b>	
III	Date and Time Functions-Conversion Functions-String Functions-Statistical Functions, Measure of Central Tendency, Measures of Variability-Missing Value Functions, Undefined and Blank Values Function. <i>Illustrative program: Identify relationships in the data</i> a) Examine the relationship between categorical fields b) Examine the relationship between a categorical and continuous field <i>Predict customer churn in telecom dataset</i> a) Build Model using CHAID b) Examine the CHAID Model c) Apply the model to new data	9+3(p)
	<b>DATA FIELD TRANSFORMATION</b>	
IV	Field transformation- Additional Field Transformation-Sequence, Data-Sampling- balancing- partitioning data, Derive, Binning, Reclassify, Control Language for Expression Manipulation (CLEM), Filler, Transform, Sequence Functions, Restructure Data. <i>Illustrative program: Create a Segmentation Model</i> <i>Create homogeneous groups (clusters) of customers based on usage patterns.</i> <i>Using functions in IBM SPSS Modeler:</i> a) Date and Time Functions b) String Functions c) Statistical Functions d) Missing Value Function	9+3(p)

*Add fields to the data*

- a) *Derive fields as formula*
- b) *Derive fields as flag or nominal*
- c) *Reclassify categorical fields*
- d) *Bin a continuous field into a categorical field with equal counts*

**INTRODUCTION TO MODEL**

V Modelling Algorithms-Supervised Models- Partition the data- Segmentation Models-Creating a model in IBM SPSS Modeler-Introduction to Linear Regression-Introduction to Logistic Regression-Introduction to Neural Networks-Multilayer Perceptron (MLP)-Radial Basis Function (RBF). . 9+3(p)  
*Illustrative program: Create a Linear Regression Model to Predict Employee Salaries. Use Logistic Regression to Predict Response to a Charity Promotion Campaign. Predicting Credit Risk using Neural Networks*

**Total Instructional Hours (45+15) 60**

**TEXT BOOKS:**

**Course Outcome**

- CO1: Understand design, build, evaluate and implement predictive models for various business applications.
- CO2: Compare the underlying predictive modeling techniques.
- CO3: Select appropriate predictive modeling approaches.
- CO4: Apply predictive modeling approaches using a suitable package such as SPSS Modeler.
- CO5: To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction

T1 :IBM CourseWare

**REFERENCE BOOKS:**

- R1: IBM SPSS Modeler Essentials ,by Jesus Salcedo, Keith McCormick
- R2: Fundamentals of Machine Learning for Predictive Data Analytic ,by john D Kelleher
- R3: Applied Predictive Modeling, by Max Kuhn

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HICET - Department of Artificial Intelligence and Machine Learning

Programme B. Tech.	Course Code 19AI6001	Name of the Course NATURAL LANGUAGE PROCESSING LAB	L 0	T 0	P 3	C 1.5
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- Course Objective**
1. To know about language processing.
  2. To create work and know about word generation in NLP.
  3. To know about continues language processing.
  4. To know the occurrence of word in NLP.
  5. To create a programs that is used in NLP for recognizing short phrases.

S. No.	Description of the Experiments
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1. Word Analysis
2. Word Generation
3. Morphology
4. N-Grams
5. N-Grams Smoothing
6. POS Tagging: Hidden Markov Model
7. POS Tagging: Viterbi Decoding
8. Building POS Tagger
9. Chunking
10. Building Chunker

Total Practical Hours 45

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

Course Outcome

- CO1: Understand the basics of NLP
- CO2: Design programs for word processing in NLP.
- CO3: Develop programs to access continues words in NLP.
- CO4: Develop programs to check the how frequently a word appears in NLP.
- CO5: Design programs using chunking concepts.

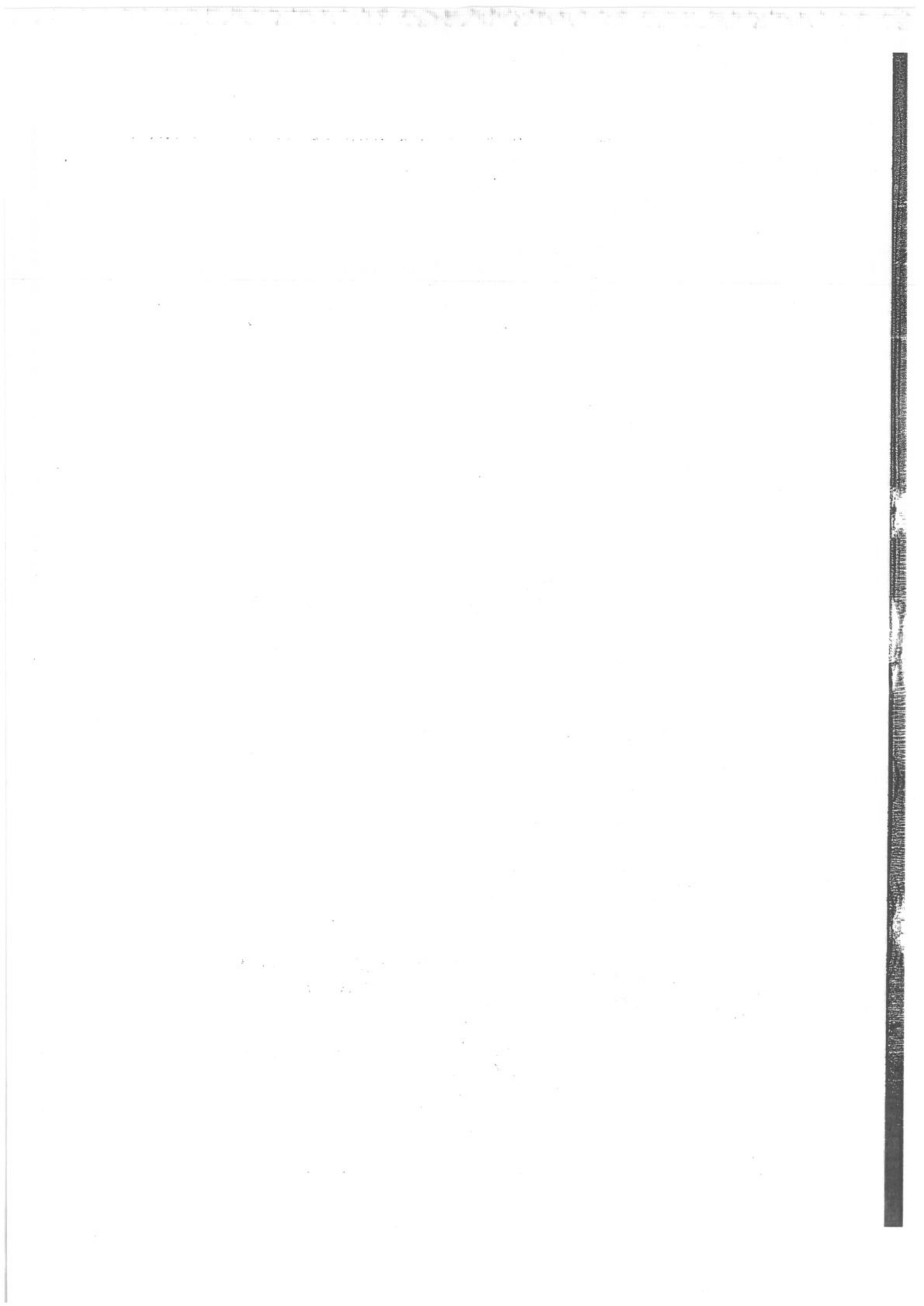
  
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<b>Programme</b> B. Tech.	<b>Course Code</b> 19AI6301	<b>Name of the Course</b> NEURAL NETWORKS	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. To learn the fundamental techniques and generalisation issue in neural computation
  2. To understand the basics of supervised and unsupervised learning
  3. To learn relationship about linear network functions through Perceptron Models
  4. To learn the concepts of Backpropagation Algorithm
  5. To introduce the Associative memories and applications of neural networks.

