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

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST

HICET

IV Yr - AIML

CHOICE BASED CREDIT SYSTEM

Revised Curriculum and Syllabus for the odd semester

Academic year 2023-2024

(Academic Council Meeting Held on 19.06.2023)

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

Chairman - BoS
AIML - HiCET

Dean-Academics

Dean (Academics)
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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.

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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)

PSO1	An ability to apply advanced core AI technologies, to extract information and provide knowledge to intelligent decision-making systems and human-AI collaboration
PSO2	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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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)
Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu.

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS
CBCS PATTERN
UNDERGRADUATE PROGRAMMES
B.TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (UG)
REGULATION-2019
For the students admitted during the academic year 2020-2021 and onwards

SEMESTER I -20 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE1101	Technical English	HS	2	1	0	3	25	75	100
2	19MA1101R	Calculus	BS	3	1	0	4	25	75	100
THEORY & LAB COMPONENT										
3	19PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	19CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	19CS1152	Object oriented programming using Python	IC	2	0	2	3	50	50	100
6	19EC1154	Basics of Electron devices and Electric Circuits	ES	2	0	2	3	50	50	100
PRACTICAL										
7	19HE1071	Language Competency Enhancement Course - I	HS	0	0	2	1	100	0	100
MANDATORY										
8	19MC1191	Induction Program	MC	0	0	0	0	0	0	0
9	19HE1072	Career Guidance – Level I	EEC	2	0	0	0	100	0	100
10	19HE1073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
Total Credits				16	2	10	20	550	350	900

SEMESTER II – 22 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE2101	Business English for Engineers	HS	2	1	0	3	25	75	100
2	19MA2104	Differential Equations And Linear Algebra	BS	3	1	0	4	25	75	100
THEORY & LAB COMPONENT										
3	19PH2151	Material Science	BS	2	0	2	3	50	50	100
4	19CY2151	Environmental Studies	BS	2	0	2	3	50	50	100

5	19CS2153	Java Fundamentals	IC	2	0	2	3	50	50	100
6	19ME2154	Engineering Graphics	ES	1	0	4	3	50	50	100
PRACTICAL										
7	19ME2001	Engineering Practices	ES	0	0	4	2	50	50	100
8	19HE2071	Language Competency Enhancement Course - II	HS	0	0	2	1	100	0	100
MANDATORY										
9	19HE2072	Career Guidance – Level II	EEC	2	0	0	0	100	0	100
Total Credits				14	2	16	22	500	400	900

SEMESTER III -21 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19AI3201	Data Structures and Algorithms	PC	3	0	0	3	25	75	100
2	19AI3202	Foundations of Artificial Intelligence	PC	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
3	19MA3152	Probability and Applied Statistics	BS	3	0	2	4	50	50	100
4	19AI3251	Digital Principles and System Design	PC	3	0	2	4	50	50	100
5	19AI3252	Clean Coding and Devops	IC	3	0	2	4	50	50	100
PRACTICAL										
6	19AI3001R	Data Structures and Algorithms Laboratory	PC	0	0	3	1.5	50	50	100
7	19AI3002	Artificial Intelligence Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY										
8	19MC3191	Indian Constitution	MC	2	0	0	0	0	0	0
9	19HE3072	Career Guidance- Level III	EEC	2	0	0	0	100	0	100
10	19HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
Total Credits				20	0	12	21	500	400	900

SEMESTER IV -19 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA4105	Discrete Mathematical Structures	BS	2	1	0	3	25	75	100
2	19AI4201	Database Management System	PC	3	0	0	3	25	75	100
3	19AI4202	Data Visualization	IC	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
4	19AI4251	Operating Systems	PC	2	0	2	3	50	50	100
5	19AI4252	Introduction to Machine Learning	PC	3	0	2	4	50	50	100

PRACTICAL										
6	19AI4001R	Database Management System Laboratory	PC	0	0	3	1.5	50	50	100
7	19AI4002	Data Visualization Laboratory	IC	0	0	3	1.5	50	50	100
MANDATORY										
8	19MC4191	Value Education - Essence of Indian Traditional Knowledge	MC	2	0	0	0	0	0	0
9	19HE4072	Career Guidance- Level IV	EEC	2	0	0	0	100	0	100
10	19HE4073	Ideation Skills	EEC	1	0	0	0	100	0	100
Total Credits				18	1	10	19	475	425	900

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

SEMESTER VII-21 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19AI7201	Cloud Computing	PC	3	0	0	3	25	75	100
2	19AI7202	AI Analyst	IC	3	0	0	3	25	75	100
3	19AI7203	Ethics and Policy Issues in AI Computing	PC	3	0	0	2	25	75	100
3	19AI73**	Professional Elective- III	PE	3	0	0	3	25	75	100
4	19**74**	Open Elective II	OE	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
5	19AI7251	Deep Learning Techniques	PC	3	0	2	4	50	50	100
PRACTICAL										
6	19AI7001	Cloud Computing Laboratory	PC	0	0	3	1.5	50	50	100
7	19AI7901	Project Phase - I	PC	0	0	3	1.5	50	50	100
Total Credits				**17**	**0**	**8**	**21**	**275**	**525**	**800**

SEMESTER VIII-14 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19AI83**	Professional Elective- IV	PE	3	0	0	3	25	75	100
2	19AI83**	Professional Elective- V	PE	3	0	0	3	25	75	100
PRACTICAL										
3	19AI8901	Project Phase - II	EEC	0	0	16	8	100	100	200
Total Credits				6	0	16	14	150	250	400

Total Credits:165

LIST OF PROFESSIONAL ELECTIVES

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

PROFESSIONAL ELECTIVE III

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19AI7301	Computer Vision	3	0	0	3	25	75	100
19AI7302	Intelligent Multi Agent and Expert systems	3	0	0	3	25	75	100
19AI7303	Cognitive Systems	3	0	0	3	25	75	100
19AI7304	Quantum Computing	3	0	0	3	25	75	100
19AI7305	Web and Social media mining	3	0	0	3	25	75	100
19IT7307	Web Development - II	0	0	3	3	50	50	100

PROFESSIONAL ELECTIVE IV

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19AI8301	Computational Neuroscience	3	0	0	3	25	75	100
19AI8303	Network Science and Modeling	3	0	0	3	25	75	100
19AI8304	Reinforcement Learning	3	0	0	3	25	75	100
19AI8305	Stream Analytics	3	0	0	3	25	75	100
19AI8311	Advanced Social Networks	3	0	0	3	25	75	100
19IT8314	Web Development - III	0	0	3	3	50	50	100

PROFESSIONAL ELECTIVE V

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19AI8306	Soft Computing in Medical Diagnostics	3	0	0	3	25	75	100
19AI8307	Pattern Recognition Algorithms	3	0	0	3	25	75	100
19AI8308	Graph Analytics for Big Data	3	0	0	3	25	75	100
19AI8309	Optimization Techniques in ML	3	0	0	3	25	75	100
19AI8310	5G Network	3	0	0	3	25	75	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

List of Life Skill Courses under Open Elective

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19LSX401	General Studies for Competitive Examinations	3	0	0	3	25	75	100
19LSX402	Human Rights, Women Rights and Gender Equality	3	0	0	3	25	75	100
19LSX403	Indian Ethos and Human Values	3	0	0	3	25	75	100
19LSX404	Indian Constitution and Political System	3	0	0	3	25	75	100
19LSX405	Yoga for Human Excellence	3	0	0	3	25	75	100

CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	21	19	24	24	21	14	**165**

*** Student can earn extra credit 35 over and above the total credits**

Chairman BoS

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PRINCIPAL
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HINDUSTHAN COLLEGE OF ENGINEERING ACADEMIC COUNCIL Chairman

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7201	CLOUD COMPUTING	3	0	0	3

Course Objective

1. To understand the concept of cloud computing.
2. To visualizes the different clouds models with respect to services and cloud eco system.
3. To learn about cloud offering and cloud management.
4. To learn about different cloud enabling technologies.
5. To understand about different implementations of virtualizations, management software.

Unit	Description	Instructional Hours
I	**INTRODUCTION:** Introduction - Essentials - Benefits - Business and IT Perspective - Cloud and Virtualization - Cloud Services Requirements - Cloud and Dynamic Infrastructure - Cloud Computing Characteristics - Cloud Adoption. Cloud Models – Cloud Characteristics - Measured Service -Cloud deployment models Security in a Public Cloud - Public versus Private Clouds - Cloud Infrastructure Self Service.	9
II	**CLOUD SERVICES AND SOLUTIONS:** Principle Technologies - Cloud Strategy - Cloud Design and Implementation using SOA - Conceptual Cloud Model - Cloud Service Defined. Cloud Solutions - Introduction - Cloud Ecosystem - Cloud Business Process Management - Cloud Service Management - Computing on Demand (CoD) – Cloud sourcing.	9
III	**CLOUD OFFERINGS AND CLOUD MANAGEMENT:** Cloud Offerings - Information Storage, Retrieval, Archive and Protection – Cloud Analytics - Testing under Cloud - Information Security - Virtual Desktop Infrastructure - Storage Cloud. Cloud Management - Resiliency - Provisioning - Asset Management – Cloud Governance - High Availability and Disaster Recovery - Charging Models, Usage Reporting, Billing and Metering	9
IV	**CLOUD ENABLING TECHNOLOGIES:** Data center Technology – Virtualization Technology – Web Technology –Multitenant Technology – case study in AWS.	9
V	**CLOUD VIRTUALIZATION:** Virtualization Defined - Virtualization Benefits - Server Virtualization - Virtualization for x86 Architecture - Hypervisor Management Software - Logical Partitioning (LPAR) - VIO Server - Virtual Infrastructure Requirements - Storage virtualization - Storage Area Networks –Network Attached storage - Cloud Server Virtualization - Virtualized Data Center.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the concept of cloud computing.
CO2: Visualizes the different clouds models with respect to services and cloud eco system.
CO3: Knowledge of cloud offering and cloud management.
CO4: Understand the different cloud enabling technologies.
CO5: Understand about different implementations of virtualizations, management software.

TEXT BOOKS:

T1: Dr.Kumar Saurabh, Cloud Computing, Second Edition,Wiley-India,2012

T2: Thomas Erl, Zaigham Mahmood, Ricardo Puttini, —Cloud Computing: Concepts, Technology and Architecturel, Prentice Hall Service Technology Series

REFERENCE BOOKS:

R1: David Marshall, Wade A. Reynolds, - Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006

R2: Chris Wolf, Erick M. Halter, - Virtualization: From the Desktop to the Enterprise, Apress 2005

R3 Danielle Ruest, Nelson Ruest - Virtualization: A Beginner"s Guide, TMH, 2009

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7202	AI ANALYST	3	0	0	3

Course Objective

1. To Familiarize the students about the evolution and relevance of AI in the world today.
2. Analyze existing and future implementations of AI solutions across multiple industries.
3. Discuss AI technology building blocks, including: natural language processing, machine and deep learning, neural networks, virtual agents, autonomics and computervision.
4. Develop a deeper understanding of machine learning techniques and the algorithm
5. Understanding the ethics and future workforce in AI

Unit	Description	Instructional Hours
I	**AI LANDSCAPES:** Definition and brief history of AI - AI Explained- AI Technologies -AI Industry Impact - Autonomous Vehicles - Smart Robotics — Goals and applications of AI - Problem-solving techniques in AI	9
II	**INTRODUCTION TO MACHINE LEARNING:** Types and approaches of ML - Different ML algorithms - Basics of neural networks - evaluating a machine learning model - Introduction to IBM Watson - IBM Watson services offerings - capabilities of each Watson service - Introduction to IBM Watson Studio	9
III	**NATURAL LANGUAGE PROCESSING:NLP** Definition and scope of NLP - Applications of NLP - Challenges and limitations in NLP- Text Preprocessing- Tokenization - Stemming and Lemmatization - Language Modeling – N-gram modelling – Text Classification – Named Entity Recognition	9
IV	**COMPUTER VISION & DEEP LEARNING:** Computer Vision Overview- AI Vision through Deep Learning - Computer Vision for the Enterprise - Deep Learning Explained - Deep learning ecosystem	9
V	**FUTURE TRENDS FOR AI:** Evolution of AI and its current state - Overview of the impact of AI on various industries - Ethical issues and challenges in AI - Bias and fairness in AI algorithms - Responsible AI development practices - AI and Automation in the Workplace - AI and Automation in the Workplace - AI in Smart Cities and IoT	9
	Total Instructional Hours	**45**

Course Outcome

- CO1: Recognize various machine learning techniques utilized in designing AI systems and applications to address real-world problems.
- CO2: Utilize these techniques in applications that involve perception, reasoning, and learning
- CO3: Perform analysis and design of a real-world problem to facilitate implementation and gain comprehension of the dynamic behavior of a system.
- CO4: Explain the role of agents and how it is related to the environment and the way of evaluating it and how agents can act by establishing goals
- CO5: Acquire the knowledge of real-world Knowledge representation

TEXT BOOKS:

T1 :IBM Courseware

REFERENCE BOOKS:

R1: Artificial Intelligence: A Modern Approach - Stuart Russell and Peter Norvig
R2: Deep Learning- Ian Goodfellow, Yoshua Bengio, and Aaron Courville
R3: Pattern Recognition and Machine Learning - Christopher M. Bishop

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7203	Ethics and Policy Issues in AI Computing	2	0	0	2

Course Objective

1.Be familiar with the Current Initiatives in AI and Ethics
2.Discussed about the frameworks and models of AI
3.Demonstrate understanding of different grades of AI systems and their ethical implications
4.Understanding of perspectives and approaches of AI ethics.
5.To be familiar with the applications and use cases of AI.