Unit	Description	Instructional Hours
	<b>INTRODUCTION TO NEURAL NETWORKS</b>	
I	Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch Pitts Model, Historical Developments, Potential Applications of ANN.	9
	<b>ESSENTIALS OF ARTIFICIAL NEURAL NETWORKS</b>	
II	Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Learning Strategy : Supervised – Unsupervised - Reinforcement, Learning Rules	9
	<b>SINGLE LAYER FEED FORWARD NETWORKS</b>	
III	Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Limitations of the Perceptron Model.	9
	<b>MULTI-LAYER FEED FORWARD NETWORKS</b>	
IV	Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.	9
	<b>ASSOCIATIVE MEMORIES</b>	
V	Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function. Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis. Neural network applications: Process identification, control, fault diagnosis.	9
<b>Total Instructional Hours</b>		<b>45</b>

- Course Outcome**
- CO1: Explain the basic concepts of neural computation
- CO2: Explain about various learning approaches on neural networks and the concepts of supervised learning
- CO3: Analyze the linear network functions through Perceptron Models
- CO4: Analyze the concepts of Backpropagation Algorithm
- CO5: Introduced to some applications of neural networks and concepts of Associative Memory

**TEXT BOOKS:**

- T1: Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2004.
- T2: Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2003.

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**REFERENCE BOOKS:**

- R1: S.N.Sivanandam, S.Sumathi,S. N. Deepa "Introduction to Neural Networks using MATLAB 6.0", TATA Mc Graw Hill, 2006.
- R2: S. Rajasekharan and G. A. Vijayalakshmi pai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications", PHI Publication, 2004.
- R3: Timothy J. Ross, " Fuzzy Logic With Engineering Applications", Tata McGraw-Hill Inc. 2000



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<b>Programme</b> B. Tech.	<b>Course Code</b> 19AI6302	<b>Name of the Course</b> BIG DATA COMPUTING	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. To understand the competitive advantages of big data analytics
  2. To understand the big data frameworks
  3. To learn data analysis methods
  4. To learn stream computing
  5. To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

Unit	Description	Instructional Hours
I	<b>INTRODUCTION TO BIG DATA</b> 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 - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.	9
II	<b>HADOOP FRAMEWORK</b> Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN	9
III	<b>DATA ANALYSIS</b> Statistical Methods:Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods,Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.	9
IV	<b>MINING DATA STREAMS</b> 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, Stock Market Predictions.	9
V	<b>BIG DATA FRAMEWORKS</b> Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.	9
<b>Total Instructional Hours</b>		<b>45</b>

- Course Outcome**
- CO1: Understand how to leverage the insights from big data analytics  
 CO2: Understand the big data frameworks  
 CO3: Analyze data by utilizing various statistical and data mining approaches  
 CO4: Perform analytics on real-time streaming data  
 CO5: Understand the various NoSql alternative database models

**TEXT BOOKS:**

- T1: Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Wiley and SAS Business Series, 2012.  
 T2: David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools,

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Techniques, NoSQL, and Graph", 2013.

**REFERENCE BOOKS:**

- R1: Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, Second Edition, 2007.
- R2: Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
- R3: P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
- R4: Richard Cotton, "Learning R - A Step-by-step Function Guide to Data Analysis, O'Reilly Media, 2013.



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<b>Programme</b>	<b>Course Code</b>	<b>Name of the Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
B. Tech.	19AI6303	ARTIFICIAL INTELLIGENCE IN BLOCK CHAIN	3	0	0	3

- Course Objective**
1. To understand the basic concepts of Blockchain.
  2. To learn Domain-Specific Applications of AI and Blockchain
  3. To understand the role of AI in Cryptocurrency
  4. To Implement DI Apps and its usage.

Unit	Description	Unit
	<b>INTRODUCTION TO BLOCKCHAIN:</b> Blockchain versus distributed ledger technology versus distributed databases - Public versus private versus permissioned blockchains - Privacy in blockchains - Introduction to Ethereum - Introduction to Hyperledger - Other blockchain platforms – Hashgraph, Corda, and IOTA	I
I	Consensus algorithms - Building DApps with blockchain tools - Introduction to the AI Landscape Technical requirements - AI – key concepts - Types of AI - Forms of AI and approaches - AI in digital transformation - AI platforms and tools	I
	<b>BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE:</b> Domain-Specific Applications of AI and Blockchain Technical requirements - Applying AI and blockchain to healthcare, supply chains, financial services, other domains. AI- and Blockchain-Driven Databases Technical requirements	II
II	- Centralized versus distributed data- Blockchain data – big data for AI analysis - Global databases - Data management in a DAO - Emerging patterns for database solutions - Empowering Blockchain Using AI The benefits of combining blockchain and AI	II
	<b>CRYPTOCURRENCY AND ARTIFICIAL INTELLIGENCE:</b> The role of AI in cryptocurrency Cryptocurrency trading - Making price predictions with AI - Market making - Development Life Cycle of a DIApp	III
III	Technical requirement.	III
	<b>IMPLEMENTING DI APPS:</b> Evolution of decentralized applications - Building a sample DIApp - Testing the sample DIApp - Deploying the sample DIApp - Retrospecting the sample DIApp	IV
IV		IV
	<b>THE FUTURE OF AI WITH BLOCKCHAIN:</b> Introduction to AI 3.0 and blockchain 3.0 - The future of converging AI and blockchain - Converging AI and blockchain in enterprise - Converging AI and blockchain in government - Converging AI and blockchain in financial services, human resources, healthcare, supplychain management.	V
V		V
	<b>Total Instructional Hours</b>	45

- Course Outcome**
- CO1: Understand emerging techniques in Block Chain
  - CO2: Apply Blockchain Concepts in AI
  - CO3: It provides conceptual understanding of Cryptocurrency
  - CO4: Design and implement DI APP
  - CO5: Implement AI with Blockchain in various real-world Applications.



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**TEXT BOOKS:**

- T1: Practical Artificial Intelligence and Blockchain, Ganesh Prasad Kumble, Packt Publications, 2020
- T2: S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.

**REFERENCE BOOKS:**

- R1: Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O'Reilly, 2014.
- R2: Roger Wattenhofer, "The Science of the Blockchain" CreateSpace Independent Publishing, 2016.
- R3: Arshdeep Bahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", VPT, 2017.



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<b>Programme</b> B. Tech.	<b>Course Code</b> 19AI6304	<b>Name of the Course</b> HUMAN MACHINE INTERACTION	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3
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- Course Objective**
1. To learn the basics of Human Machine Interaction
  2. To become familiar with the design technologies for Individuals.
  3. To learn about how emotion affects user experience.
  4. To learn the details of user interface.
  5. To learn the details of Human Machine Learning

Unit	Description	Instructional Hours
<b>BASICS OF HML</b>		
I	The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – elements – interaction- Case Studies	9
<b>DESIGN &amp; SOFTWARE PROCESS</b>		
II	Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HMI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design	9
<b>MODELS AND THEORIES</b>		
III	HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.	9
<b>MOBILE HMI</b>		
IV	Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies	9
<b>WEB INTERFACE DESIGN</b>		
V	Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies	9
<b>Total Instructional Hours</b>		<b>45</b>

- Course Outcome**
- CO1: Design effective dialog for Human Machine Interfacing  
 CO2: Design effective HMI for individuals and persons with disabilities  
 CO3: Assess the importance of user feedback  
 CO4: Explain the HMI implications for designing multimedia/ ecommerce/e-learning Web sites.  
 CO5: Develop meaningful user interface.