Unit	Description	Instructional Hours
I	**Introduction To Ethics Of AI:** Role of Artificial Intelligence in Human Life, Understanding Ethics, Why Ethics in AI? Ethical Considerations of AI, Current Initiatives in AI and Ethics, Ethical Issues with our relationship with artificial Entities	6
II	**Framework And Models:** AI Governance by Human-right centered design, Normative models, Role of professional norms, Teaching Machines to be Moral.	6
III	**Ethics of information and Ethics of AI:** Ethical issues - different strengths/grades of AI -AI algorithms- effects of its ontological differences.	6
IV	**Perspectives And Approaches:** Perspectives on Ethics of AI, Integrating ethical values and economic value, Automating origination, AI a Binary approach, Machine learning values, Artificial Moral Agents	6
V	**Cases And Application:** Ethics of Artificial Intelligence in Transport, Ethical AI in Military, Biomedical research, Patient Care, Public Health, Robot Teaching, Pedagogy, Policy, Smart City Ethics.	6
	Total Instructional Hours	**30**

Course Outcome

CO1: Understanding of role of AI in human life
CO2: Analyze about the framework and models of AI
CO3: Understanding of ethical information of AI
CO4: Exploring about the perspectives and approaches on ethics of AI
CO5: Understand about the real time applications of AI

TEXT BOOKS:

T1: Paula Boddington, —Towards a Code of Ethics for Artificial Intelligencel, Springer,2017

T2: Markus D. Dubber, Frank Pasquale, Sunit Das, —The Oxford Handbook of Ethics of AII, Oxford University Press Edited book, 2020

T3: S. Matthew Liao, —Ethics of Artificial Intelligencel, Oxford University Press Edited Book, 2020

REFERENCE BOOKS:

R1: Wallach, W., & Allen, C, —Moral machines: ceaching robots right from wrongl, OxfordUniversityPress,2008.

R2: Bostrom and E. Yudkowsky. —The ethics of artificial intelligencel. In W. M. Ramsey and K. Frankish, editors, The Cambridge Handbook of Artificial Intelligence, Cambridge University Press, Cambridge, 2014.

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7251	DEEP LEARNING TECHNIQUES	3	0	2	4

Course Objective

1. Remember the theoretical aspects Machine Learning and Math formulation
2. Understand the basics of Deep Learning and Neural Networks
3. Understand and Analyse the architecture of Deep Networks
4. Apply optimization strategies in Deep Learning Networks
5. Analyze various libraries and open source software for deep learning

Unit	Description	Instructional Hours
I	**A Review of Machine Learning** The Learning Machines- the Math behind Machine Learning-Techniques of Machine Learning: Regression-Classification-Clustering- Underfitting and Overfitting-Optimization-Gradient Descent-Logistic Regression-Evaluating Models- Case Study: Images segmentation – Object Detection. Illustrative Programs: Create a simple Neural Network Classifier Model on MNIST handwritten digital dataset using NumPy, Matplotlib and Keras Libraries-Implement YOLO algorithm to detect an object in an image input.	9+3
II	**Introduction to Deep Learning** Foundations of Neural Networks and Deep Learning: Neural Networks, Training Neural Networks: Backpropagation Learning- Importance of Activation Functions, Loss Functions and Hyper parameters- Fundamentals of Deep Networks: Definition of Deep Learning- Architectural Principles of Deep Networks- Building blocks of Deep Networks- Illustrative Programs: Implement Sentiment Analysis using Keras and TensorFlow Python libraries	9+3
III	**Architectures of Deep Learning Networks** Unsupervised Pretrained Networks-Convolutional Neural Networks (CNN)-Recurrent Neural Networks- Recursive Neural Networks- Case Study: Opinion Mining using Recurrent Neural Networks- Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks- Illustrative Programs: Build a CNN Image Classification Python Model to find whether the image consist of pneumonia.	9+3
IV	**Optimization of Deep Neural Networks** Optimization for Training Deep Models: How Learning Differs from Pure Optimization -Challenges in Neural Network Optimization - Basic Algorithms - Parameter Initialization Strategies - Algorithms with Adaptive Learning Rates - Approximate Second-Order Methods - Optimization Strategies and Meta-Algorithms- Case Study: Dialogue Generation with LSTMs- Illustrative Programs: Implement Time Series Forecasting with Deep Learning using PyTorch (LSTM-RNN).	9+3
V	**Python and Deep Learning** TensorFlow- Pytorch- NumPy- Scikit-Learn- Scipy- Pandas-Microsoft CNTK-Keras- Theano- MXNet- Features of Python Libraries in Deep Learning-Illustrative Programs: Implement an Opinion Mining in Recurrent Neural network- Implement a Transfer Learning concept in Image Classification.	9+3
	Total Instructional Hours	**45+15**

Course Outcome

CO1: Able to Remember the theoretical aspects Machine Learning and Math formulation
CO2: Able to Understand the basics of Deep Learning and Neural Networks
CO3: Able to Understand and Analyse the architecture of Deep Networks
CO4: Able to Apply optimization strategies in Deep Learning Networks
CO5: Able to Analyze various libraries and open source software for deep learning

TEXT BOOKS:

T1: Josh Patterson & Adam Gibson , Deep Learning A Practitioner's Approach, O'reilly, 2017.

T2: Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.

T3: Francois Chollet, "Deep Learning with Python", Manning Publications, 2018.

REFERENCE BOOKS:

R1: Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress, 2017.

R2: Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018.

R3. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.

R4. Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7001	CLOUD COMPUTING LABORATORY	0	0	3	1.5

Course Objective

1. To configure various virtualization tools such as Virtual Box, VMware workstation.
2. To design and deploy a web application in a PaaS environment.
3. To learn how to simulate a cloud environment to implement new schedulers.
4. To install and use a generic cloud environment that can be used as a private cloud.
5. To manipulate large data sets in a parallel environment.

S. No.	Description of the Experiments
1.	Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2.	Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3.	Install Google App Engine. Create hello world app and other simple web applications using python/java.
4.	Use GAE launcher to launch the web applications.
5.	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6.	Find a procedure to transfer the files from one virtual machine to another virtual machine.
7.	Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
8.	Install Hadoop single node cluster and run simple applications like wordcount.
	Total hours 45

Course Outcome

CO1: Configure various virtualization tools such as Virtual Box, VMware workstation.
CO2: Design and deploy a web application in a PaaS environment.
CO3: Learn how to simulate a cloud environment to implement new schedulers.
CO4: Install and use a generic cloud environment that can be used as a private cloud.
CO5: Manipulate large data sets in a parallel environment.

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PROFESSIONAL ELECTIVE III

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7301	COMPUTER VISION	3	0	0	3

Course Objective

1. Be familiar with the theoretical aspects of computing with images.
2. Have described the foundation of image formation, measurement, and analysis.
3. Have implemented common methods for robust image matching and alignment.
4. Have gained exposure to object and scene recognition, categorization from images.
5. To be familiar with the applications of Computer Vision.

Unit	Description	Instructional Hours
I	Introduction : What is Computer Vision-The Many facts of Computer Vision-Exploring the Computer Vision World – Image Formation-Images, Image Model, Image Devices for Computer Vision- Geometric primitives and Images-Photometric image formation-The digital camera-Light and Shading -Color	9
II	Image Processing-: Images and Imaging Operations-Point operators- linear filtering, neighbourhood operators, fourier transforms, Pyramids and wavelets - Geometric transformations - Global optimization .	9
III	Feature Detection and Matching – points and patches, edges, lines,-Segmentation - Active contours, Split and, Mean shift and mode finding-Feature-based Alignment – 2D, 3D feature-based alignment, pose estimation, Geometric intrinsic calibration,Image Stitching	9
IV	Dense motion estimation – Optical flow – layered motion, parametric motion, Structure from Motion- Recognition – object detection, face recognition, instance recognition, category recognition, Stereo Correspondence – Epipolar geometry, correspondence, 3D reconstruction-Shape from X, Active range finding, Surface representations, Point-based representations, Volumetric representations.	9
V	Applications: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians	9
	Total Instructional Hours	**45**

Course Outcome

- CO1: Understanding of the theoretical aspects of computing with images.
- CO2: Understand the foundation of image formation, measurement, and analysis.
- CO3: Understand the common methods for robust image matching and alignment.
- CO4: Exploring object and scene recognition, categorization from images.
- CO5: Understanding of various applications of Computer Vision.

TEXT BOOKS:

T1: Forsyth D. A. and Ponce J., "Computer Vision – A Modern Approach", Second Edition, Pearson Education, 2012.

T2: Szeliski R., "Computer Vision: Algorithms and Applications", Springer, 2010.

REFERENCE BOOKS:

R1: E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012
R2: D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7302	Intelligent Multi Agent and Expert systems	3	0	0	3

Course Objective

1.To learn the concept of how to learn patterns and concepts from data without being explicitly programmed

2.To know about Multi Agent in global Planning

3.To learn about knowledge based Agent to represents frame Representation.

4.To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances

5.To be familiar with the applications of Expert System

Unit	Description	Instructional Hours
I	Introduction : what is an agent?: agents and objects; agents and expert systems; agents and distributed systems; typical application areas for agent systems Intelligent Agents: the design of intelligent agents - reasoning agents (eg AgentO), agents as reactive systems (eg subsumption architecture); hybrid agents (eg PRS); layered agents (eg Interrap) a contemporary (Java-based) framework for programming agents (eg the Jack language, the JAM! system)	9
II	Multi-Agent Systems: Classifying multi-agent interactions - cooperative versus non-cooperative; zero-sum and other interactions; what is cooperation? how cooperation occurs - the Prisoner's dilemma and Axelrod's experiments; Interactions between self-interested agents: auctions & voting systems: negotiation; Interactions between benevolent agents: cooperative distributed problem solving (CDPS), partial global planning; coherence and coordination;	9
III	Knowledge Based Agent-Knowledge Representation-Knowledge Representation Techniques-Logical, Semantic ,Frame Representation, Production Rules-Propositional Logic –Rules of Inference – Inductive and Deductive Reasoning	9
IV	Artificial intelligence in Manufacturing-Artificial Intelligence in Civil Engineering, Artificial Intelligence in Gaming Industry-Artificial Intelligence in HR-Artificial intelligence in Medicine	9
V	Expert System- Components of Expert System-Why Expert System-Capabilities of Expert system-Applications of Expert System	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understanding of the theoretical aspects of computing with agents

CO2: Understand the foundation of multi agent system formation, measurement, and analysis.

CO3: Understand the common methods for Rules of Inference

CO4: Exploring real time applications in Industry

CO5: Understanding of various applications of Expert System

TEXT BOOKS:

T1: An Introduction to Multi Agent Systems - Second Edition. Michael Wooldridge (Wiley, 2009)

T2: Multiagent Systems by Gerhard Weiss, 2nd edition, The MIT Press

REFERENCE BOOKS:

R1: Programming Multi-agent Systems in Agent Speak Using Jason. Rafael H. Bordini, Jomi Fred Hubner and Michael Wooldridge (Wiley, 2007)

Website1: https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligent_systems.htm

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7303	COGNITIVE SYSTEMS	3	0	0	3

Course Objective

1. To know the theoretical background of cognition.
2. To understand the link between cognition and computational intelligence.
3. To explore probabilistic programming language.
4. To study the computational inference models of cognition.
5. To study the computational learning models of cognition.

Unit	Description	Instructional Hours
I	**PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE** Philosophy: Mental-physical Relation – From Materialism to Mental Science – Detour before the naturalistic turn – The Philosophy of Science – The Mind in Cognitive Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing – Neurosciences: Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.	9
II	**COMPUTATIONAL INTELLIGENCE** Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making – Decision making under Uncertainty – Learning – Language – Vision – Robotics.	9
III	**PROBABILISTIC PROGRAMMING LANGUAGE** WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration – Other basic computation.	9
IV	**IMPLEMENTING THE INFERENCE MODELS OF COGNITION** Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.	9
V	**IMPLEMENTING THE LEARNING MODELS OF COGNITION** Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models – Occam's Razor – Learning (Deep) Continuous Functions – Mixture Models.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the underlying theory behind cognition.
CO2: Connect to the cognition elements computationally.
CO3: Implement mathematical functions through WebPPL.
CO4: Develop a cognitive inference model.
CO5: Develop a cognitive learning model.

TEXT BOOKS:

T1: Robert A. Wilson, Frank C. Keil, "The MIT Encyclopedia of the Cognitive Sciences", The MIT Press, 1999.

REFERENCE BOOKS:

R1: Noah D. Goodman, Andreas Stuhlmuller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of book, https://dippl.org/.

R2: Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org/.

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7304	QUANTUM COMPUTING	3	0	0	3

Course Objective

1. To Study the structural units of quantum computers of the future, forming an understanding of the differences between quantum bits and classical bits.
2. To Study of basic quantum logical operations and algorithms for processing quantum information
3. To Master the basic knowledge about the practical use of quantum algorithms and quantum programming skills.
4. To Demonstrate quantum algorithms such as Shor's and Grover's search
5. To Analyze quantum algorithms including Deutsch's algorithm and Deutsch's-Jozsa algorithm . Quantum error correction and fault-tolerant computation.

Unit	Description	Instructional Hours
I	**Introduction to Quantum Computation** Quantum bits, Bloch sphere representation of a qubit, multiple qubits. Background Mathematics and Physics: Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.	9
II	**Quantum Circuits** single qubit gates, multiple qubit gates, design of quantum circuits.	8
III	**Quantum Information and Cryptography** Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.	10
IV	**Quantum Algorithms** Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Simon's algorithm, Shor factorization, Grover search.	9
V	**Noise and error correction** Graph states and codes, Quantum error correction three- and nine-qubit quantum codes, fault tolerant computation.	9
	Total Instructional Hours	45

Course Outcome

CO1: Understanding quantum computation
CO2: Understanding Hilber space, entanglement and basics of quantum mechanics
CO3: Comparision between classical and quantum information theory
CO4: Demonstrate quantum algorithms such as Shor's and Grover's
CO5: Analyzing quantum algorithms including Deutsch's algorithm and Deutsch's-Jozsa algorithm . Quantum error correction and fault-tolerant computation.

TEXT BOOKS:

T1: Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press. 2002

T2: Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 2004

REFERENCE BOOKS:

R1: Pittenger A. O., An Introduction to Quantum Computing Algorithms, 2000

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7305	WEB AND SOCIAL MEDIA MINING	3	0	0	3

Course Objective

1. To understand the social media mining and its essentials.
2. To understand network measures and network models in social media mining.
3. To understand data mining essentials, interactions and diffusion in social media.
4. To understand mining twitter, Facebook and web pages.
5. To understand Mining the Semantically Marked-Up Web and writing web crawlers.