**TEXT BOOKS:**

- T1: Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, —Human Computer InteractionI, 3rd Edition, Pearson Education, 2004 (UNIT I, II & III)  
 T2: Brian Fling, —Mobile Design and DevelopmentI, First Edition, O'Reilly Media Inc., 2009 (UNIT – IV)  
 T2: Bill Scott and Theresa Neil, —Designing Web InterfacesI, First Edition, O'Reilly, 2009. (UNIT-V)

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**REFERENCE BOOKS:**

R1: Stuart K. Card, Thomas P. Moran, Allen Newell, The Psychology of Human-Computer Interaction, CRC Press, 2017

R2: Bhattacharia, Human Computer Interaction MC GRAW HILL INDIA

R3: Benyon David, Designing Interactive Systems, Pearson, 2013



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Programme	Course Code	Name Of The Course	L	T	P	C
B. Tech.	19AI6306	<b>FOUNDATIONS OF DATA SCIENCE</b>	3	0	0	3

**COURSE OBJECTIVES:**

1. To understand the data science fundamentals and process.
2. To learn to describe the data for the data science process.
3. To learn to describe the relationship between data.
4. To utilize the Python libraries for Data Wrangling.
5. To present and interpret data using visualization libraries in Python

Unit	Description	Instructional Hours
UNIT I	INTRODUCTION	9

Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – build the model – presenting findings and building applications – Data Mining – Data Warehousing – Basic Statistical descriptions of Data

UNIT II	DESCRIBING DATA	9
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Types of Data – Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages – Describing Variability – Normal Distributions and Standard (z) Scores

UNIT III	DESCRIBING RELATIONSHIPS	9
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Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r<sup>2</sup> –multiple regression equations –regression towards the mean

UNIT IV	PYTHON LIBRARIES FOR DATA WRANGLING	9
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Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables

UNIT V	DATA VISUALIZATION	9
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Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting – Geographic Data with Basemap – Visualization with Seaborn.

**TOTAL INSTRUCTIONAL HOURS 45**

**COURSE OUTCOMES:**

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

- CO1: Define the data science process
- CO2: Understand different types of data description for data science process
- CO3: Gain knowledge on relationships between data
- CO4: Use the Python Libraries for Data Wrangling
- CO5: Apply visualization Libraries in Python to interpret and explore data

**TEXT BOOKS**

1. David Cielen, Arno D. B. Meysman, and Mofamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III)
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)

**REFERENCE BOOK**

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.



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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.Tech/B.E	19IT6308	Web Development - I	0	0	3	3

**Course Objective**

1. To build web applications using the Express.js framework
2. Focus on industry-practices like functional programming
3. To get practice with object-oriented design and object-oriented design
4. To Learn about the PostgreSQL with Sequelize models
5. To practice EJS Templating, security, and version control.

**Experiment No.**

**Description of the Experiments**

- Introduction to Node.js**  
 1 In this module students are introduced to Node.js - they learn how to install it and write programs on it and use Node.js REPL. Students also start using GitHub and learn how to collaborate on code with others using the git tool.
- Working with NPM**  
 2 This module is an introduction to Node.js package manager for students where they start writing custom NPM modules. They also explore and use built-in modules of Node.js
- Node.js deep dive**  
 3 In this module students start building their first application and learn how to use closure to emulate private methods.
- Testing**  
 4 In this module students are introduced to testing. They start writing tests for their application, learn how to use Jest to run the tests and pre-commit hooks to run the tests automatically before each commit
- Databases and Sequelize**  
 5 In this module students get to learn about databases and set up a PostgreSQL database. They learn how to connect to a database from a Node.js application and then work on the database by creating Sequelize models to manipulate data.
- Backend Web development with Express.js**  
 6 In this module, students develop their first application and connect it to the PostgreSQL database on their machine, and begin learning the basics of the CRUD pattern by building some additional features to the application that they're working on.
- Add User Interface for To-do Application**  
 7 This module teaches students how to create interfaces for their application. They also practice converting a given visual design into working HTML and CSS.
- EJS Templating**  
 8 This module teaches touches upon the basics of the MVC pattern, instructing student how to render dynamic data inside their HTML pages using EJS templates. This module also lets the student practice how to deploy their work to a remote server.
- HTML forms to save and accept user inputs**  
 9 This module teaches students how to accept user input on their application via form element in HTML. Students also explore more of the CRUD pattern, moving onto creation of resources using forms, deletion of existing resources, and learn about Cross Site Request Forgery (CSRF) and how authenticity tokens can be used to prevent such attacks. Students are also introduced to APIs.
- User Authentication and final wrap-up**  
 10 In this module students dig deeper into Sequelize association, migration and validation. They build a functional user sign-up page, learn about password storage and play around with browser cookies, sessions, user authentication, and related best practices. They also learn to display one-off flash messages.



**Course  
Outcome**

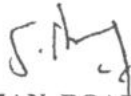
- CO1: Build web applications using Express.js.
- CO2: Manipulate data using both imperative and functional programming techniques.
- CO3: Model real-world systems using object-oriented design.
- CO4: Write HTML & CSS to create elegant web pages.
- CO5: Build database applications using Sequelize.

**TEXT BOOKS:**

This course does not require students to use physical textbooks. Instead, original course material (videos, text and images) has been prepared for students to go through and is open-sourced under Creative Commons Attribution-ShareAlike 4.0 International License © Freshworks Inc. & Pupilfirst Pvt. Ltd. This course material may include some third-party content with a compatible license, and external links for additional reading on the Internet. Students are also taught how to search for information on their own.

**REFERENCE BOOKS:**

- R1- 1. Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education, 2007.
- R2- 2. Mike Cantelon, Marc Hartert, T.J. Holowaychuk, Nathan Rajlich" Node.js in Action", Manning Publications, 2014.
- R3- 3. David Gutman, Fullstack Node.js The Complete Guide to Building Production Apps with Node.js , Fullstack.io 2019.



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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.Tech/B.E	19IT7307	Web Development - II	0	0	3	3

1. Understand the basic architecture of front end applications and create web

Applications using React TypeScript front-end stack.

**Course Objective**

2. Interaction between a client-side application and server-side app via an API.
3. Industry practices for state management and usage of static types.
4. Best practices with regard to the development of a modern client-side application.
5. To build TypeScript projects from scratch to scale.

**Experiment No.**

**Description of the Experiments**

- 1 **React fundamentals** This module introduces students to development using TypeScript by setting up a development environment, introducing them to the TypeScript programming language and the React framework, and demonstrates some of the basic concepts that underpin the use of React for building dynamic reactive user interfaces.
- 2 **State management** This module introduces students to the Hooks feature of React, on the usage of callback functions and how to use them to build dynamic components that maintain an internal state. This module also demonstrates state management by building a form and accepting user input.
- 3 **A deeper dive into React Hooks** This module discusses the common pitfalls of state management, introduces in-browser persistent storage, demonstrates additional standard hooks and the creation and use of custom hooks.
- 4 **Client-side routing** This module covers the concept of client-side routing as a separate behaviour from server-side route management. It demonstrates the various aspects of client-side routing such as the use of path parameters, query parameters, programmatic navigation and the operation of links and URLs that are handled client-side.
- 5 **Types in depth and Variants**  
This module takes a deeper dive into TypeScript's type system, demonstrating concepts such as function types, custom-defined types, generics, and union types. It also instructs the student why the "any" type should be avoided in practice, and finishes up with a demonstration of TypeScript's type inference behaviour.
- 6 **Modelling and managing complex states**  
This module teaches students how to manage complex states using the state reducer pattern, and then demonstrates the pattern by implementing it using React's useReducer hook.
- 7 **APIs and state modelling**  
Through this module, students are introduced to using APIs to interface their client-side code with the server-side, how to model types to allow this interaction to take place, how to maintain a session with the backend, and how to work with pageable APIs.
- 8 **Best practices and npm packages**  
This module covers the best practices of front-end development, including the importance of accessibility and WAI-ARIA standards, and use of third-party packages from the NodeJS ecosystem

## Production React Apps

- 9 This final module focuses on production-specific optimizations of a React application, best practices for its build & deployment process, and the configuration of a progressive web app.

Total Instructional Hours 45

### Course Outcome

CO1: Be able to create Single Page Web Applications (SPA) using React,

Typescript and TailwindCSS.

CO2: Have a solid understanding of static types, and know how to port untyped

JavaScript to TypeScript

CO3: Learn typed state management that is inline with a backend data model.

CO4: Able to Modelling and managing complex states

CO5: Practice API and state Modelling

### TEXT BOOKS:

This course does not require students to use physical textbooks. Instead, original course material (videos, text and images) has been prepared for students to go through and is open-sourced under Creative Commons Attribution-ShareAlike 4.0 International License © Freshworks Inc. & Pupilfirst Pvt. Ltd. This course material may include some third-party content with a compatible license, and external links for additional reading on the Internet. Students are also taught how to search for information on their own.

### REFERENCE BOOKS:

R1: Learning React: Functional Web Development with React and Redux 1st Edition by Alex Banks, Eve Porcello .O'REILLY publication.