Unit	Description	Instructional Hours
I	Introduction: What is Social Media Mining-New Challenges for Mining-Essentials: Graph Essentials-Graph Basics-Graph Representation-Types of Graphs-Connectivity in Graphs-Special Graphs-Graph Algorithms.	8
II	Network Measures: Centrality-Transitivity and Reciprocity-Balance and Status-Similarity-Network Models: Properties of Real-World Networks-Random Graphs-Small-World Model-Preferential Attachment Model.	9
III	Data Mining Essentials: Data-Data Preprocessing-Data Mining Algorithms-Supervised Learning-Unsupervised Learning-Communities and Interactions: Community Analysis-Community Detection-Community Evolution-Community Evaluation-Information Diffusion in Social Media: Herd Behavior-Information Cascades-Diffusion of Innovations-Epidemics.	10
IV	Mining Twitter: Overview-Why Is Twitter All the Rage?- Exploring Twitter's API-Analyzing the 140 Characters-Mining Facebook: Overview-Exploring Facebook's Social Graph API-Analyzing Social Graph Connections-Mining Web Pages: Overview-Scraping, Parsing, and Crawling the Web-Discovering Semantics by Decoding Syntax-Entity-Centric Analysis: A Paradigm Shift.	9
V	Mining the Semantically Marked-Up Web: Overview-Micro formats: Easy-to-Implement Metadata-From Semantic Markup to Semantic Web: A Brief Interlude-The Semantic Web: An Evolutionary Revolution-Writing Web Crawlers: Traversing a Single Domain-Crawling an Entire Site-Crawling Across the Internet.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understanding of the social media mining and its essentials.
CO2: Understand the network measures and network models in social media mining.
CO3: Understand the data mining essentials, interactions and diffusion in social media.
CO4: Understanding mining twitter, Facebook and web pages.
CO5: Understanding of Mining the Semantically Marked-Up Web and writing web crawlers.

TEXT BOOKS:

T1: Reza Zafarani, Mohammad Ali Abbasi and Huan Liu, "Social Media Mining", Cambridge University Press, April 20, 2014.
T2: Matthew A. Russell, "Mining the Social Web", Second Edition, O'Reilly, 2013.

REFERENCE BOOKS:

R1: Ryan Mitchell, "Web Scraping with Python", Second Edition, O'Reilly, 2020.
R2: Lam Thuy Vo, "Mining Social Media: Finding Stories in Internet Data", Paperback – Illustrated, 25 November 2019.
R3: Shalin Hai-Jew, "Social Media Data Extraction and Content Analysis", IGI Global, Hardcover Import, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI7401	BUSINESS ANALYTICS	3	0	0	3

Course Objective

1. Be familiar with the various aspects of Business analytics.
2. Use business analytics in decision-making.
3. To apply the appropriate analytics and generate solutions
4. Model and analyze the business situation using analytics.
5. To summarise about Enterprise reporting

Unit	Description	Instructional Hours
I	**BUSINESS VIEW OF IT, DIGITAL DATA:** Business Process, Baldrige Framework, IT in Business, IT Applications, Characteristics, Information users and their requirements, Digital Data – Introduction, Good Life Database, Structured Data, Unstructured Data, Semi-Structured Data	9
II	**OLTP AND OLAP, GETTING STARTED WITH BUSINESS INTELLIGENCE** OLTP,OLAP, OLAP Architectures, Data Models of OLTP and OLAP, Data Models, Role of OLAP tools, OLAP – Multidimensional Data, ERP Data, Decision Support, BI, Data, Definition, Purpose of BI, Evolution, Need for BI, Usage of BI, BI in various stages, Value Chain, Business Analytics	9
III	**BI DEFINITION, CONCEPTS, DATA INTEGRATION** BI Component Framework, Usage of BI, BI users, Applications of BI, BI Roles, Responsibilities, Practices , Skills for BI, BI tools, Data Warehouse, Goals, Data Mart, ODS, Approaches, Data Sources, Mapping , Staging, Data Integration (DI), DI Technologies, Data Quality, Data Profiling, Case Study	9
IV	**MULTIDIMENSIONAL DATA MODELING** Data Modeling, Types, Techniques, Fact Table, Dimension table, Models, Life cycle, Measures, Metrics, KPIs, Performance management	9
V	**ENTERPRISE REPORTING** Perspectives, Report, Enterprise Reporting, Scorecard, Dashboards, Creating Dashboards, Scorecard vs Dashboards, Different Analysis types, Statistics in analytics, Data description, Statistical tests, hypothesis and t-test Correlation, regression, ANOVA, F- test, Time Series Analysis, BI and cloud computing, BI for ERP systems.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: To understand the role of Business Analytics in decision making
CO2: Identify the appropriate tool for the analytics scenario
CO3: To apply the tools and generate solutions
CO4: Analyze & interpret the results
CO5: Summarise about enterprise reporting

TEXT BOOKS:

T1: R.N .Prasad and Seema Acharya ,"Fundamentals of Business Analytics",Wiley 2nd Edition, 2021

T2: James R. Evans, "Business Analytics-Methods, Models and Decisions ",Pearson Ed, 2012

REFERENCE BOOKS:

R1 Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, "Business Analytics Principles, Concepts, and Applications - What, Why, and How" , Pearson Ed, 2014

R2 Christian Albright S and Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", Fifth edition, Cengage Learning, 2015

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PROFESSIONAL ELECTIVE V

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	19AI8306	SOFT COMPUTING IN MEDICAL DIAGNOSTICS	3	0	0	3

Course Objective

1. To be familiar with the theoretical aspects of soft computing.
2. To have knowledge on neural networks.
3. To understand fuzzy networks.
4. To gain exposure on soft computing in medical diagnostics.
5. To be familiar with various applications of soft computing.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SOFT COMPUTING** Soft computing Constituents and Conventional Artificial Intelligence – Neural Networks and its advantages – Application Scope of Neural Networks – Hybrid Systems – Genetic Algorithm - Soft Computing	9
II	**NEURAL NETWORKS AND ITS TYPES** Artificial Neural Network -Terminologies of ANN – Supervised Learning Networks – Perceptron Networks – Back Propagation Network – Radial Basis Network – Unsupervised Learning Networks – Kohonen Self-organizing Feature Maps	9
III	**FUZZY NETWORKS** Fuzzy Logic – Extension Principles and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Inference Systems - Mamdami Fuzzy models – Adaptive Neuro-Fuzzy Inference Systems(Architecture, Algorithm, Learning methods) – CART Algorithm for Tree Induction	9
IV	**SOFT COMPUTING IN MEDICAL DIAGNOSTICS** Healthcare Data – Examples of AI in Healthcare – Virtual Assistants in Drug Development – Risk Assessment of Cervical Cancce in Women-Based on Convolutional Neural Network – Diagnosis of Depression using Neuro-Fuzzy Model of Soft Computing	9
V	**APPLICATIONS OF SOFT COMPUTING** A Fusion Approach of Multispectral Images with SAR Image for Flood Area Analysis – Genetic Algorithm Based Internet Search Technique – Issues in designing a genetic algorithm for internet search	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understanding basic idea of soft computing.
CO2: Understanding neural networks.
CO3: Understanding of fuzzy networks.
CO4: Understanding the application of soft computing in medical diagnostics.
CO5: Understanding various applications of soft computing.

TEXT BOOKS:

T1: Principles of Soft Computing – SN Sivanandam, SN Deepa., 2008

T2: Neuro- Fuzzy and Soft Computing – JSR Jang, CT Sun, E MIZUTANI, Original Edition

T3: Online Resource: https://www.researchgate.net/publication/355966759

REFERENCE BOOKS:

R1: Advanced Soft Computing Techniques in Data Science, IoT and Cloud Computing, Springer Cham.
R2: Introduction to Soft Computing- Neuro Fuzzy and Genetic Algorithms, Samir Roy, Udit Chakraborty

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	19AI8307	PATTERN RECOGNITION ALGORITHMS	3	0	0	3

Course Objective

1. To understand the Basic neural network architecture and algorithms
2. To analyse the fundamentals of pattern recognition and its application.
3. To understand several supervised and unsupervised algorithms suitable for pattern classification.
4. To Apply the Pattern and Neural Classifiers Concepts for classification applications.
5. To understand the various Graphical Approaches.

Unit	Description	Instructional Hours
I	**PATTERN RECOGNITION OVERVIEW** :Typical Pattern Recognition System, Patterns and Features Extraction, Training and Learning in Pattern Recognition system, Different types of Pattern Recognition Approaches – Statistical, Syntactic, Neural. Discriminant functions	9
II	**STATISTICAL PATTERN RECOGNITION** :Parametric estimation and supervised learning, Maximum likelihood estimation, Bayesian parameter estimation, Non-parametric approaches - Parzen window, k-NN estimation, Unsupervised Learning – Clustering Concepts.	9
III	**SYNTACTIC PATTERN RECOGNITION** :Grammar Based Approaches, Elements of Formal Grammars, Parsing Concepts – Parsing Algorithm, Transition Networks in Parsing, Higher Dimensional Grammars, Stochastic Grammars, Graphical Approaches – Graph Isomorphism, Attributed Graphs.	10
IV	**ARTIFICIAL INTELLIGENCE**: Introduction and historical perspective, Hard and Soft AI– disciplines and applications, Theories of Intelligence, Detecting and Measuring Intelligence, Knowledge based approach, the prepare-deliberate engineering trade-off, Procedural v/s Declarative knowledge, Criticism of symbolic AI, Knowledge representation, desirable properties of KR schemata, Use of predicate calculus in AI.	9
V	**EXPERT SYSTEMS:** Components of Expert Systems, Production rules, Backwards vs Forward reasoning, Statistical reasoning, Meta level knowledge, Introspection, Knowledge engineering case studies, Heuristic search of state space, DFS, BFS, UCS, choice of a search algorithm, Admissibility theorems, search performance metrics, AI programming environments. AI oriented language and architecture.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: A good knowledge of Pattern Recognition system
CO2: Fundamental understanding of classifiers such as linear discriminant function, quadratic discriminant function, nearest neighbor rule, neural network and SVM.
CO3: Ability to evaluate the performance of static pattern recognition.
CO4: A good understanding of feature selection algorithms.
CO5: Ability to evaluate the performance of various classifiers on real-world datasets.

TEXT BOOKS:

T1: O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.

T2: S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009

REFERENCE BOOKS:

R1: C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006 .

R2: P.A Devijver and J. Kittler, Pattern Recognition: A Statistical Approach, Prentice-Hall International, Englewood Cliffs, NJ, 1980.

R3: K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Ed. Academic Press, New York, 1990.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	19AI8308	GRAPH ANALYTICS FOR BIG DATA	3	0	0	3

Course Objective

1. To have knowledge on the statistical techniques for Big data Analytics.
2. To acquire understanding in mining data streams.
3. To Enable the students to know about clustering techniques.
4. To Usage of graph analytics and thus to provide solutions.
5. To learn about Hadoop map, Reduce programming.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO BIG DATA** Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.	9
II	**DATA ANALYSIS, CLUSTERING AND CLASSIFICATION** Regression Modelling - Multivariate Analysis - Bayesian Modelling – Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction. Overview of Clustering - K-means – Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions. - Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes 'Theorem - Naïve Bayes Classifier.	9
III	**STREAM MEMORY** Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.	9
IV	**ASSOCIATION AND GRAPH MEMORY** Advanced Analytical Theory and Methods: Association Rules - Overview – Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Finding Association& finding similarity - Graph Analytics for Big Data: Graph Analytics - The Graph Model - Representation as Triples - Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases – Graph Analytics Algorithms and Solution Approaches - Technical Complexity of Analyzing Graphs- Features of a Graph Analytics Platform.	9

V	**FRAMEWORKS AND VISUALIZATION** MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 – Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques; Systems and Analytics Applications - Analytics using Statistical packages-Approaches to modeling in Analytics – correlation, regression, decision trees, classification, association-Intelligence from unstructured information-Text analytics-Understanding of emerging trends and Technologies-Industry challenges and application of Analytics- Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply statistical techniques for Big data Analytics.
CO2: Analyze problems appropriate to mining data streams.
CO3: Apply the knowledge of clustering techniques in data mining.
CO4: Use Graph Analytics for Big Data and provide solutions
CO5: Apply Hadoop map Reduce programming for handing Big Data

TEXT BOOKS:

T1: David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
T2: Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press.
T3: Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.

REFERENCE BOOKS:

R1: EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
R2: Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and Its Applications", Wiley Publishers, 2015.
R3: Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers "CRC Press, 2015.

Chairman, Board of Studies

Chairman - BoS
AIML - HiCET

Dean – Academics

Dean (Academics)
HiCET

HINDUSTHAN ACADEMIC COUNCIL • HINDUSTHAN COLLEGE OF ENGG. & TECH. • Chairman

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	19AI8309	OPTIMIZATION TECHNIQUES IN ML	3	0	0	3

Course Objective

1.To learn about the basics of machine learning.

2.To learn about the optimization in ML.

3.To learn about unconstrained optimization in ML.

4.To learn about constrained optimization.

5.To learn about various algorithms optimization.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction: Basic principles, Applications, Challenges. Supervised learning: Linear Regression with one variable and multiple variables, Gradient Descent, Classification, Logistic Regression.	6
II	**OPTIMIZATION** Need for unconstrained methods in solving constrained problems, necessary conditions of unconstrained optimization, structure methods, quadratic models, methods of line search, steepest descent method; conjugate-direction methods: methods for sums of squares and nonlinear equations; linear programming: simplex methods, duality in linear programming, transportation problem.	10
III	**UNCONSTRAINED OPTIMIZATION** Line search method: Wolf condition, Goldstein condition, sufficient decrease and backtracking, Newtons method and Quasi Newton method; trust region method: the Cauchy point, algorithm based on Cauchy point, improving on the Cauchy point, the Dog-leg method, two-dimensional subspace reduction; nonlinear conjugate gradient method: the Fletcher Reeves method	10
IV	**CONSTRAINED OPTIMIZATION** Penalty method, quadratic penalty method, convergence, non-smooth penalty function, L1 penalty method, augmented Lagrangian method; quadratic programming, Schur complementary, null space method, active set method for convex QP; sequential quadratic programming, convex programming.	10
V	**ALGORITHMS OPTIMZATION** Gradient based techniques such as Adam, AdaGrad, AdaDelta, Gradient Descent (GD), Stochastic Gradient Descent (SGD) etc. Metaheuristic techniques such as Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Differential Evolution (DE).	9
	Total Instructional Hours	45

Course Outcome	CO1:	To understand the basics of machine learning
	CO2:	To understand the different types of optimization problems
	CO3:	To explain the working principles of optimization techniques
	CO4:	To use optimization techniques in various problems
	CO5:	To use optimization techniques in various algorithms

TEXT BOOKS:

T1: Chong, E. K. and Zak, S. H., An Introduction to Optimization, 2nd Ed., Wiley India (2001).

T2: Luenberger, D. G. and Ye, Y., Linear and Nonlinear Programming, 3rd Ed., Springer (2008).

REFERENCE BOOKS:

R1: Kambo, N. S., Mathematical Programming Techniques, East-West Press (1997).