R2: The Road to React: Your journey to master plain yet pragmatic React.js by Robin Wieruch



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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.Tech/B.E	19IT8314	Web Development-II	0	0	3	3

**Course Objective**

- To allow the student to learn more about production-ready deployments.
- To know the workflow using pull-requests
- To practice JS Bundling of integration of JS into non-JS backend
- Different approaches of training.
- Knowledge about of the popular Docker

**Experiment No.**

**Description**

- Workflow using pull-requests**  
This module acts as an advanced guide to the usage of git in development teams, where the norm is to develop on branches, perform peer-reviews, and to re-work based on reviews before merging. Since this cycle is most often performed using online tooling that uses pull requests to achieve this workflow, students are taught how to open a pull request, make changes, submit work for review and then update code based on review.
- JS Bundling - integration of JS into non-JS backends**  
This module covers the history of why "bundling" as a process exists for the JS ecosystem, the most common bundling tools, and the general methodology. This module also covers the new "import maps" feature that allows for similar capability without the use of a bundling tool.
- Compile to JS languages - options & approaches**  
This module covers the reason why languages that compile to JS exist, the different purposes that they serve, and demonstrate a few of the most popular options and the differences between each.
- Testing**  
This module covers the importance of testing, the different approaches to testing such as unit testing, integration testing, and hybrid testing. It should also cover popular libraries that are used to help with testing, and also common pitfalls in the practice of testing and how to avoid them.
- CI/CD - Continuous integration & delivery**  
This module teaches students about modern development processes that enable teams to release changes quickly and often, by leading them through the process of setting up an automated system that detects changes to code to run tests and then linking that to the deployment of code that passes its test suite to a remote server.
- Application environments**  
This module teaches students about the different environments in which an application is expected to run. This module explains the differences between the environments that a student has already operated in - development, testing & production, and also introduces the concept of a staging environment which acts as a gateway to the production environment.
- Containerization**  
This module covers the field of containerization - where complex applications are packaged to run in isolated spaces called containers. The approach for covering this topic involves the use of the popular Docker (OCI) standard, teaching students how to build a Docker image for their web application, and how to deploy this image to different targets.
- Internationalisation and localization**  
This module covers i18n, teaching students the basics of setting up their web applications to support users who prefer or require a language different from the

default language of the app, and/or live in a timezone that is different from the default. This module also covers L10n, teaching students how to use the i18n framework to customise their web application for another locale.

**Error logging & debugging**

9 This module covers the practice of logging and notification of runtime errors that occur on a deployed application. This module also covers the process that is followed to detect the source of a bug, and how testing can be used to ensure a fix and to prevent recurrences.

Total Practical Hours 45

**Course Outcome**

- CO1: Be able to bundle a codebase with non-trivial JS dependencies and code.
- CO2: Know how to differentiate between popular JS flavours and pick one that is suitable for a task.
- CO3: Understand why testing is important, what TDD is, and be able to write both unit and integration tests for Rails applications that use JS in the front-end.
- CO4: Be able to set up a CI/CD pipeline for a server-side application, ensuring the code reaches production automatically after tests pass.
- CO5: Know how to organise & communicate development work using pull requests and be aware of container-based deployments, be able to build a Docker image for their web application and then deploy that image to a web server

**TEXT BOOKS:**

This course does not require students to use physical textbooks. Instead, original course material (videos, text and images) has been prepared for students to go through and is open-sourced under Creative Commons Attribution-ShareAlike 4.0 International License © Freshworks Inc. & Pupilfirst Pvt. Ltd. This course material may include some third-party content with a compatible license, and external links for additional reading on the Internet. Students are also taught how to search for information on their own.



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Programme	Course Code	Name Of The Course / NPTEL	L	T	P	C
B. Tech.	19AI3311	<b>ADVANCED SOCIAL NETWORKS</b>	3	0	0	3

- Course Objective**
1. To understand the components of web based social networks
  2. To learn knowledge representation using ontology.
  3. To mine the users community in social networks.
  4. To understand the evolution of social networks through various models
  5. To mine the opinions of the users in social networks

Unit	Description	Instructional Hours
I	<b>INTRODUCTION</b> Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks - Development of Social Network Analysis - Key concepts and measures in network analysis – Electronic sources for network analysis - Discussion networks - Blogs and online communities - Web-based networks-Applications of Social Network Analysis.	9
II	<b>MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION</b> Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.	9
III	<b>MINING COMMUNITIES AND SOCIAL MEDIA MINING</b> Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms – Social Media Mining-Classification- Challenges- Research issues –Applications.	9
IV	<b>EVOLUTION</b> Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction.	9
V	<b>TEXT, OPINION AND MULTIMEDIA DATA MINING</b> Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis – Multimedia mining-Architecture- Image mining- Image Tagging- Shallow artificial Neural Networks.	9
<b>TOTAL INSTRUCTIONAL HOURS</b>		45

- Course Outcome**
- CO1: Work on the internal components of social networks
  - CO2 : Represent Knowledge using Ontology
  - CO3 : Mine the behavior of the users in social networks
  - CO4 : Predict the possible next outcome of social networks
  - CO5 : Mine the opinions of the user social networks.



**TEXT BOOKS:**

- T1 - Charu C. Aggarwal, "Social Network Data Analytics"; Springer; 2011  
T2 - Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.  
T3 - Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1<sup>st</sup> edition, 2010.

**REFERENCE BOOKS :**

- R1 - Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2011.  
R2 - Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.  
R3 - . Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2009.  
R4 - . Toby Segaran, "Programming Collective Intelligence", O'Reilly, 2012



  
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<b>Programme</b>	<b>Course Code</b>	<b>Name Of The Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
B. Tech.	19AI6401	Cyber Security and Intelligence	3	0	0	3

1. To understand the cyber security techniques
2. To understand various types of cyber-attacks and cyber-crimes.
3. To learn threats and risks within context of the cyber security.
4. To have an overview of the cyber laws & concepts of cyber forensics
5. To study the defensive techniques against these attacks.

**Course Objective**

Unit	Description	Instructional Hours
I	<b>INTRODUCTION TO CYBER SECURITY</b> Introduction -Computer Security - Threats -Harm - Vulnerabilities - Controls - Authentication -Access Control and Cryptography - Web—User Side - Browser Attacks - Web Attacks -Targeting Users - Obtaining User or Website Data - Email Attacks	9
II	<b>CYBERSPACE AND THE LAW &amp; CYBER FORENSIC</b> Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics	9
III	<b>CYBERCRIME: MOBILE AND WIRELESS DEVICES</b> 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 ,Organizational security Policies and Measures in Mobile Computing Era, Laptops	9
IV	<b>CYBER SECURITY: ORGANIZATIONAL IMPLICATIONS</b> Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.	9
V	<b>PRIVACY ISSUES</b> Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Datalinking and profiling, privacy policies and their specifications, privacy policy languages; privacy in different domains	9
<b>TOTAL INSTRUCTIONAL HOURS</b>		<b>45</b>

AIML

**Course Outcome**

- CO1: Work on the Analytical skills  
CO2 : Analyze cyber-attacks, types of cybercrimes, cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks  
CO3 : Interpret and forensically investigate security incidents.  
CO4 : Apply policies and procedures to manage Privacy issues  
CO5 : Design and develop secure software modules.

**TEXT BOOKS:**

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B.B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithms, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

**REFERENCES BOOKS:**

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa (John) Wu, J. David Irwin, CRC Press T&F Group.