R2: Boyd, S. and Vandenberghe, L., Convex Optimization, Cambridge Univ. Press (2004).

R3: Nocedel, J. and Wright, S. Numerical Optimization, Springer (2006).

Chairman, Board of Studies

Chairman - BoS
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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	19AI8310	5G NETWORK	3	0	0	3

Course Objective

1. To understand the basic concept of 5G.
2. To learn the available 5G Channel access methods.
3. To understand the Radio Access Technologies for 5G.
4. To be familiar with Channel Models for 5G.
5. To Gain knowledge about Enabling Technologies in wireless Communication.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO 5G** Introduction to 5G – Use Cases - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization - 3GPP and IMT2020 - Spectrum for 5G – 5G deployment - Options, Challenges and Applications.	9
II	**5G CHANNEL ACCESS METHODS** OFDM and OFDMA – MIMO OFDM – Generalized Frequency Division Multiplexing(GFDM) – Non-Orthogonal Multiple Access (NOMA) - Universal Filtered OFDM –Filter bank multicarrier (FBMC)- Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods	9
III	**RADIO ACCESS NETWORK FOR 5G NR** 5G NR requirements - 5G Core Network Architecture - Radio-Access Network (RAN)-Radio Protocol Architecture -User Plane Protocols-Radio Link Control - Medium-Access Control – Physical Layer functions -Control Plane Protocols - Network Slicing- RAN virtualization-Spectrum Management in 5G	9
IV	**CHANNEL MODELS FOR 5G NR** Channel Hierarchy in 5G NR – Logical Channels and Transport Channels in 5G NR - Physical Layer Data Channels in 5G NR - Downlink Physical Channel and Uplink Physical Channels - Propagation Channel models for 5G	9
V	**ENABLING TECHNOLOGIES FOR 5G** Device-to-Device (D2D) Communication - 5G for Massive Machine Type Communication and Massive IoT- V2X Communication - Full Duplex and Green Communication -mmWave Communications -Massive MIMO and Beamforming Techniques	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understanding the various 5G standards.
CO2: Analyse various channels access methods.
CO3: Understand the Radio Access Technologies in wireless Communication.
CO4: Exploring Channel models in 5G.
CO5: Understanding the various Communication Technologies.

TEXT BOOKS:

T1: Saad Z. Asif, "5G Mobile Communications Concepts and Technologies, CRC Press, 1st Edition, 2019.

T2: Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", John Wiley & Sons, 1st Edition, 2015.

REFERENCE BOOKS:

R1: Erik Dahlman, Stefan Parkvall, Johan Skold "5G NR: The Next Generation Wireless Access Technology", Academic Press, 1st Edition, 2018.

R2: D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.

R3: Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.

R4: R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, 1st Edition, 2017.

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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

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST

HICET

III - AML

CHOICE BASED CREDIT SYSTEM

Revised Curriculum and Syllabus for the odd semester

Academic year 2023-2024

(Academic Council Meeting Held on 19.06.2023)

CURRICULUM
R2019

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS
CBCS PATTERN
UNDERGRADUATE PROGRAMMES
B.TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (UG)
REGULATION-2019
For the students admitted during the academic year 2021-2022 and onwards

SEMESTER I -20 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE1101	Technical English	HS	2	1	0	3	40	60	100
2	21MA1101	Calculus	BS	3	1	0	4	40	60	100
THEORY & LAB COMPONENT										
3	21PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	21CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	21CS1152	Object oriented programming using Python	IC	2	0	2	3	50	50	100
6	21EC1154	Basics of Electron devices and Electric Circuits	ES	2	0	2	3	50	50	100
PRACTICAL										
7	21HE1001	Language Competency Enhancement Course - I	HS	0	0	2	1	100	0	100
MANDATORY										
8	21MC1191	Induction Program	MC	0	0	0	0	0	0	0
9	21HE1072	Career Guidance – Level I	EEC	2	0	0	0	100	0	100
10	21HE1073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
Total Credits				**16**	**2**	**10**	**20**	**580**	**320**	**900**

SEMESTER II – 22 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE2101	Business English for Engineers	HS	2	1	0	3	40	60	100
2	21MA2104	Differential Equations And Linear Algebra	BS	3	1	0	4	40	60	100
THEORY & LAB COMPONENT										
3	21PH2151	Material Science	BS	2	0	2	3	50	50	100
4	21CY2151	Environmental Studies	BS	2	0	2	3	50	50	100

5	21CS2153	Java Fundamentals	IC	2	0	2	3	50	50	100
6	21ME2154	Engineering Graphics	ES	1	0	4	3	50	50	100
PRACTICAL										
7	21ME2001	Engineering Practices	ES	0	0	4	2	60	40	100
8	21HE2001	Language Competency Enhancement Course - II	HS	0	0	2	1	100	0	100
MANDATORY										
9	21HE2072	Career Guidance – Level II	EEC	2	0	0	0	100	0	100
Total Credits				14	2	16	22	540	360	900

SEMESTER III -21 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
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
THEORY & LAB COMPONENT										
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
PRACTICAL										
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
MANDATORY										
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
THEORY										
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
THEORY & LAB COMPONENT										
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

SEMESTER V -24 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21AI5201	Computer Networks	PC	3	0	0	3	40	60	100
2	21AI5202	Data Analytics	PC	3	0	0	3	40	60	100
3	21HE5181	Management Information System	HS	3	0	0	3	40	60	100
4	21AI53**	Professional Elective- I	PE	3	0	0	3	40	60	100
THEORY & LAB COMPONENT										
5	21AI5251	Object Oriented Analysis and Design	PC	2	0	2	3	50	50	100
6	21AI5252	Introduction to Design Thinking	IC	2	0	2	3	50	50	100
PRACTICAL										
7	21AI5001	Networks Lab	PC	0	0	3	1.5	60	40	100
8	21AI5002	Data Analytics Lab	PC	0	0	3	1.5	60	40	100
9	21AI5701	MOOC / Industrial Training / Seminar	EEC	0	0	2	1	100	0	100
10	21HE5071	Soft Skills-I	EEC	1	0	0	1	100	0	100
11	21HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
Total Credits				**18**	**0**	**12**	**24**	**680**	**420**	**1100**

SEMESTER VI-24 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21AI6201	Theory of Computation	PC	3	0	0	3	40	60	100
2	21AI6202	Development of Machine Learning Models	IC	3	0	0	3	40	60	100
3	21AI6203	Natural Language Processing	PC	3	0	0	3	40	60	100
4	21AI63**	Professional Elective- II	PE	3	0	0	3	40	60	100
5	21**64**	Open Elective I	OE	3	0	0	3	40	60	100
THEORY & LAB COMPONENT										
6	21AI6251	Predictive Modeling	IC	3	0	2	4	50	50	100

PRACTICAL										
7	21AI6001	Natural Language Processing Lab	PC	0	0	3	1.5	60	40	100
8	21AI6801	Mini Project	EEC	0	0	3	1.5	50	50	100
9	21HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
10	21HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
Total Credits				20	0	8	24	560	380	1000

SEMESTER VII-21 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21AI7201	Cloud Computing	PC	3	0	0	3	40	60	100
2	21AI7202	AI Analyst	IC	3	0	0	3	40	60	100
3	21AI7203	Ethics and Policy Issues in AI Computing	PC	2	0	0	2	40	60	100
3	21AI73**	Professional Elective- III	PE	3	0	0	3	40	60	100
4	21**74**	Open Elective II	OE	3	0	0	3	40	60	100
THEORY & LAB COMPONENT										
5	21AI7251	Deep Learning Techniques	PC	3	0	2	4	50	50	100
PRACTICAL										
6	21AI7001	Cloud Computing Lab	PC	0	0	3	1.5	60	40	100
7	21AI7002	Data Visualization Lab	IC	0	0	3	1.5	60	40	100
Total Credits				17	0	8	21	370	370	800

SEMESTER VIII-14 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21AI83**	Professional Elective- IV	PE	3	0	0	3	40	60	100
2	21AI83**	Professional Elective- V	PE	3	0	0	3	40	60	100
PRACTICAL										
3	21AI8901	Project Work	EEC	0	0	16	8	100	100	200
Total Credits				6	0	16	14	180	220	400

Total Credits:165

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE I

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI5301	AI for Cyber Security	3	0	0	3	40	60	100
21AI5302	Internet of things	3	0	0	3	40	60	100
21AI5303	Advanced Machine Learning	3	0	0	3	40	60	100
21AI5304	Introduction to Robotics	3	0	0	3	40	60	100
21AI5305	Bioinformatics	3	0	0	3	40	60	100
21AI5306	Computer Architecture and Organization	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE II

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI6301	Neural Networks	3	0	0	3	40	60	100
21AI6302	Big data Computing	3	0	0	3	40	60	100
21AI6303	AI in Blockchain	3	0	0	3	40	60	100
21AI6304	Human Machine Interaction	3	0	0	3	40	60	100
21AI6305	Social Networks	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE III

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI7301	Computer Vision	3	0	0	3	40	60	100
21AI7302	Intelligent Multi Agent and Expert systems	3	0	0	3	40	60	100
21AI7303	Cognitive Systems	3	0	0	3	40	60	100
21AI7304	Quantum Computing	3	0	0	3	40	60	100
21AI7305	Web and Social media mining	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE IV

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI8301	Computational Neuroscience	3	0	0	3	40	60	100
21AI8302	Data Science	3	0	0	3	40	60	100
21AI8303	Network Science and Modeling	3	0	0	3	40	60	100
21AI8304	Reinforcement Learning	3	0	0	3	40	60	100
21AI8305	Stream Analytics	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE V

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI8306	Soft Computing in Medical Diagnostics	3	0	0	3	40	60	100
21AI8307	Pattern Recognition Algorithms	3	0	0	3	40	60	100
21AI8308	Graph Analytics for Big Data	3	0	0	3	40	60	100
21AI8309	Optimization in ML	3	0	0	3	40	60	100
21AI8310	5G Network	3	0	0	3	40	60	100

OPEN ELECTIVE

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI6401	Cyber Security and Intelligence	3	0	0	3	40	60	100
21AI7401	Business Analytics	3	0	0	3	40	60	100

List of Life Skill Courses under Open Elective

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21LSX401	General Studies for Competitive Examinations	3	0	0	3	40	60	100
21LSX402	Human Rights, Women Rights and Gender Equality	3	0	0	3	40	60	100
21LSX403	Indian Ethos and Human Values	3	0	0	3	40	60	100
21LSX404	Indian Constitution and Political System	3	0	0	3	40	60	100
21LSX405	Yoga for Human Excellence	3	0	0	3	40	60	100

As per the AICTE guideline, in Semester I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Students who will be enrolled his name in HICET NCC are eligible to undergo these subjects. Earned extra credits printed in the Consolidated Mark sheet as per the regulation. NCC course level 1 & Level 2 will be added in the open elective subject in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.

Semester	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	NCC General and National Integration	1	0	0	1	100	0	100
2	Social services and community development	1	0	0	1	100	0	100
3	General awareness, communication and Aero engines	1	0	0	1	100	0	100

VERTICALS FOR MINOR DEGREE

Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.

AIML OFFERING MINOR DEGREE

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21AI5601	Sem 5: Data structures using C Programming	MDC	3	0	0	3	3
2	21AI6601	Sem 6: Introduction to Databases	MDC	3	0	0	3	3
3	21AI6602	Sem6: Foundation of Artificial Intelligence & Machine Learning	MDC	3	0	0	3	3
4	21AI7601	Sem 7: Introduction to Robotics	MDC	3	0	0	3	3
5	21AI7602	Sem 7: Natural Language Processing	MDC	3	0	0	3	3
6	21AI8601	Sem 8: Deep Learning -Principles& Practices	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I
Fintech and Block Chain

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CS5602	Financial Management	MDC	3	0	0	3	3
2	21XXXX	Fundamentals of Investment	MDC	3	0	0	3	3
3	21XXXX	Banking, Financial Services and Insurance	MDC	3	0	0	3	3
4	21XXXX	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	21XXXX	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	21XXXX	Introduction to Fintech	MDC	3	0	0	3	3

Vertical II
Entrepreneurship

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21BA5601	Foundations of Entrepreneurship	MDC	3	0	0	3	3
2	21XXXX	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
3	21XXXX	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
4	21XXXX	Principles of Marketing Management For Business	MDC	3	0	0	3	3
5	21XXXX	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
6	21XXXX	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical III Environment and Sustainability

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CE5602	Sustainable infrastructure Development	MDC	3	0	0	3	3
2	21XXXX	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	21XXXX	Sustainable Bio Materials	MDC	3	0	0	3	3
4	21XXXX	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	21XXXX	Green Technology	MDC	3	0	0	3	3

6	21XXXX	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

B. TECH (HONS) AI & ML

Vertical I ROBOTICS	Vertical II BLOCK CHAIN TECHNOLOGY	Vertical III CYBER PHYSICAL SYSTEMS
Sem 5: 21AI5203 Foundations of Robotics	Sem 5: 21AI5204 Public Key Infrastructure and Trust Management	Sem 5: 21AI5205 Cyber Physical Systems
Sem 6: 21AI6204 Sensors and Actuators	Sem 6: 21AI6206 Introduction to block chain	Sem 6: 21AI6208 Communication for CPS
Sem 6: 21AI6205 Robots, bots and communication	Sem 6: 21AI6207 Cryptocurrency	Sem 6: 21AI6209 CPS System Design
Sem 7 21AI7204 Human-Robot Interaction	Sem 7 21AI7206 Smart Contracts and Solidity	Sem 7 21AI7208 CPS for Internal and External Security
Sem 7: 21AI7205 Medical Robotics	Sem 7 21AI7207 Block chain and distributed ledger technology	Sem 7 21AI7209 Biomedical Instrumentation for Cyber Physical Systems
Sem 8: 21AI8201 Fundamentals of Autonomous Systems	Sem 8: 21AI8202 Bitcoin Essentials and Use-Cases	Sem 8: 21AI8203 Security and Privacy of CPS

B. TECH (HONS) AI & ML SPECIALIZATION WITH ROBOTICS

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21AI5203	Sem 5: Foundations of Robotics	PC	3	0	0	3	3
2	21AI6204	Sem 6: Sensors and Actuators	PC	3	0	0	3	3
3	21AI6205	Sem 6: Robots, bots and communication	PC	3	0	0	3	3
4	21AI7204	Sem 7: Human-Robot Interaction	PC	3	0	0	3	3
5	21AI7205	Sem 7: Medical Robotics	PC	3	0	0	3	3
6	21AI8201	Sem 8: Fundamentals of Autonomous Systems	PC	3	0	0	3	3

B. TECH (HONS) AI & ML SPECIALIZATION WITH BLOCK CHAIN

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21AI5204	Sem 5: Public Key Infrastructure and Trust Management	PC	3	0	0	3	3
2	21AI6206	Sem 6: Introduction to block chain	PC	3	0	0	3	3
3	21AI6207	Sem 6: Cryptocurrency	PC	3	0	0	3	3
4	21AI7206	Sem 7: Smart Contracts and Solidity	PC	3	0	0	3	3
5	21AI7207	Sem 7: Block chain and distributed ledger technology	PC	3	0	0	3	3
6	21AI8202	Sem 8: Bitcoin Essentials and Use-Cases	PC	3	0	0	3	3

B. TECH (HONS) AI & ML SPECIALIZATION WITH CYBER PHYSICAL SYSTEMS

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21AI5205	Sem 5: Cyber Physical Systems	PC	3	0	0	3	3
2	21AI6208	Sem 6: Communication for CPS	PC	3	0	0	3	3
3	21AI6209	Sem 6: CPS System Design	PC	3	0	0	3	3
4	21AI7208	Sem 7: CPS for Internal and External Security	PC	3	0	0	3	3
5	21AI7209	Sem 7: Biomedical Instrumentation for Cyber Physical Systems	PC	3	0	0	3	3
6	21AI8203	Sem 8: Security and Privacy of CPS	PC	3	0	0	3	3

CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	21	19	24	24	21	14	165

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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI5201	COMPUTER NETWORKS	3	0	0	3

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	**OVERVIEW & PHYSICAL LAYER** Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission Media – Switching – Circuit-switched Networks – Packet Switching.	9
II	**DATA LINK LAYER** 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	**NETWORK AND ROUTING** 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	**TRANSPORT LAYER** 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	**APPLICATION LAYER** 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
Total Instructional Hours		**45**

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.

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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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21AI5202	DATA ANALYTICS	3	0	0	3

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
I	**Introduction to Analytics** 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
II	**Introduction to Data Understanding and Preprocessing** 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
III	**Mathematical and Scientific applications for Data Analysis** 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
IV	**Analysing Web Data** Data wrangling, Web scrapping, Combing and merging data sets, Reshaping and pivoting, Data transformation, String Manipulation, case study for web scrapping.	8
V	**Model Development and Evaluation** Model development using Linear Regression, Model Visualization, Prediction and Decision Making, Model Evaluation: Over-fitting, Under-fitting and Model Selection	10
	Total Instructional Hours	**45**

Course Outcome

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 analysi.
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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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21HE5181	Management Information System	3	0	0	3

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.

Unit	Description	Instructional hours
I	**INTRODUCTION** 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	**SYSTEM ANALYSIS AND DESIGN** 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	**INFORMATION SYSTEMS** 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	**TECHNOLOGY OF INFORMATION SYSTEM** 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	**TRANSACTION PROCESSING AND SUPPORT SYSTEM** Transaction processing system – Office automation systems – Decision support systems –Executive information systems – Artificial intelligence and Expert systems.	9
	Total Instructional Hours	**45**

Course Outcome

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.

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.	21AI5251	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	**UNIFIED PROCESS AND USE CASE DIAGRAMS** 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. *Illustrative Programs: Document the Software Requirements Specification (SRS) for the Student information system.*	6+3
II	**STATIC UML DIAGRAMS** Class Diagram— Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition - When to use Class diagrams. *Illustrative Programs: 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.*	6+3
III	**DYNAMIC AND IMPLEMENTATION UML DIAGRAMS** Dynamic Diagrams – UML interaction diagrams - System sequence diagram – Collaboration diagram – When to use Communication Diagrams - State machine diagram and Modeling –When to use State Diagrams - Activity diagram – When to use activity diagrams - Implementation Diagrams - Component and Deployment Diagrams – When to use Component and Deployment diagrams. *Illustrative Programs: 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.*	6+3
IV	**DESIGN PATTERNS** 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. *Illustrative Programs: Improve the reusability and maintainability of the software system by applying appropriate design pattern*	5+4
V	**TESTING** Object Oriented Methodologies – Software Quality Assurance – Impact of object orientation on Testing – Develop Test Cases and Test Plans *Illustrative Programs: Implement the modified system and test it for various scenarios*	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 Developmentl, Third Edition, Pearson Education, 2005.
T2: Ali Bahrami - Object Oriented Systems Development - McGraw Hill International Edition - 1999

REFERENCE BOOKS:

R1: Erich Gamma, a n d Richard Helm, Ralph Johnson, John Vlissides, —Design patterns: Elements of Reusable
Object-Oriented Softwarel, Addison-Wesley, 1995
R2: Erich Gamma, a n d Richard Helm, Ralph Johnson, John Vlissides, —Design patterns: Elements of Reusable
Object-Oriented Softwarel, 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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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI5001	NETWORKS LABORATORY	0	0	3	1.5

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.	Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
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.	Simulation of DNS using UDP sockets.
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

Course Outcome

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

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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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21AI5002	DATA ANALYTICS LABORATORY	0	0	3	1.5

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
3	Preparing Data 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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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech.	21HE5072	DESIGN THINKING	1	0	0	1

Course Objective

- To expose students to the design process
- To develop and test innovative ideas through a rapid iteration cycle.
- To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
	DESIGN ABILITY	
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
	DESIGNING TO WIN	
II	Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	4
	DESIGN TO PLEASE AND DESIGNING TOGETHER	
III	Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	4
	DESIGN EXPERTISE	
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
	Total Instructional Hours	**15**

Course Outcome

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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SEMESTER - 5

HONOURS WITH SPECIALIZATION

(CYBER PHYSICAL SYSTEMS)

Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI5205	CYBER PHYSICAL SYSTEM	3	0	0	3

Course Objective

1. Obtain cyber physical systems fundamentals and principles knowledge as building blocks to promote further design and implementation of more complex real time systems.
2. Understand cyber physical systems design for synchronous model with specific case study for arm processor
3. In what way cyber physical systems are crucial for the optimal performance of asynchronous model
4. Comprehend the cyber physical systems design and implementation in dynamical models
5. Hybridization of cyber physical systems which will help the students to anticipate upcoming technologies
6. Gain overall understand of the cyber physical systems for that will suit practical, engineering and industrial needs

Unit	Description	Instructional Hours
I	**INTRODUCTION TO CYBER PHYSICAL SYSTEMS** Introduction- Cyber-Physical Systems Design Recommendations-Cyber-Physical System Requirements-Requirements Engineering-Interoperability-Real Time System-GPU Computing-internet Of Things (IOT)- Radio Frequency Identification Technology-Wireless Sensor Networks Technology-Powerline Communication-Ubiquitous Computing Fundamentals-CASE STUDY: Cyber Physical Vehicle Tracking System	9
II	**SYNCHRONOUS MODEL** Reactive Components-Variables, Valuations, And Expression-Execution, Extended-State Machines-Properties Of Components-Finite State Components-Combinational Components-Nondeterministic Components-Input Enabled Components-Task Graphs And Await Dependencies-Parallel Composition-Synchronous Designs-Synchronous Circuits-Synchronous Networks.	10
III	**ASYNCHRONOUS MODEL** Asynchronous Process-States, Internal Actions-Executions, Extended State Machines-Operation On Process-Asynchronous Design Primitives-Blocking Vs Non-Blocking Synchronization-Deadlocks-Shared Memory-Asynchronous Coordination Protocols-Reliable Transmission-Safety Specifications-Invariants Of Transition Systems.	8
IV	**DYNAMICAL SYSTEM** Continuous Time Model-Continuously Evolving Inputs And Outputs -Models With Disturbance-Composing Components Stability-Linear Systems Linearity-Solutions Of Linear Differential Equations Stability-Designing Controllers-Stabilizing Controller-PID Controllers-Analysis Techniques	8
V	**HYBRID SYSTEMS** Hybrid Dynamical Model-Hybrid Process, Process Composition-Zeno Behavior-Stability-Designing Hybrid Systems-Automated Guided Vehicle-Obstacle Avoidance With Multi Robot Coordination-Multi Hop Control Networks-Linear Hybrid Automata-Example Pursuit Game-Formal Model-Symbolic Reachability Analysis-Timed Automata	10
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the basics of cyber physical systems
CO2: Design synchronous models for Real Time applications
CO3: Design Asynchronous models for Real Time applications.
CO4: Develop Deep Understanding on selection of hardware and software's for designing dynamical systems
CO5: Design and implement cyber physical system and address the problems and limitations for real world problems.

TEXT BOOKS:

T1: Rajeev Alur, Principles Of Cyber Physical Systems, 1st Edition, MITPress 2015.

T2: Raj Rajkumar , "Cyber Physical Systems," 2nd Edition, Elsevier 2015 3. Edward D Lamie, "Computing Fundamentals Of Cyber Physical Systems " , 2nd Edition, Newnes Elsevier Publication.

REFERENCE BOOKS:

R1: "Introduction to Embedded Systems — A Cyber— Physical Systems Approach" - E. A. Lee, Sanjit Seshia

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HONOURS WITH SPECIALIZATION

(ROBOTICS)

Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI5203	FOUNDATIONS OF ROBOTICS	3	0	0	3

Course Objective

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.

Unit	Description	Instructional Hours
I	**INTRODUCTION AND ROBOT KINEMATICS** 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	**ROBOT DRIVES AND CONTROL** 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	**ROBOT SENSORS** 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	**ROBOT CELL DESIGN AND APPLICATION** 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	**ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS** 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
	Total Instructional Hours	**45**

Course Outcome

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

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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HONOURS WITH SPECIALIZATION

(BLOCKCHAIN TECHNOLOGY)

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	21AI5205	PUBLIC KEY INFRASTRUCTURE AND TRUST MANAGEMENT	3	0	0	3

Course Objective

1. To understand about public key technology and a public key infrastructure.
2. To Understand the relationship of identity management to PKI
3. To Understand the components of a public key infrastructure..
4. To Understand the issues related to Trust management mechanisms
5. To Understand Secure Crypto protocols like SSL and so on

Unit	Description	Instructional Hours
I	**INTRODUCTION** Uses of cryptography, the concept devil and Alice. Principle of Cryptography. PKCS standards IEEE P1363, Block cipher modes of operation and data transformation for asymmetrical algorithms, Data transformation for RSA algorithm, Cryptographic Protocols, Protocol properties, Attributes of cryptographic protocols.	9
II	**PUBLIC KEY INFRASTRUCTURE** Crypto Hardware and software, Smart cards, Universal Crypto interface, Real world attacks, Evaluation and certification, Public Key Infrastructure, PKI Works.	9
III	**DEVELOPING PKI** Directory service, Requesting certificate revocation information, Practical Aspects Of PKI Construction- The course of construction of PKI, Basic questions about PKI construction, The most important PKI suppliers.	9
IV	**IMPLEMENTATION** The internet and the OSI model The OSI model, Crypto standards for OSI Layers 1 and 2-Crypto extensions for ISDN (Layer 1), Cryptography in the GSM standard (Layer 1), Crypto extensions for PPP (Layer 2), Virtual private networks	9
V	**SECURE CRYPTO PROTOCOLS** IPsec and IKE, IPsec, IKE, SKIP, Critical assessment of IPsec, Virtu al private network with IPsec, SSL, TLS AND WTLS (Layer 4)SSL working method, SSL protocol operation, Successful SSL, Technical comparison between IPsec and SSL, WTLS.	9
	Total Instructional Hours	**45**

Course Outcome	CO1:	Distinguish between public key technology and a public key infrastructure.
	CO2:	Understand the relationship of identity management to PKI
	CO3:	Understand the components of a public key infrastructure..

	CO4:	Understand the issues related to Trust management mechanisms.
	CO5:	Understand Secure Crypto protocols like SSL and so on.

TEXT BOOKS:

1. Klaus schmeh:"Cryptography and public key infrastructure on the internet", 1st Edition, Allied Publishers, 2004.

2.Kaufman, Perlman and Speciner, "Network Security: Private Communication in a public world", Prentice Hall of India/ Pearson Education, New Delhi, 2004.

3.C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd

REFERENCE BOOK:

1. Wenbo Mao: "Modern Cryptography : theory and practice", 1st Edition, Pearson Education, 2005.

2.Behrouz Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", Tata McGraw Hill Publishing Company , New Delhi, 2010

3.Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2

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MINOR DEGREE IN AIML

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	21AI5601	DATA STRUCTURES USING C PROGRAMMING	3	0	0	3

Course Objective

1. Understand the fundamental concepts of Programming such as Pointers, Structures and union
2. Understand the concept of various linear data structures like Linked list
3. Understand the concept of stack and queue.
4. Understand the various non-linear data structures like binary tree, binary search tree, AVL
5. Understand graph algorithms for solving real world problems

Unit	Description	Instructional Hours
I	**FUNDAMENTAL CONCEPTS OF C PROGRAMMING** Pointers – Definition – Initialization – Pointers arithmetic. Structures and unions – definition – Structure within a structure – Union – Programs using structures and Unions – Storage classes, Pre-processor directives.	8
II	**LINKED LIST** Representation – Basic Operations – Types: Singly linked list – Doubly linked list – Circular linked list – Applications: Polynomial Addition, Sparse Matrices.	9
III	**STACK AND QUEUE** Stack: Array and Linked Stacks – Applications: Balancing Symbols, Expression conversion, Postfix evaluation, Recursion – Queue: Array and Linked Queue, Circular Queue – Double Ended Queue – Applications.	9
IV	**TREE** Tree Terminologies – Binary tree: Representation - Tree traversal: In-order, Pre-order, Post order, Level order – Binary Search Tree: Representation – Operations – AVL Tree – B-Tree – Applications: Expression tree.	9
V	**GRAPH AND HASHING** Graph: Terminologies – Representation of Graph - Graph traversal – Topological sort – Hashing: Hash table – Hash functions – Resolving Collision Techniques: Separate chaining – Open addressing – Double hashing.	10
	Total Instructional Hours	**45**

Course Outcome

CO1: Comprehend the working of linear data structures and identify their applications.

CO2: Apply recursion on specific applications

CO3: Understand the various tree data structures for efficient storage and retrieval of data.

CO4: Employ graph data structure for solving real world problems

CO5: Apply suitable methods for efficient data access through hashing

TEXT BOOKS:

T1: Mark A.Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2010.

T2: Reema Thareja, —Programming in C, Oxford University Press, Second Edition, 2016.