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**AIML - CO'S, PO'S & PSO'S MAPPING-ACADEMIC YEAR ( 2022-2023)**

**REGULATION-2022**

**Semester – I**

Course Code & Name: 22MA1101/ MATRICES AND CALCULUS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	1	2
Avg	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2

Course Code & Name: 22CY1151/ CHEMISTRY FOR CIRCUIT ENGINEERING

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	3	1	1	1	1	-	1	-	1	2	-	-
CO2	2	3	2	1	1	1	1	-	1	-	1	2	-	-
CO3	2	2	2	2	1	1	1	-	1	-	1	2	-	-
CO4	2	2	3	1	2	1	1	-	1	-	2	2	-	1
CO5	2	3	3	2	2	1	1	-	1	-	1	2	-	-
Avg	2	2.6	2.6	1.4	1.4	1	1	-	1	-	1.2	2	0	1

Course Code & Name: 22HE1151 / ENGLISH FOR ENGINEERS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2					1	2	2	2	3	1	1	1	2
CO2	2	1			1	1	1	2	2	3		2		2

CO3	2	1			1	1	2	3	3	3		1	1	2
CO4	2	1				1	2	2	2	3	1	1		
CO5	2					1	1	2	3	3		1	1	2
Avg	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2

**Course Code & Name: 22CS1152 /Object Oriented Programming using Python**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	3	-	2	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO4	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2	2	2
Avg	2	3	3	-	2	-	-	-	2	-	-	2	2	2

**Course Code & Name: 22IT1152 /Introduction to Web Application Development**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3			1	2					1	2	1
CO2	3	3	3	1	2	1	2				1	1	2	2
CO3	3	2	3	2	1		2		1		2	2	2	2
CO4	3	3	3	1		1	2		1			2	2	3
CO5	3	3	3		2		2		1		1	3	1	2
Avg	3	2.8	3	1.2	1	0.6	2		0.6		0.8	2	1.8	2

**SEMESTER - II**

**Course Code & Name : 22MA2103 Differential Equations And Linear Algebra**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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<b>CO1</b>	3	3	3	3	3	-	-	-	-	-	-	2	2	1	
<b>CO2</b>	3	3	3	2	2	-	-	-	-	-	-	2	2	2	
<b>CO3</b>	3	3	3	2	3	-	-	-	-	-	-	2	2	2	
<b>CO4</b>	3	3	3	3	3	-	-	-	-	-	-	2	2	3	
<b>CO5</b>	3	3	3	3	3	-	-	-	-	-	-	2	1	2	
<b>AVG</b>	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2	

Course Code & Name : 22PH2101      Basics of Material Science

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	2					1	2	2	2	3	1	1	1	2
<b>CO2</b>	2	1			1	1	1	2	2	3		2		2
<b>CO3</b>	2	1			1	1	2	3	3	3		1	1	2
<b>CO4</b>	2	1				1	2	2	2	3	1	1		
<b>CO5</b>	2					1	1	2	3	3		1	1	2
<b>Avg</b>	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2

Course Code & Name : 22HE2151      Effective Technical Communication

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	2	3	3	1	1	1	1	-	1	-	1	2	-	-
<b>CO2</b>	2	3	2	1	1	1	1	-	1	-	1	2	-	-
<b>CO3</b>	2	2	2	2	1	1	1	-	1	-	1	2	-	-
<b>CO4</b>	2	2	3	1	2	1	1	-	1	-	2	2	-	1
<b>CO5</b>	2	3	3	2	2	1	1	-	1	-	1	2	-	-
<b>Avg</b>	2	2.6	2.6	1.4	1.4	1	1	-	1	-	1.2	2	-	1

Course Code & Name: 22PH2151      Physics for Circuit Engineering

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	1	3	3	2	0	0	0	3	0	3	0	1	0
<b>CO2</b>	3	1	2	2	2	3	0	1	2	0	3	2	1	0
<b>CO3</b>	3	2	2	2	2	3	0	1	2	0	2	2	1	0



<b>CO4</b>	3	1	2	2	0	3	0	1	0	0	2	2	1	0
<b>CO5</b>	3	1	2	1	2	0	0	0	0	0	2	3	1	0
<b>Avg</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>0</b>

**Course Code & Name: 22CS2253 Java Fundamentals**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	3	3	3	0	0	1	1	0	0	0	0	1	1	0
<b>CO2</b>	3	3	3	1	2	1	1	0	0	0	1	1	1	1
<b>CO3</b>	3	2	3	2	1		2	0	1	0	2	2	3	2
<b>CO4</b>	3	3	3	1	0	1	2	0	1	0	0	2	2	3
<b>CO5</b>	3	3	3	0	2		2	0	1	0	1	3	3	3
<b>Avg</b>	3	2.8	3	0.8	1	1	1.6	0	0.6	0	0.8	1.8	2	1.8

**Course Code & Name: 22IT2253 Dynamic Web Design**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	3	1	0	0	1	0	0	0	0	0	1	1	1	2
<b>CO2</b>	1	1	1	0	1	0	0	0	1	0	0	1	1	2
<b>CO3</b>	1	1	1	0	1	0	0	0	0	1	0	1	0	1
<b>CO4</b>	1	1	1	0	0	0	0	0	1	0	1	1	0	1
<b>CO5</b>	1	1	1	0	0	0	0	0	0	1	1	1	1	1
<b>Avg</b>	1.4	1	1	0	0.6	0	0	0	0.4	0.4	0.6	1	0.6	1.4

**Course Code & Name: 22ME2001 Engineering Practices**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	1	3	0	2	0	0	0	3	0	3	0	1	0
<b>CO2</b>	3	1	2	0	2	3	0	1	2	0	3	2	1	0
<b>CO3</b>	3	2	2	0	2	3	0	1	2	0	2	2	1	0

<b>CO4</b>	3	1	2	0	0	3	0	1	0	0	2	2	1	0
<b>CO5</b>	3	1	2	0	2	0	0	0	0	0	2	3	1	0
<b>Avg</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>0</b>

**Course Code & Name: 22HE2071 Design Thinking**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	1	3	2	1	0	0	2	0	0	1	1	0
<b>CO2</b>	3	2	1	3	2	3	0	1	2	0	0	2	1	1
<b>CO3</b>	3	3	1	3	2	1	0	1	2	0	0	1	1	1
<b>CO4</b>	3	2	1	3	0	1	0	1	0	0	0	2	1	1
<b>CO5</b>	3	1	1	3	2	2	0	0	2	0	0	1	1	0
<b>Avg</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>

**Course Code & Name: 22HE2072 Soft Skills and Aptitude 1**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	1	1	0	2	0	0	1	0	1	0	3	1	0
<b>CO2</b>	3	1	2	0	1	0	0	1	0	1	0	1	0	0
<b>CO3</b>	3	1	1	0	3	0	0	1	0	1	0	2	1	0
<b>CO4</b>	3	1	3	0	2	0	0	1	0	1	0	1	1	1
<b>CO5</b>	3	1	3	0	1	0	0	1	0	1	0	1	1	0
<b>Avg</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>0</b>

## Semester – III

Course Code & Name: 21MA3152 - Probability and Applied Statistics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	3	2	3
CO3	2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3
Avg	2.8	2.8	2.8	2.8	2.8	-	-	-	-	-	-	2.6	2.4	2.6

Course Code & Name: 21AI3201 Data Structures and Algorithms

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	3			3	1		2	2	2	3
CO2	3	3	3	2	3			3	1		2	2	2	3
CO3	3	2	3	2	3			3	1		2	2	2	3
CO4	3	3	3	2	3			3	1		2	2	2	3
CO5	3	3	3	2	3			3	1		2	2	2	3
Avg	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>2</b>	<b>3</b>	-	-	<b>3</b>	<b>1</b>	-	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>

Course Code & Name: 21AI3202 - Foundations of Artificial Intelligence

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	3	0	1	3	0	0	3	1	1	2	2	1
CO2	2	2	3	1	1	1	0	0	3	1	1	2	2	2
CO3	3	2	3	2	2	0	0	0	1	1	1	2	2	3
CO4	3	1	3	1	1	2	0	0	1	2	1	2	3	3
CO5	1	2	2	1	3	2	1	0	2	3	3	2	3	1

<b>Avg</b>	<b>2</b>	<b>1.6</b>	<b>2.8</b>	<b>1</b>	<b>1.6</b>	<b>1.6</b>	<b>0.2</b>	<b>0</b>	<b>2</b>	<b>1.6</b>	<b>1.4</b>	<b>2</b>	<b>2.4</b>	<b>2</b>
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**Course Code & Name: 21AI3252 Clean Coding and Devops**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	3	2	3	3	2	3	1	1	2	2	2	3
<b>CO2</b>	3	3	3	2	3	3	2	3	1	1	2	2	2	3
<b>CO3</b>	3	2	3	2	3	3	2	3	1		2	2	2	3
<b>CO4</b>	3	3	3	2	3	3	2	3	1		2	2	2	3
<b>CO5</b>	3	3	3	2	3	3	2	3	1		2	2	2	3
<b>Avg</b>	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>0.4</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>