REFERENCE BOOKS:

R1: Aaron M. Tenenbaum, Yeedidyah Langsam, Moshe J. Augenstein, 'Data structures using C', Pearson Education, 2008.

R2: Stephen G. Kochan, "Programming in C", Fourth edition, Pearson Education, 2015.

R3: Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21AI5252	INTRODUCTION TO DESIGN THINKING	2	0	2	3

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
I	**DESIGN THINKING HISTORY AND OVERVIEW** 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.*Illustrative program:Listening and HMW*	9
II	**KEY HABITS** 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 *Illustrative program:USER RESEARCH and PRACTICE MAPPING INSIGHTS FROM USER RESEARCH*	7+2(P)
III	**USER RESEARCH AND MAKE** 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.*Illustrative program: PRACTICE IDEATION AND PRIORITIZATION,COLLABORATIVELY CONSOLIDATE STORYBOARDS*	5+4(P)
IV	**USER FEEDBACK AND TEACHING** 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.*Illustrative program:DEVELOP A SUMMARY HILL STATEMENT AND BUILD YOUR STORY BOARD AND HILL INTO A PROTOTYPE*	3+6(P)
V	**LOGISTICS AND APPLICATIONS** 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.*Illustrative program:PRACTICE TEACHING SELECTED SECTION AND USER FEEDBACK*	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
CO4: Students learn how to map insights from user research.

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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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI5301	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

Unit	Description	Instructional Hours
I	**INTRODUCTION TO CYBER SECURITY** 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
II	**MACHINE LEARNING SYSTEMS SECURITY** 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
III	**APPLYING AI METHODS TO NETWORK ATTACK DETECTION** 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
IV	**CYBER ATTACKS IN IOT ARCHITECTURE** 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
V	**BLOCKCHAIN-BASED CYBERSECURITY** 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
	Total Instructional Hours	**45**

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.

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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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI5302	Internet of Things	3	0	0	3

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

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTERNET OF THINGS** Definition & 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	9
II	**IOT NETWORK ARCHITECTURE AND DESIGN** 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	9
III	**DEVELOPING INTERNET OF THINGS** IoT Design Methodology, 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.	9
IV	**DATA ANALYTICS AND SECURING IOT** 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	9
V	**CASE STUDIES** 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	9
	Total Instructional Hours	**45**

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 Madisetti, "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.

REFERENCE BOOKS:

R1: Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

R2: Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, 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 CunoPfister ,2011

R4: Adrian McEwen &Hakim Cassimally ,"Designing the Internet of Things"- (Nov 2013) .

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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI5303	Advanced Machine Learning	3	0	0	3

Course Objective

1. To understand pattern classification algorithms to classify multivariate data.
2. To understand the Implementation of genetic algorithms
3. To gain knowledge about Q-Learning
4. To create new machine learning techniques.
5. To understand reinforcement learning task.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Learning Problems Perspectives and Issues Concept Learning Version Spaces and Candidate eEliminations – Inductive bias – Decision Tree learning – Representation – Algorithm –Heuristic Space Search	9
II	**NEURAL NETWORKS AND GENETIC ALGORITHMS** 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	**BAYESIAN AND COMPUTATIONAL LEARNING** 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	**INSTANT BASED LEARNING** K- Nearest Neighbor Learning Locally weighted Regression Radial-Bases Functions – Case Based Learning.	9
V	**ADVANCED LEARNING** 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
	Total Instructional Hours	**45**

Course Outcome

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.

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. astie, 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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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI5304	Introduction to Robotics	3	0	0	3

Course Objective

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.

Unit	Description	Instructional Hours
I	**INTRODUCTION AND ROBOT KINEMATICS** 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	**ROBOT DRIVES AND CONTROL** 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	**ROBOT SENSORS** 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	**ROBOT CELL DESIGN AND APPLICATION** 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	**ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS** 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
	Total Instructional Hours	**45**

Course Outcome

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

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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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI5305	Bioinformatics	3	0	0	3

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.

Unit	Description	Instructional Hours
I	**NETWORK PROTOCOLS AND BIOLOGICAL DATABASES** 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	9
II	**STRING MATCHINGAND DYNAMIC PROGRAMMING** 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.	9
III	**DATABASE SEARCH ALGORITHMS** 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.	9
IV	**MOLECULAR PHYLOGENY ANALYSIS AND GENE PREDICTION** 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.	9
V	**STRUCTURE PREDICTION OF PROTEINS** 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, *ab initio* approach, threading method; Systems biology: Introduction to metabolic pathways; Introduction to computer aided drug design (CAD).	9
	Total Instructional Hours	**45**

Course Outcome

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. 2nd 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.	21AI5306	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
I	**BASIC STRUCTURE OF A COMPUTER SYSTEM** Functional Units –Basic Operational Concepts-Performance – Instructions: Language of the Computer – Operations, Operands – Representing Instructions– Logical operations – Decision making – MIPS Addressing.	9
II	**ARITHMETIC FOR COMPUTERS** Addition and Subtraction – Multiplication – Division – Floating Point- Floating Point Representation – Floating Point Operations – Sub-word Parallelism	9
III	**PROCESSOR AND CONTROL UNIT** Basic MIPS implementation – Building Datapath – Control Implementation Scheme – Pipelining –Pipelined Datapath and Control – Handling Data hazards & Control hazards – Exceptions	9
IV	**PARALLEL PROCESSORS** 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
V	**MEMORY AND I/O SYSTEMS** 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
	Total Instructional Hours	**45**

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

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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(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

II - AIML

CHOICE BASED CREDIT SYSTEM

Revised Curriculum and Syllabus for the odd semester

Academic year 2023-2024

(Academic Council Meeting Held on 19.06.2023)

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

SEMESTER I (Credit : 19)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
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	2	0	2	3	4	50	50	100
5	22IT1152	Introduction to Web Application Development	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
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
MANDATORY COURSES											
8	22MC1091/ 22MC1092	அறிவியல் தமிழ் / Indian Constitution	MC	2	0	0	0	2	100	0	100
			TOTAL	**16**	**1**	**8**	**19**	**26**	**480**	**320**	**800**

SEMESTER II (Credits – 22)											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA2103	Differential Equations And 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
THEORY WITH LAB COMPONENT											
4	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
5	22PH2151	Physics For Circuit Engineering Programme	BSC	2	0	2	3	4	50	50	100
6	22CS2253	Java Fundamentals	ICC	2	0	2	3	4	50	50	100
7	22IT2253	Dynamic Web Design	PCC	2	0	1	2	3	50	50	100
PRACTICAL											
7	22ME2001	Engineering Practices	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
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
MANDATORY COURSES											
10	22MC2091/ 22MC2092	தமிழர்மரபு/ *Heritage of Tamils*	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, inanyone of the personality and character development programmes and undergo training for about 80 hours							
			TOTAL	**18**	**1**	**12**	**22**	**29**	**630**	**370**	**1000**

SEMESTER III (Credits – 25)											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA3106	Discrete Mathematics	BSC	3	1	0	4	4	40	60	100
2	22AI3201	Data Structures	PCC	3	0	0	3	4	40	60	100
3	22AI3202	Foundations of Artificial Intelligence	PCC	3	1	0	4	4	40	60	100
4	22AI3203	Microprocessor and Embedded Systems	ESC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5	22AI3253	Clean Coding and Devops	ICC	3	0	2	4	4	50	50	100
PRACTICAL											
6	22AI3001	Microprocessor and Embedded Systems Laboratory	ESC	0	0	4	2	4	60	40	100
7	22AI3002	Foundations of Artificial Intelligence Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	22HE3071	Soft Skills And Aptitude -II	SEC	1	0	0	1	1	100	0	100
9	22AI3003	Data Structures Laboratory	AEC	0	0	4	2	4	60	40	100
10	22MC3191	Essence of Indian Traditional Knowledge	MC	2	0	0	0	2	100	0	100
			TOTAL	**18**	**2**	**14**	**25**	**34**	**590**	**410**	**1000**

SEMESTER IV (Credits – 23)											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2	22AI4201	Database Management Systems	PCC	3	1	0	4	3	40	60	100
3	22AI4202	Software Engineering	PCC	3	0	0	3	3	40	60	100
4	22AI4203	Data Visualization	ICC	3	0	0	3	3	40	60	100
5	22MA4102	Discrete Structures and Graph Theory	BSC	2	1	0	3	4	40	60	100
THEORY WITH LAB COMPONENT											
6	22AI4251	Operating Systems	PCC	2	0	2	3	4	50	50	100

PRACTICAL											
7	22AI4001	Database Management Systems Laboratory	PCC	0	0	4	2	4	60	40	100
8	22AI4002	Data Visualization Laboratory	ICC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9	22HE4071	Soft Skills -3	SEC	1	0	0	1	1	100	0	100
			TOTAL	**16**	**2**	**10**	**23**	**28**	**470**	**430**	**900**

SEMESTER V (Credits – 22)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22AI5201	Machine Learning Techniques-1	PCC	3	1	0	4	4	40	60	100
2	22AI5202	Computer Networks	PCC	3	0	0	3	3	40	60	100
3	22AI53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4	22AI53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5	22AI53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22AI5251	Introduction to Design Thinking	ICC	2	0	2	3	4	50	50	100
PRACTICAL											
7	22AI5001	Machine Learning Techniques-1 Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
			TOTAL	**18**	**1**	**6**	**22**	**25**	**410**	**390**	**800**

SEMESTER VI (Credits – 24)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22AI6201	Machine Learning Techniques-2	PCC	3	0	0	3	3	40	60	100
2	22HE6101	Professional Ethics	HSC	3	0	0	3	3	40	60	100
3	22AI63XX	Professional Elective-4/ AI ANALYST	PEC/ICC	3	0	0	3	3	40	60	100

4	22AI63XX	Professional Elective-5/ BUSINESS INTELLIGENCE	PEC/ICC	3	0	0	3	3	40	60	100
5	22AI64XX	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
6	22AI64XX	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
7	22CY6101	Environmental Studies	BSC	2	0	0	2	3	40	60	100
PRACTICAL											
8	22AI6001	Machine Learning Techniques-2 Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9	**22HE6071**	Soft Skills - 5	SEC	2	0	0	2	2	100	0	100
			TOTAL	**22**	**0**	**4**	**24**	**27**	**440**	**460**	**900**

SEMESTER VII (Credits – 20)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22AI7201	Big Data Analytics	PCC	3	0	0	3	3	40	60	100
2	22AI7202	Deep Learning	PCC	3	1	0	4	4	40	60	100
3	22AI73XX	Professional Elective-6 /Predictive Modeling	PEC/ICC	3	0	0	3	3	40	60	100
4	22XX74XX	Open Elective – 3*	OEC	3	0	0	3	3	40	60	100
5	22XX74XX	Open Elective – 4*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
6	22AI7001	Deep Learning Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
7	22AI7701	Internship - II*	SEC	0	0	0	2	2	100	0	100
			TOTAL	**15**	**1**	**4**	**20**	**22**	**360**	**340**	**700**

*** - Four weeks internship carries 2 credit and it will be done in before Semester VI summer vacation/placement training and same will be evaluated in Semester VII.**

SEMESTER VIII (Credits – 10)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
EEC COURSES (SE/AE)											
1	22AI8901	Project Work/Granted Patent	SEC	0	0	20	10	20	100	100	200
			TOTAL	**0**	**0**	**20**	**10**	**20**	**100**	**100**	**200**

Note:

1. As per the AICTE guideline, in Semester I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students' who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extracredits printed in the Consolidated Mark sheet as per the regulation.
2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
3. The above-mentioned NCC Courses will be offered to the Students who are going to be admitted in the Academic Year 2022 – 23.

SEMESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH.PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	3	-	2	-	-	25
3	ESC	6	2	5	-	-	-	-	-	13
4	PCC	-	5	13	17	12	5	9	-	61
5	PEC	-	-	-	-	9	6	3	-	18
6	OEC	-	-	-	-	-	6	6	-	12
7	EEC	3	3	3	1	1	2	2	10	25
8	MC	✓	✓							
	Total	19	22	25	23	22	24	20	10	165

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3

4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3

10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Biorefinery	OEC	3	0	0	3	3

Note: Non Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
3	22AI7401	Fundamentals Of Management For Engineers	OEC	3	0	0	3	3

OPEN ELECTIVE IV

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3

3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Data Science	Vertical II Full Stack Development	Vertical III Network And Cloud Computing	Vertical IV Cyber Security and Data Privacy	Vertical V Computer Vision And Virtual Reality	Vertical VI Emerging Technologies
22AI5301 Data Engineering	**22AI5304** Internet and Web Development	**22AI5307** Wireless Sensor Networks	**22AI5310** Ethical Hacking	**22AI5313** Computer Graphics and Multimedia	**22AI5316** Soft Computing
22AI5302 Information Retrieval Techniques	**22AI5305** UI and UX Design	**22AI5308** Cloud Computing	**22AI5311** Web and Android Security	**22AI5314** Image and video analytics	**22AI5317** Natural Language Processing
22AI5303 Data Science Tools And Techniques	**22AI5306** Mobile Application Development	**22AI5309** Cloud Storage infrastructure	**22AI5312** Modern Cryptography and Network Security	**22AI5315** Game Programming	**22AI5318** Quantum Computing
22AI6301 R Programming For Data Science	**22AI6303** Dev-ops	**22AI6305** Social and Information Networks	**22AI6307** Application of AI in Cyber Security	**22AI6309** Computer Vision	**22AI6311** Stream Analytics
22AI6302 Fuzzy logic and Neural Networks	**22AI6304** Web Application Security	**22AI6306** 5G Network	**22AI6308** Cyber Forensic & investigation	**22AI6310** Introduction to Augmented Reality	**22AI6312** 3D Printing and Design
22AI7301 Recommender Systems	**22AI7302** Middleware framework	**22AI7303** Cloud Security	**22AI7304** Digital and Mobile Forensics	**22AI7305** Virtual Reality	**22AI7306** Intelligent Multi Agent and Expert Systems

Note:
Students are permitted to choose all professional electives from any of the verticals.

Vertical I
Data Science

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	**22AI5301**	Data Engineering	PEC	3	0	0	3	3
2	**22AI5302**	Information Retrieval Techniques	PEC	3	0	0	3	3

3	22AI5303	Data Science Tools And Techniques	PEC	3	0	0	3	3
4	22AI6301	R Programming For Data Science	PEC	3	0	0	3	3
5	22AI6302	Fuzzy logic and Neural Networks	PEC	3	0	0	3	3
6	22AI7301	Recommender Systems	PEC	3	0	0	3	3

Vertical II
Full Stack Development

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5304	Internet and Web Development	PEC	3	0	0	3	3
2	22AI5305	UI and UX Design	PEC	3	0	0	3	3
3	22AI5306	Mobile Application Development	PEC	3	0	0	3	3
4	22AI6303	Devops	PEC	3	0	0	3	3
5	22AI6304	Web Application Security	PEC	3	0	0	3	3
6	22AI7302	Middleware Framework	PEC	3	0	0	3	3

Vertical III
Network And Cloud Computing

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5307	Wireless Sensor Networks	PEC	3	0	0	3	3
2	22AI5308	Cloud Computing	PEC	3	0	0	3	3
3	22AI5309	Cloud Storage infrastructure	PEC	3	0	0	3	3
4	22AI6305	Social and information Networks	PEC	3	0	0	3	3
5	22AI6306	5G Network	PEC	3	0	0	3	3
6	22AI7303	Cloud Security	PEC	3	0	0	3	3

Vertical IV
Cyber Security and Data Privacy

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5310	Ethical Hacking	PEC	3	0	0	3	3

2	22AI5311	Web and Android Security	PEC	3	0	0	3	3
3	22AI5312	Modern Cryptography and Network Security	PEC	3	0	0	3	3
4	22AI6307	Application of AI in Cyber Security	PEC	3	0	0	3	3
5	22AI6308	Cyber Forensic & investigation	PEC	3	0	0	3	3
6	22AI7304	Digital and Mobile Forensics	PEC	3	0	0	3	3

Vertical V
Computer Vision And Virtual Reality

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5313	Computer Graphics and Multimedia	PEC	3	0	0	3	3
2	22AI5314	Image and video analytics	PEC	3	0	0	3	3
3	22AI5315	Game Programming	PEC	3	0	0	3	3
4	22AI6309	Computer Vision	PEC	3	0	0	3	3
5	22AI6310	Introduction to Augmented Reality	PEC	3	0	0	3	3
6	22AI7305	Virtual Reality	PEC	3	0	0	3	3

Vertical VI
Emerging Technologies

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5316	Soft Computing	PEC	3	0	0	3	3
2	22AI5317	Natural Language Processing	PEC	3	0	0	3	3
3	22AI5318	Quantum Computing	PEC	3	0	0	3	3
4	22AI6311	Stream Analytics	PEC	3	0	0	3	3
5	22AI6312	3D Printing and Design	PEC	3	0	0	3	3
6	22AI7306	Intelligent Multi Agent and Expert Systems	PEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honors) or Minor Degree. For B.E. / B. Tech. (Honors), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For a minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

VERTICALS FOR MINOR DEGREE

Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.

AIML OFFERING MINOR DEGREE

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5231	Sem 5: Datastructures using C Programming	MDC	3	0	0	3	3
2	22AI6231	Sem 6: Introduction to Databases	MDC	3	0	0	3	3
3	22AI6232	Sem6: Foundation of Artificial Intelligence & Machine Learning	MDC	3	0	0	3	3
4	22AI7231	Sem 7: Introduction to Robotics	MDC	3	0	0	3	3
5	22AI7232	Sem 7: Natural Language Processing	MDC	3	0	0	3	3
6	22AI8231	Sem 8: Deep Learning -Principles& Practices	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I
Fintech and Block Chain

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22MB5231	Financial Management	MDC	3	0	0	3	3
2	22MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	22MB6232	Banking, Financial Services and Insurance	MDC	3	0	0	3	3
4	22MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	22MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	22MB8231	Introduction to Fintech	MDC	3	0	0	3	3

Vertical II
Entrepreneurship

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22MB5232	Foundations of Entrepreneurship	MDC	3	0	0	3	3
2	22MB6233	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
3	22MB6234	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
4	22MB7233	Principles of Marketing Management For Business	MDC	3	0	0	3	3
5	22MB72334	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
6	22MB8232	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical III
Environment and Sustainability

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CE5232	Sustainable infrastructure Development	MDC	3	0	0	3	3
2	22AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3

3	22BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3
4	22ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	22CE7233	Green Technology	MDC	3	0	0	3	3
6	22CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

B. TECH (HONS) AI & ML

Vertical I ROBOTICS	Vertical II BLOCK CHAIN TECHNOLOGY	Vertical III CYBER PHYSICAL SYSTEMS
22AI5204 Foundations of Robotics	22AI5205 Public Key Infrastructure and Trust Management	22AI5206 Cyber Physical Systems
22AI6203 Sensors and Actuators	22AI6205 Introduction to block chain	22AI6207 Communication for CPS
22AI6204 Robots, bots and communication	22AI6206 Cryptocurrency	22AI6208 CPS System Design
22AI7203 Human-Robot Interaction	22AI7205 Smart Contracts and Solidity	22AI7207 CPS for Internal and External Security
22AI7204 Medical Robotics	22AI7206 Block chain and distributed ledger technology	22AI7208 Biomedical Instrumentation for Cyber Physical Systems
22AI8201 Fundamentals of Autonomous Systems	22AI8202 Bitcoin Essentials and Use-Cases	22AI8203 Security and Privacy of CPS

B. TECH (HONS) AI & ML SPECIALIZATION WITH ROBOTICS

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5204	Sem 5: Foundations of Robotics	PC	3	0	0	3	3
2	22AI6203	Sem 6: Sensors and Actuators	PC	3	0	0	3	3
3	22AI6204	Sem 6: Robots, bots and communication	PC	3	0	0	3	3
4	22AI7203	Sem 7: Human-Robot Interaction	PC	3	0	0	3	3
5	22AI7204	Sem 7: Medical Robotics	PC	3	0	0	3	3
6	22AI8201	Sem 8: Fundamentals of Autonomous Systems	PC	3	0	0	3	3

B. TECH (HONS) AI & ML SPECIALIZATION WITH BLOCK CHAIN TECHNOLOGY

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5205	Sem 5: Public Key Infrastructure and Trust Management	PC	3	0	0	3	3
2	22AI6205	Sem 6: Introduction to block chain	PC	3	0	0	3	3
3	22AI6206	Sem 6: Cryptocurrency	PC	3	0	0	3	3
4	22AI7205	Sem 7: Smart Contracts and Solidity	PC	3	0	0	3	3
5	22AI7206	Sem 7: Block chain and distributed ledger technology	PC	3	0	0	3	3
6	22AI8202	Sem 8: Bitcoin Essentials and Use-Cases	PC	3	0	0	3	3

B. TECH (HONS) AI & ML SPECIALIZATION WITH CYBER PHYSICAL SYSTEMS

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5206	Sem 5: Cyber Physical Systems	PC	3	0	0	3	3
2	22AI6207	Sem 6: Communication for CPS	PC	3	0	0	3	3
3	22AI6208	Sem 6: CPS System Design	PC	3	0	0	3	3
4	22AI7207	Sem 7: CPS for Internal and External Security	PC	3	0	0	3	3
5	22AI7208	Sem 7: Biomedical Instrumentation for Cyber Physical Systems	PC	3	0	0	3	3
6	22AI8203	Sem 8: Security and Privacy of CPS	PC	3	0	0	3	3

Credit Distribution R2022

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

HINDUSTHAN ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Chairman BoS

Chairman - BoS
AIML - HiCET

Dean Academics

Dean (Academics)
HiCET

Principal

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	22MA3106	DISCRETE MATHEMATICS (AIML)	3	1	0	4

Course Objective

The learner should be able to

1. Introduce logical theory and proportional calculus techniques that will create logical thinking.
2. Generalize counting problems using mathematical induction, inclusion and exclusion principles.
3. Study the Boolean algebra which is used in the Boolean logics and circuits.
4. Apply formal mathematical methods to prove properties of languages, and Context free grammar.
5. To impart discrete knowledge in computer engineering through finite automata theory.

Unit	Description	Instructional Hours
I	**MATHEMATICAL LOGIC** Propositional logic - Tautology and Contradiction - Propositional equivalences - Normal forms - Principal normal forms - Theory of Inference.	12
II	**COMBINATORICS** Mathematical induction – Recurrence relations – Solving linear recurrence relations - generating functions – principle of inclusion and exclusion – applications.	12
III	**LATTICES AND BOOLEAN ALGEBRA** Lattices – Properties of lattices – Lattices as algebraic system – Sub lattices - some special lattices – Boolean algebra – Definition and simple properties.	12
IV	**FORMAL LANGUAGES** Languages and Grammars-Classification of Grammars-Pumping Lemma For Regular Languages-Context Free Languages, Push down automata and Turing machine.	12
V	**FINITE STATE AUTOMATA** Concepts of Automata Theory – Finite Automata – Types of finite Automata - Deterministic Finite State Automata(DFA), Non Deterministic Finite State Automata (NFA) – Transition Diagrams - Equivalence of DFA and NFA.	12
	Total Instructional Hours	**60**

Course Outcome

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

CO1: Study the notion of mathematical thinking, mathematical proofs, and algorithmic thinking and be able to apply them in problem solving.

CO2: Solve problems using counting techniques and recurrence relations.

CO3: Gain knowledge about Lattices and Boolean Algebra.

CO4: Understand the knowledge of formal languages like Compiler Design.

CO5: Understand the knowledge of finite automata theory and design discrete problems.

TEXT BOOKS:

T1 - Ralph. P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", Fifth Edition, Pearson Education Asia, Delhi, 2016.

T2-. , Kenneth H rosen , "Discrete Mathematics and its Application", Tata McGraw Hill,New Delhi,2018.

REFERENCE BOOKS :

R1 - Jean Paul Trembley ,RManohar, "Discrete Mathematical Structures with Application to Computer Science", McGraw Hill,Inc. New York, 30th reprint, 2008.

R2- Kenneth H.Rosen, "Discrete Mathematics and its Applications", seventh Edition,TataMcGraw Hill Pub.Co.Ltd.,New Delhi, 2013.

R3- John. C. Martin ,Introduction to Languages and the Theory of Computation, , Tata McGraw-Hill,

2003.
R4 - Hopcroft J.E and Ullman,J.D, "Introduction to Automata Theory, Languages and Computation", Narosa Publishing House, Delhi, 2002.
R5 - Jean-Paul Tremblay and R. Manohar – "Discrete Mathematical Structures with Applications to Computer Science" Tata – McGraw Hill Publications – 2008.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	22AI3201	DATA STRUCTURES	3	0	0	3

Course Objective

1. Understand the fundamental concepts of linear data structures
2. Comprehend the concept of various linear data structures like list, stack and queue.
3. Acquire the various non-linear data structures like binary tree, binary search tree, AVL, splay tree and red black tree.
4. Understand the concepts of Sorting, Searching and Hashing techniques
5. Apply graph algorithms for solving real world problems

Unit	Description	Instructional Hours
	FUNDAMENTALS OF DATA STRUCTURES AND LINKED LIST	
I	Introduction – Need for data structures – Types of data structures – List ADT-Single Linked List-Doubly Linked List-Circular Linked List- its operations.	9
	STACK AND QUEUE	
II	Stack: Array and Linked Stacks – Applications: Balancing Symbols, Expression conversion, Postfix evaluation – Queue: Array implementation of Queue and Linked list implementation of Queue, Circular Queue and its operations.	9
	TREES	
III	Tree ADT-Binary Tree-Tree Traversal Algorithms-Search Tree: Binary Search Tree-AVL Tree- B+ trees- Priority Queues- Binary Heap	9
	SEARCHING, SORTING AND HASHING	
IV	Searching: Linear search – Binary Search – Sorting: Insertion sort- Bubble sort – Selection sort – Merge sort-Quick sort- Hash Functions – Separate Chaining – Open Addressing: Linear Probing – Quadratic Probing – Double Hashing	9
	GRAPHS	
V	Definitions – Representation of Graphs – Types of Graph – Depth-first traversal – Breadth-first traversal – Topological Sort – Minimum Spanning Tree-Prim's Algorithm-Kruskal's Algorithms-Dijkstra's Shortest path algorithm	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Comprehend the working of linear data structures and identify their applications.

CO2: Acquire knowledge the most common abstractions for data collections (e.g., stacks, queues, lists).

CO3: Understand the various tree data structures for efficient storage and retrieval of data.

CO4: Apply Algorithms for solving problems like sorting and searching.

CO5: Employ graph data structure for solving real world problems

TEXT BOOKS:

T1: Mark A.Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2010.

T2: Reema Thareja, —Programming in C, Oxford University Press, Second Edition, 2016.

REFERENCE BOOKS:

R1: Aaron M. Tenenbaum, Yeedidyah Langsam, Moshe J. Augenstein, 'Data structures using C', Pearson Education, 2008.

R2: Stephen G. Kochan, "Programming in C", Fourth edition, Pearson Education, 2015.

R3: Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22AI3202	FOUNDATIONS OF ARTIFICIAL INTELLIGENCE	3	1	0	4

Course Objective

1. To understand concepts of Artificial Intelligence and characteristics of intelligent agents
2. To learn the different search strategies in AI
3. To understand various knowledge representation techniques
4. To understand the concepts of Planning and uncertainty
5. To learn the concepts of learning in AI

Unit	Description	Instructional Hours
I	**INTRODUCTION** 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.	12
II	**SEARCHING TECHNIQUES** 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.	12
III	**KNOWLEDGE REPRESENTATION** 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.	12
IV	**PLANNING AND UNCERTAINITY** 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.	12
V	**LEARNING** Learning from observation - Inductive learning - Decision trees - Explanaiion based learning - Statistical Learning methods - Reinforcement Learning Case Study: Chat bot System.	12
	Total Instructional Hours	**60**

Course Outcome

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.

TEXT BOOKS:

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

REFERENCE BOOKS:

R1: M.Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc., 1st Edition, 2008.

R2: David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", 2nd Edition, Cambridge University Press, 2010.

R3: Wolfgang Ertel, "Introduction to Artificial Intelligence", 1st Edition, Springer, 2017.

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22AI3253	CLEAN CODING AND DEVOPS	3	0	2	4

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
I	**INTRODUCTION TO CLEANCODING** 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)
II	**COMMENTS, FORMATTING AND OBJECTS** 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)
III	**INTRODUCTION TO DEV-OPS** 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)
IV	**ADVANCED DEV-OPS** 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)
V	**INTRODUCTION TO DEV-OPS ON CLOUD** 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)
	Total Instructional Hours	**(44 + 16) 60**

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.