**Course Code & Name: 21AI3251 Digital Principles and System Design**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	2	2	1	1	0	1	0	1	1	3	0	0
<b>CO2</b>	3	3	2	2	2	2	0	1	0	1	0	1	0	2
<b>CO3</b>	3	3	2	2	2	2	0	1	0	1	0	2	0	1
<b>CO4</b>	3	3	2	2	2	2	0	1	0	1	1	1	0	1
<b>CO5</b>	3	3	2	2	2	2	0	1	0	1	1	1	0	2
<b>Avg</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>1</b>

**Course Code & Name: 21AI3001 – Data Structures and Algorithms Laboratory**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	0	0	0	1	0	0	0	0	0	1	1	1	0
<b>CO2</b>	3	2	1	1	1	0	0	0	1	0	0	1	1	0

CO3	3	2	1	1	1	0	0	0	1	1	0	1	0	1
CO4	3	2	1	1	0	0	0	0	1	0	1	1	0	1
CO5	3	0	0	0	0	0	0	0	0	1	1	1	1	0
Avg	3	1	1	1	1	0	0	0	1	0	1	1	1	0

Course Code & Name: 21AI3002 Artificial Intelligence Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	3	0	1	1	0	0	1	1	1	1	2	2
CO2	1	2	3	1	1	1	0	0	1	1	1	1	2	2
CO3	1	2	3	2	2	0	0	0	1	1	1	1	2	2
CO4	1	1	3	1	1	2	0	0	1	2	1	2	2	3
CO5	1	2	2	1	3	2	1	0	2	3	3	2	2	3
Avg	3	2	0	0	1	0	0	0	0	0	1	2	1	0

### Semester – IV

Course Code & Name: 21MA4105 - Discrete Mathematical Structures

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	1	1	-	-	-	-	-	1	2	2	2
CO2	2	3	2	1	1	-	-	-	-	-	1	2	2	2
CO3	2	2	2	2	1	-	-	-	-	-	1	2	2	2
CO4	2	2	3	1	2	-	-	-	-	-	2	2	3	3
CO5	2	3	3	2	2	-	-	-	-	-	3	2	3	3
Avg	2	2.6	2.4	1.4	1.4	-	-	-	-	-	1.6	2	2.4	2.4

Course Code & Name: 21AI4201 Database Management Systems

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	-	-	-	-	-	-	-	-	2	2	-

CO2	2	1	2	1	3	-	-	-	-	-	-	1	3	-
CO3	2	1	2	1	2	-	-	-	-	-	-	1	2	-
CO4	2	3	-	-	1	-	-	-	-	-	-	2	3	-
CO5	1	1	2	1	-	-	-	-	-	-	-	1	2	-
Avg	2	1.6	1.4	0.6	1.2	-	-	-	-	-	-	1.4	2.4	-

Course Code & Name: 21AI4202 Data Visualization

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	-	2	2	-	3	3	-	3	3	3
CO2	2	3	3	2	2	-	2	2	3	3	2	2	3	3
CO3	3	3	3	2			3			2	3	2	2	2
CO4	3	2	2	2	2				2		2	2	2	2
CO5	2	2	2	2			2				2	2	2	2
Avg	2.6	2.6	2.6	2.2	2	2	2.25	2	2.666667	2.666667	2.25	2.2	2.4	2.4

Course Code & Name: 21AI4251 Operating Systems

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	2	-	-	-	-	-	3	-
CO2	2	3	3	3	-	-	3	-	-	-	3	-	3	2
CO3	3	-	-	-	-	-	2	-	-	-	2	3	3	-
CO4	3	2	3	-	-	-	2	-	3	-	2	-	3	-
CO5	3	-	-	-	-	-	3	-	3	-	2	3	3	-
Avg	2.8	1	1.2	0.6	0	0	2.4	0	1.2	0	1.8	1.2	3	0.4

Course Code & Name: 21AI4252 Introduction to Machine Learning

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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CO1	3	3	3			1	1					1	1	
CO2	3	3	3	1	2	1	1				1	1	1	1
CO3	3	2	3	2	1		2		1		2	2	3	2
CO4	3	3	3	1		1	2		1			2	2	3
CO5	3	3	3		2		2		1		1	3	3	3
Avg	3.00	2.80	3.00	0.80	1.00	0.60	1.60	-	0.60	-	0.80	1.80	2.00	1.80

**Course Code & Name: 21AI4001 Database Management Systems Laboratory**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	1	-	-	-	-	-	-	-	3	1
CO2	3	3	-	2	2	2	-	-	-	-	-	-	3	1
CO3	3	3	-	2	2	2	-	2	-	-	-	-	3	1
CO4	3	3	1	2	2	2	-	-	-	-	-	-	3	1
CO5	3	3	1	2	2	2	-	-	-	-	3	-	3	1
Avg	<b>3</b>	<b>3</b>	<b>0.4</b>	<b>1.6</b>	<b>1.8</b>	<b>1.6</b>	<b>-</b>	<b>0.4</b>	<b>-</b>	<b>-</b>	<b>0.6</b>	<b>-</b>	<b>3</b>	<b>1</b>

**Course Code & Name: 21AI4002 Data Visualization Laboratory**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	1	1	0	1	0	1	1	3	0	0
CO2	3	3	2	2	2	2	0	1	0	1	0	1	0	2
CO3	3	3	2	2	2	2	0	1	0	1	0	2	0	1
CO4	3	3	2	2	2	2	0	1	0	1	1	1	0	1
CO5	3	3	2	2	2	2	0	1	0	1	1	1	0	2
Avg	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>1</b>

## Semester – V

Course Code & Name: 19AI5201/ Computer Networks

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	1	-	-	2	2	-	3	2	1
CO2	3	3	3	3	-	1	-	-	2	2	-	3	2	1
CO3	3	3	3	3	-	1	-	-	2	2	-	3	2	1
CO4	3	3	3	3	-	1	-	-	2	2	-	3	2	1
CO5	3	3	2	2	-	1	-	-	2	2	3	3	2	2
Avg	<b>3</b>	<b>3</b>	<b>2.8</b>	<b>2.8</b>	<b>0.4</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>0.6</b>	<b>3</b>	<b>2</b>	<b>1.2</b>

Course Code & Name: 19AI5202/ Data Analytics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	3	2	1	0	0	2	0	0	1	1	0
CO2	3	2	1	3	2	3	0	1	2	0	0	2	1	1
CO3	3	3	1	3	2	1	0	1	2	0	0	1	1	1
CO4	3	2	1	3	0	1	0	1	0	0	0	2	1	1
CO5	3	1	1	3	2	2	0	0	2	0	0	1	1	0
Avg	<b>3</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>

Course Code & Name: 19HE5181/ Management Information System

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	0	0	0	3	0	3	0	1	0
CO2	3	1	2	2	2	3	0	1	2	0	3	2	1	0
CO3	3	3	2	2	2	3	0	1	2	0	2	2	1	0
CO4	3	1	2	2	0	3	0	1	0	0	2	2	1	0

CO5	3	1	2	1	2	0	0	0	0	0	2	3	1	0
Avg	3	2	2	2	2	2	0	1	1	0	2	2	1	0

**Course Code & Name: 19AI5251/ Object Oriented Analysis And Design**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1					3	3	3							
CO2	2	2			3	3								
CO3	2		2	3	3	3								
CO4	2	1	2	2		3								
CO5	2	2	2	2	3	3	3				2	2		
Avg	2	1.6	2	2.3	3	3	3				2	2		

**Course Code & Name: 19AI5252 / Introduction to Design Thinking**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	3			3	1		2	2	2	3
CO2	3	3	3	2	3			3	1		2	2	2	3
CO3	3	2	3	2	3			3	1		2	2	2	3
CO4	3	3	3	2	3			3	1		2	2	2	3
CO5	3	3	3	2	3			3	1		2	2	2	3
Avg	3	2.8	3	2	3	0	0	3	1	0	2	2	2	3

**Course Code & Name: 19AI5001 Networks Lab**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	0	0	0	3	0	3	0	1	0
CO2	3	1	2	2	2	3	0	1	2	0	3	2	1	0
CO3	3	3	2	2	2	3	0	1	2	0	2	2	1	0
CO4	3	1	2	2	0	3	0	1	0	0	2	2	1	0

<b>CO5</b>	3	1	2	1	2	0	0	0	0	0	2	3	1	0
<b>Avg</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>0</b>

**Course Code & Name: 19AI5002/ Data Analytics Lab**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	1	3	2	1	0	0	2	0	0	1	1	0
<b>CO2</b>	3	2	1	3	2	3	0	1	2	0	0	2	1	1
<b>CO3</b>	3	3	1	3	2	1	0	1	2	0	0	1	1	1
<b>CO4</b>	3	2	1	3	0	1	0	1	0	0	0	2	1	1
<b>CO5</b>	3	1	1	3	2	2	0	0	2	0	0	1	1	0
<b>Avg</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>

**Course Code & Name: 19AI5301 AI for Cyber Security**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	3	3	2	2	1		2	3		3	2	
<b>CO2</b>	3	3	3	3	2	2	1			3		3		2
<b>CO3</b>	3	3	3	3	2	1	1		1	3		3	2	2
<b>CO4</b>	3	3	3	3	2	1			1	3		3		3
<b>CO5</b>	3	3	3	3	2	1			1	3		3	2	
<b>Avg</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>1.4</b>	<b>0.6</b>	<b>0</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>1.2</b>	<b>1.4</b>

**Course Code & Name: 19AI5302 Internet of things**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	1	0	0	3	0	0	0	0	0	2	2	1	2
<b>CO2</b>	3	1	3	0	3	0	0	0	1	0	0	1	1	2
<b>CO3</b>	3	1	2	0	3	0	0	0	0	1	0	3	0	1
<b>CO4</b>	1	1	3	0	0	0	0	0	1	0	1	1	0	1
<b>CO5</b>	3	1	1	0	0	0	0	0	0	1	1	1	1	1

<b>Avg</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>1</b>
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**Course Code & Name: 19AI5303      Advanced Machine Learning**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	2	0	0	3	0	0	0	0	0	2	2	1	2
<b>CO2</b>	3	1	3	0	3	0	0	0	1	0	0	1	1	2
<b>CO3</b>	3	3	2	0	3	0	0	0	0	1	0	3	0	1
<b>CO4</b>	1	1	3	0	0	0	0	0	1	0	1	1	0	1
<b>CO5</b>	3	1	1	0	0	0	0	0	0	1	1	1	1	1
<b>Avg</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>1</b>

**Course Code & Name: 19AI5304      Introduction to Robotics**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	0	0	0	1	0	0	0	0	0	1	1	1	0
<b>CO2</b>	3	2	1	1	1	0	0	0	1	0	0	1	1	0
<b>CO3</b>	3	2	1	1	1	0	0	0	1	1	0	1	0	1
<b>CO4</b>	3	2	1	1	0	0	0	0	1	0	1	1	0	1
<b>CO5</b>	3	0	0	0	0	0	0	0	0	1	1	1	1	0
<b>Avg</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>

**Course Code & Name: 19AI5305 Bioinformatics**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	2	3	3		2	0	0	0	0	2	3	3	3	3
<b>CO2</b>	2	3				0	0	0	0	1	3	1		3
<b>CO3</b>	1		3		2	0	0	0	0	2	0	2	2	
<b>CO4</b>		1		3		0	0	0	0	1	1	1	3	
<b>CO5</b>			3	3	2	0	0	0	0	2	1	1		3
<b>Avg</b>	<b>1.7</b>	<b>2.3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2.3</b>	<b>2.8</b>

**Course Code & Name: 19AI5306/ Computer Architecture and Organization**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	0	0	0	3	0	3	0	1	0
CO2	3	1	2	2	2	3	0	1	2	0	3	2	1	0
CO3	3	3	2	2	2	3	0	1	2	0	2	2	1	0
CO4	3	1	2	2	0	3	0	1	0	0	2	2	1	0
CO5	3	1	2	1	2	0	0	0	0	0	2	3	1	0
Avg	3	2	2	2	2	2	0	1	1	0	2	2	1	0

**Semester – VI**

**Course Code & Name: 19AI6201 Theory of Computation**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1			1			2	2	2	3	3	2		
CO2	2		1	2	1			2	3		3	1	1	
CO3	2		2	2	2	2		3	2	3		1		
CO4	2		3		2	2			3	3	2	1		1
CO5	0				2	2	2		2					
Avg	1.4	0	1.2	1	1.4	1.2	0.8	1.4	2.4	1.8	1.6	1	0.2	0.2

**Course Code & Name: 19AI6202 DEVELOPMENT OF MACHINE LEARNING MODELS**

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	3	2	1	0	0	2	0	0	1	1	0
CO2	3	2	1	3	2	3	0	1	2	0	0	2	1	1
CO3	3	3	1	3	2	1	0	1	2	0	0	1	1	1
CO4	3	2	1	3	0	1	0	1	0	0	0	2	1	1
CO5	3	1	1	3	2	2	0	0	2	0	0	1	1	0
Avg	3	2	1	3	2	2	0	1	2	0	0	1	1	1



**Course Code & Name: 19AI6203      Natural Language Processing**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	2	2	2	2	2	1	1	2	2	3	3	2
<b>CO2</b>	3	3	3	2	2	2	2	1	1	2	1	2	3	2
<b>CO3</b>	3	3	3	2	2	2	2	1	1	2	1	2	3	3
<b>CO4</b>	3	3	2	2	2	2	2	1	2	2	1	3	3	2
<b>CO5</b>	3	3	2	2	2	2	2	1	2	2	2	3	3	2
<b>Avg</b>	3	3	2.4	2	2	2	2	1	1.4	2	1.4	2.6	3	2.2

**Course Code & Name: 19AI6251      PREDICTIVE MODELING**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	1	3	2	1	0	0	2	0	0	1	1	0
<b>CO2</b>	3	2	1	3	2	3	0	1	2	0	0	2	1	1
<b>CO3</b>	3	3	1	3	2	1	0	1	2	0	0	1	1	1
<b>CO4</b>	3	2	1	3	0	1	0	1	0	0	0	2	1	1
<b>CO5</b>	3	1	1	3	2	2	0	0	2	0	0	1	1	0
<b>Avg</b>	3	2	1	3	2	2	0	1	2	0	0	1	1	1

**Course Code & Name: 19AI6001      Natural Language Processing Lab**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	3	-	-	1	1	-	-	-	-	1	1	-
<b>CO2</b>	3	3	3	1	2	1	1	-	-	-	1	1	1	1
<b>CO3</b>	3	2	3	2	1		2	-	1	-	2	2	3	2
<b>CO4</b>	3	3	3	1		1	2		1	-	-	2	2	3
<b>CO5</b>	3	3	3	-	2	-	2	-	1	-	1	3	3	3

<b>Avg</b>	3.0	2.8	3.0	1.3	1.7	1.0	1.6	-	1.0	-	1.3	1.8	2.0	2.3
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**Course Code & Name:** 19AI6801 Mini Project

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	0	0	0	1	0	0	0	0	0	1	1	1	0
<b>CO2</b>	3	2	1	1	1	0	0	0	1	0	0	1	1	0
<b>CO3</b>	3	2	1	1	1	0	0	0	1	1	0	1	0	1
<b>CO4</b>	3	2	1	1	0	0	0	0	1	0	1	1	0	1
<b>CO5</b>	3	0	0	0	0	0	0	0	0	1	1	1	1	0
<b>Avg</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>

**Course Code & Name:** 19AI6301 Neural Networks

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	1	3	2	1	0	0	2	0	0	1	1	0
<b>CO2</b>	3	2	1	3	2	3	0	1	2	0	0	2	1	1
<b>CO3</b>	3	3	1	3	2	1	0	1	2	0	0	1	1	1
<b>CO4</b>	3	2	1	3	0	1	0	1	0	0	0	2	1	1
<b>CO5</b>	3	1	1	3	2	2	0	0	2	0	0	1	1	0
<b>Avg</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>

**Course Code & Name:** 19AI6302 Big data Computing

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	2	1	0	2	0	0	1	0	1	1	3	1	0

<b>CO2</b>	3	2	2	0	1	0	0	1	0	1	0	1	0	0
<b>CO3</b>	3	2	1	0	3	0	0	1	0	1	0	2	1	0
<b>CO4</b>	3	2	3	0	2	0	0	1	0	1	1	1	1	1
<b>CO5</b>	3	2	3	0	1	0	0	1	0	1	1	1	1	0
<b>Avg</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>0</b>

**Course Code & Name:** 19AI6303 AI in Blockchain

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	2	1	0	0	0	0	0	0	2	3	3	2	1
<b>CO2</b>	3	2	1	2	1	0	0	0	0	1	3	1	3	0
<b>CO3</b>	3	2	1	1	1	0	0	0	0	2	0	2	1	0
<b>CO4</b>	3	2	1	0	0	0	0	0	0	1	1	1	2	1
<b>CO5</b>	3	2	1	0	0	0	0	0	0	2	1	1	1	0
<b>Avg</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>

**Course Code & Name:** 19AI6304 Human Machine Interaction

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	3	3	2	0	0	0	3	0	3	0	1	0
<b>CO2</b>	3	1	2	2	2	3	0	1	2	0	3	2	1	0
<b>CO3</b>	3	3	2	2	2	3	0	1	2	0	2	2	1	0
<b>CO4</b>	3	1	2	2	0	3	0	1	0	0	2	2	1	0
<b>CO5</b>	3	1	2	1	2	0	0	0	0	0	2	3	1	0
<b>Avg</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>0</b>

**Course Code & Name:** 19AI6306 Foundations Of Data Science

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	3	3	2	0	0	0	3	0	3	0	1	0
<b>CO2</b>	3	1	2	2	2	3	0	1	2	0	3	2	1	0

<b>CO3</b>	3	3	2	2	2	3	0	1	2	0	2	2	1	0
<b>CO4</b>	3	1	2	2	0	3	0	1	0	0	2	2	1	0
<b>CO5</b>	3	1	2	1	2	0	0	0	0	0	2	3	1	0
<b>Avg</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>0</b>

**Course Code & Name: 19IT6308 Web Development - I**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	2	0	0	2	0	0	0	0	0	1	2	3	0
<b>CO2</b>	3	2	1	0	1	0	0	0	0	0	0	3	2	0
<b>CO3</b>	3	2	0	0	3	0	0	0	0	1	0	2	0	0
<b>CO4</b>	3	3	1	0	0	0	0	0	0	0	1	2	0	0
<b>CO5</b>	3	3	0	0	0	0	0	0	0	1	1	3	1	0
<b>Avg</b>	<b>3</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>0</b>

**Course Code & Name: 19AI6401 Cyber Security and Intelligence**

<b>PO&amp; PSO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	3	3	1	3				1		1	2	2	3
<b>CO2</b>	3	3	3	1	3				1		1	2	2	3
<b>CO3</b>	3	2	3	2	3				1		2	2	2	3
<b>CO4</b>	3	3	3	1	3				1		1	2	2	3
<b>CO5</b>	3	3	3	1	3				1		1	2	2	3
<b>Avg</b>	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>1.2</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1.2</b>	<b>2</b>	<b>2</b>	<b>3</b>



Year	Sem	Course code & Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
I	II	22MA2103- Differential Equations And Linear Algebra	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2
		22PH2101- Basics of Material Science	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2
		22HE2151 - Effective Technical Communication	2	2.6	2.6	1.4	1.4	1	1	-	1	-	1.2	2	0	1
		22PH2151- Physics for Circuit Engineering	2.8	2.6	2.2	1.6	1.4	0	1	0.8	0.4	1.2	1.8	1.8	1.2	1.4
		22IT2253- Dynamic Web Design	1.4	1	1	0	0.6	0	0	0	0.4	0.4	0.6	1	0.6	1.4
		22ME2001- Engineering Practices	3	1	2	0	2	2	0	1	1	0	2	2	1	0
		22HE2071- Design Thinking	3	2	1	3	2	2	0	1	2	0	0	1	1	1
		22HE2072- Soft Skills and Aptitude 1	3	1	2	0	2	0	0	1	0	1	0	2	1	0
		22CS2253-Java Fundamentals	3	2.8	3	0.8	1	1	1.6	0	0.6	0	0.8	1.8	2	1.8

**DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**

**REGULATIONS 2019 WITH AMENMENDS**

**Mapping of Course Outcome and Programme Outcome:**



Year	Sem	Course code & Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2		
II	III	21MA3152 - Probability and Applied Statistics	2.8	2.8	2.8	2.8	2.8	-	-	-	-	-	-	2.6	2.4	2.6		
		21AI3201 - Data Structures and Algorithms	3	2.8	3	2	3	-	-	3	1	-	2	2	2	2	3	
		21AI3202 - Foundations of Artificial Intelligence	2	1.6	2.8	1	1.6	1.6	0.2	0	2	1.6	1.4	2	2	2.4	2	
		21AI3252 – Clean Coding and Devops	3	2.8	3	2	3	3	2	3	1	0.4	2	2	2	2	3	
		21AI3251 – Digital Principles and System Design	3	3	2	2	2	2	0	1	0	1	1	1	2	0	1	
		21AI3001 – Data Structures and Algorithms Laboratory	3	1	1	1	1	0	0	0	0	1	0	1	1	1	1	0
		21AI3002 – Artificial Intelligence Laboratory	3	2	0	0	0	1	0	0	0	0	0	1	2	1	0	
		19MC3191-Indian Constitution																
	IV	21AI4201 – Database Management System	2	1.6	1.4	0.6	1.2	-	-	-	-	-	-	-	1.4	2.4	-	
		21AI4202- Data Visualization	2.6	2.6	2.6	2.2	2	2	2.25	2	2.666667	2.666667	2.25	2.2	2.4	2.4		
		21AI4251– Operating Systems	2.8	1	1.2	0.6	0	0	2.4	0	1.2	0	1.8	1.2	3	0.4		
		21MA4105 - Discrete Mathematical Structures	2	2.6	2.4	1.4	1.4	-	-	-	-	-	1.6	2	2.4	2.4		



VI	19AI6201 Theory of Computation	1.4	0	1.2	1	1.4	1.2	0.8	1.4	2.4	1.8	1.6	1	0.2	0.2
	<b>19AI6202 DEVELOPMENT OF MACHINE LEARNING MODELS</b>	3	2	1	3	2	2	0	1	2	0	0	1	1	1
	19AI6203 Natural Language Processing	3	3	2.4	2	2	2	2	1	1.4	2	1.4	2.6	3	2.2
	<b>19AI6251-PREDICTIVE MODELING</b>	3	2	1	3	2	2	0	1	2	0	0	1	1	1
	19XX6401 - Open Elective- I														
	19AI63XX -Professional Elective- I														
	19AI6001 Natural Language Processing Lab	3.0	2.8	3.0	1.3	1.7	1.0	1.6	-	1.0	-	1.3	1.8	2.0	2.3
	19AI6801 Mini Project	3	1	1	1	1	0	0	0	1	0	1	1	1	0

**PROFESSIONAL ELECTIVE**

II	VI	<b>19AI6301</b> Neural Networks	3	2	1	3	2	2	0	1	2	0	0	1	1	1	
		19AI6302 Big data Computing	3	2	2	0	2	0	0	0	1	0	1	1	2	1	0
		19AI6303 AI in Blockchain	3	2	1	1	0	0	0	0	0	0	2	2	2	2	0
		19AI6304 Human Machine Interaction	3	2	2	2	2	2	0	1	1	1	0	2	2	1	0
		19AI6306 Foundations Of Data Science	3	2	2	2	2	2	0	1	1	1	0	2	2	1	0
		<b>19IT6308</b> Web Development - I	3	2	0	0	1	0	0	0	0	0	0	1	2	1	0

		<b>19AI6401</b> Cyber Security and Intelligence	3	2.8	3	1.2	3	0	0	0	1	0	1.2	2	2	3
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**Chairman - BoS**  
**AIML - HiCET**

  
**Dean (Academics)**  
**HiCET**