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.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	22AI3203	MICROPROCESSOR AND EMBEDDED SYSTEMS	3	0	0	3

Course Objective

1. Study the Architecture of 8085 and 8086 microprocessor.
2. Learn the design aspects of I/O and Memory Interfacing circuits.
3. Study about communication and bus interfacing.
4. Study about overview of embedded systems
5. Analyze the various case studies to understand embedded system for a real time application

Unit	Description	Instructional Hours
I	**8086 MICROPROCESSOR** Introduction to Microprocessor – Architecture of Microprocessor 8085-Internal registers-Block diagram of 8085-Programmer's model of 8085-pin configuration of 8085-Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set – Assembly language programming – Modular Programming - Interrupts and interrupt service routines. Case study: I5 and I7 processors	9
II	**8086 SYSTEM BUS STRUCTURE** 8086 signals – Basic configurations – System bus timing –System design using 8086 – Introduction to Multiprogramming – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.	9
III	**I/O INTERFACING** Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer Interface – Keyboard /display controller – Interrupt controller – DMA controller.	9
IV	**EMBEDDED SYSTEMS AN OVERVIEW** Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES - Core of an Embedded System – All processor/controller, Memory, Sensors, Actuators – Communication Interface – Characteristics of Embedded system – Qualitative attributes of Embedded system	9
V	**RTOS BASED EMBEDDED SYSTEM DESIGN** Operating System basics - Types of operating systems - Task, process and threads - Task scheduling – Task communication - How to choose an RTOS - Integration and testing of Embedded hardware and firmware - Embedded system Development Environment: IDE, Cross compilation	9
	Total Instructional Hours	45

Course Outcome

CO1: Design and implement programs on 8086 microprocessor.
CO2: Design I/O circuits.
CO3: Design Memory Interfacing circuits.
CO4: Design and implement embedded systems
CO5: Design RTOS based embedded systems methodologies

TEXT BOOKS:

T1	Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", Prentice Hall of India, 2011.
T2	Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011
T3	Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlayt, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Pearson, Second Edition
T4	Shibu K V, Introduction to Embedded Systems, Tata McGraw Hill Education Private
T5	Microprocessor Architecture, Programming and Application with the8085, Ramesh S. Gaonakar, PenramLnternational Publishing, Mumbai, (2011).

REFERENCE BOOKS:

R1: Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2012
R2: A.K.Ray,K.M.Bhurchandi,"Advanced Microprocessors and Peripherals",3rd Edition,Tata McGrawHill,2012.
R3: The 8051 Microcontrollers Architecture, Programming & Applications Kenneth J. Ayala
R4: R.S.Gaonkar,"Microprocessor Architecture Programming and Application",with 8085,Wiley Eastern LTD.,New Delhi,2013.
R5: Embedded Systems: Architecture, Programming And Design, By Raj Kamal Second Edition, Tata McGraw Hill Education Private

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22AI3003	DATA STRUCTURES LABORATORY	0	0	4	2

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.
4. To implement traversal operations of trees and graphs
5. To understand concepts about various algorithm design techniques, searching and sorting techniques

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^{th} 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'th smallest and k'th 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: 60

Course Outcome

CO1: Apply good programming design methods for program development.

CO2:Apply the different data structures for implementing solutions to practical problems.

CO3:Develop recursive programs using trees ,graphs.

CO4:DevelopMinimum spanning tree using prim's and kruskal's algorithm.

CO5:Develop about various algorithm design techniques

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22AI3002	FOUNDATIONS OF ARTIFICIAL INTELLIGENCE LABORATORY	0	0	4	2

Course Objective

1. To learn Prolog
2. To understand and learn LISP
3. To learn the methodical way of solving problem
4. To learn the methodical way of 4-queen problems
5. To learn the methodical way of medical diagnostic

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: 60

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

CO4: learn the methodical way of 4-queen problems
CO5: learn the methodical way of medical diagnostics

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Programme	Course code	Name of the course	L	T	P	C
B.TECH	22AI3001	MICROPROCESSOR AND EMBEDDED SYSTEMS LABORATORY	0	0	4	2

Course Objective

1. Demonstrate the 8086 Microprocessor kit and perform basic operation.
2. Understand the peripheral devices and interface to 8086 Microprocessor.
3. Apply the programming concepts to 8051 Microcontroller.
4. Use proper peripheral devices and interface with 8051 Microcontroller.
5. Build a small low-cost embedded system using ARM processor

Expt. No	Description of the Experiments
1	Basic arithmetic and Logical operations using 8086 Microprocessor kit and MASM software.
2	Code conversion and Matrix operations using 8086 Microprocessor kit and MASM software.
3	Sorting and Searching using 8086 Microprocessor kit and MASM software.
4	Serial and Parallel interface with 8086 Microprocessor.
5	Basic arithmetic and Logical operations using 8051Microcontroller.
6	Code conversion and squaring using 8051Microcontroller.
7	A/ D Converter and D/A Converter interface with 8051 Microcontroller.
8	Stepper motor control interface using 8051 Microcontroller.
9	LED blinking using ARM Processor.
10	ADC and temperature sensor interfacing with ARM Processor.

Total Instructional Hours 60

Course Outcome

CO1: Analyze the performance of 8086 programs for various types of inputs.

CO2: Interface different I/Os with processor.

CO3: Formulate the design logic of 8051 programs.

CO4: Develop an industrial application using 8051 Microcontroller.

CO5: Design an embedded system application.

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Programme	Course code	Name of the course	L	T	P	C
B.TECH	22MC3191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2	0	0	0

Course Objective

The student should be able

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life.
3. To impart basic principles of thought process, It has and Dharma Shastra and connecting society and nature.
4. To understand the concept of Intellectual and intellectual property rights with special Reference.
5. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and Indian philosophy.

Unit	Description	Instructional Hours
I	**Introduction to traditional knowledge:** Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vs indigenous knowledge, traditional knowledge vs western knowledge	9
II	**Protection of traditional knowledge:** The need for protecting traditional knowledge, Significance of TK Protection, value of TK in global economy, Role of Government to harness TK	9
III	**Itihas and Dharma**-Shastra **Itihas**: The Mahabharata - The Puranas - The Ramayana **Dharma**-Shastra: Manu Needhi - The Tirukkural – Thiru Arutpa	9
IV	**Traditional knowledge and intellectual property:** Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge	9
V	**Indian philosophy** Jain – Buddhist – Charvaka – Samkhya - Yoga - Nyaya - Vaisheshika - Saiva	9

Siddhanta

Total Instructional Hours 45

Course Outcome

CO1	**Identify the concept of Traditional knowledge and its importance.**
CO2	**Explain the need and importance of protecting traditional knowledge.**
CO3	Explain the need and importance of Itihas and Dharma Shastra.
CO4	**Interpret the concepts of Intellectual property to protect the traditional knowledge.**
CO5	Interpret the concepts of indian philosophy to protect the traditional knowledge.

REFERENCES:

R1 Traditional Knowledge System in India, by Amit Jha, 2009.

R2 Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.

R3 "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

R4 V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.

R5 V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am.

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Programme	Course Code	Course Title	L	T	P	C
B.TECH	22HE3071	Soft Skills and Aptitude - II	1	0	0	1

Course Objectives:

1. Solve Logical Reasoning questions of easy to intermediate level
2. Solve Quantitative Aptitude questions of easy to intermediate level
3. Solve Verbal Ability questions of easy to intermediate level
4. Display good writing skills while dealing with essays

Unit	Description	Instructional Hours
I	**Logical Reasoning** Clocks - Calendars - Direction Sense - Cubes - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency	9
II	**Quantitative Aptitude** Time and work: Work with different efficiencies, Pipes and cisterns, Work equivalence, Division of wages - Time, Speed and Distance: Basics of time, speed and distance, Relative speed, Problems based on trains, Problems based on boats and streams, - Profit and loss, Basic terminologies in profit and loss - Averages - Weighted average	12
III	**Verbal Ability** Sentence Correction: Subject-Verb Agreement, Modifiers, Parallelism, Pronoun-Antecedent Agreement, Verb Time Sequences, Comparisons, Prepositions, Determiners - Sentence Completion and Para-jumbles: Pro-active thinking, Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues), Fixed jumbles, Anchored jumbles.	7
IV	**Writing skills for placements** Essay writing: Idea generation for topics, Best practices, Practice and feedback	2
	Total Instructional Hours	30

Course Outcome:

CO1: Students will avoid the various fallacies that can arise through the misuse of logic.

CO2: Students would opt for alternate methods to solve the problems rather than conventional methods.

CO3: Students will heighten their awareness of correct usage of English grammar in writing and speaking

CO4: Students will be concise and clear, using professional language for placements.

REFERENCE BOOKS:

R1: A New Approach To Reasoning Verbal & Non-Verbal By B.S. Sijwali

R2: How to prepare for data interpretation for CAT by Arun Sharma.

R3: How to Crack TEST OF REASONING in all competitive examinations by Jaikishan and Premkishan.

R4: Quantitative Aptitude for Competitive Examinations - Dr. R.S. Aggarwal, S. Chand

R5: Word Power Made Easy by Norman Lewis

R:6 Six weeks to words of power by Wilfred Funk

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Coimbatore - 641 032.

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

I - AIML

CHOICE BASED CREDIT SYSTEM

Revised Curriculum and Syllabus for the odd semester

Academic year 2023-2024

(Academic Council Meeting Held on 19.06.2023)

Hindusthan College of Engineering and Technology
(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi& Accredited by NAAC with 'A' Grad
Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu.

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 2023-2024 and onwards

SEMESTER I (Credit : 18)											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
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
EEC COURSES (SE/AE)											
6	22HE1073	Introduction To Soft Skills (Common To All Branches)	SEC	1	0	0	0	1	100	0	100
7	22HE1072	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
MANDATORY COURSES											
8	22MC1093/ 22MC1094	□□□□□□□□□□ /HERITAGE OF TAMIL	MC	2	0	0	1	2	100	0	100
9	22MC1095	Universal Human Values (Common to all branches)	AEC	2	0	0	0	2	40	60	100
			TOTAL	**17**	**1**	**8**	**18**	**26**	**580**	**320**	**900**

SEMESTER II (Credits – 23)											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA2103	Differential Equations and 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
THEORY WITH LAB COMPONENT											
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	22IT2251 / 22CS2253	Python programming and Practices / Java Fundamentals	PCC/ICC-2	2	0	2	3	4	50	50	100
6	22IT2253	Dynamic Web Design	PCC	2	0	1	2	3	50	50	100
PRACTICAL											
7	22ME2001	Engineering Practices	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8	22HE2071	Design Thinking	AEC	2	0	2	2	2	100	0	100
9	22HE2073	SOFT SKILLS AND APTITUDE-I	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSES											
10	22MC2094/ 22MC2095	□□□□□□□□ □□□□□□□□□□□□□□□ / TAMILS AND TECHNOLOGY	MC	2	0	0	1	2	100	0	100
11	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, inanyone of the personality and character development programmes and undergo training for about 80 hours							
			TOTAL	**18**	**1**	**13**	**23**	**29**	**640**	**360**	**1000**

SEMESTER III (Credits – 25)											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22MA3103	Discrete Mathematics and Graph Theory	BSC	3	1	0	4	4	40	60	100
2	22CS3201	Data Structures	PCC	3	0	0	3	4	40	60	100
3	22CS3202	Operating Systems	PCC	3	1	0	4	4	40	60	100
4	22CS3203	Digital Principles And Computer Organization	ESC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5	22CS3251/ 22CS3253	Object Oriented Programming Using Java / Clean Coding and Devops	PCC/ICC-3	3	0	2	4	4	50	50	100
PRACTICAL											
6	22CS3001	Digital Principles And Computer Organization Laboratory	ESC	0	0	4	2	4	60	40	100
7	22CS3002	Operating Systems Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	22HE3071	Soft Skills And Aptitude -II	SEC	1	0	0	1	1	100	0	100
9	22CS3003	Data Structures Laboratory	AEC	0	0	4	2	4	60	40	100
10	22MC3191	Essence of Indian Traditional Knowledge	MC	2	0	0	0	2	100	0	100
			TOTAL	**17**	**2**	**14**	**25**	**34**	**590**	**410**	**1000**

SEMESTER IV (Credits – 23)											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2	22CS4201	Software Engineering	PCC	3	0	0	3	3	40	60	100
3	22CS4202/ 22CS4204	Foundations of Data Science/ Data Visualization	PCC/ICC-4	3	0	0	3	3	40	60	100
4	22CS4203	Database Management Systems	PCC	3	1	0	4	4	40	60	100
5	22CS4205	Microprocessor and Microcontrollers	PCC	3	0	0	3	3	40	60	100

THEORY WITH LAB COMPONENT											
6	22MA4152	Applied Statistics with R Programming and Queuing theory	BSC	2	0	2	3	4	50	50	100
PRACTICAL											
7	22CS4001	Database Management Systems Laboratory	PCC	0	0	4	2	4	60	40	100
8	22CS4002 /22CS4003	Data science Laboratory / Data Visualization Lab	PCC/ICC-5	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9	22HE4071	Soft Skills -3	SEC	1	0	0	1	1	100	0	100
			TOTAL	**17**	**1**	**10**	**23**	**28**	**470**	**430**	**900**

SEMESTER V (Credits – 22)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22CS5201	Theory Of Computation	PCC	3	1	0	4	4	40	60	100
2	22CS5202	Computer Networks	PCC	3	0	0	3	3	40	60	100
3	22CS53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4	22CS53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5	22CS53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22CS5251 /22CS5252	Object Oriented Analysis and Design / Introduction to Design Thinking	PCC/ICC-6	2	0	2	3	4	50	50	100
PRACTICAL											
7	22CS5001	Engineering Clinic	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
			TOTAL	**18**	**1**	**6**	**22**	**25**	**410**	**390**	**800**

SEMESTER VI (Credits – 24)											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22CS6201	Machine Learning Techniques	PCC	3	0	0	3	3	40	60	100
2	22HE6101	Professional Ethics	HSC	3	0	0	3	3	40	60	100
3	22CS63XX	Professional Elective-4/Development of Machine Learning Models	PEC/ICC-7	3	0	0	3	3	40	60	100
4	22CS63XX	Professional Elective-5/ Predictive Modeling	PEC/ICC-8	3	0	0	3	3	40	60	100
5	22CS64XX	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
6	22CS64XX	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
7	22CY6101	Environmental Studies	BSC	2	0	0	2	3	40	60	100
PRACTICAL											
8	22CS6001	Machine Learning Techniques Lab	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9	22HE6071	Soft Skills - 5	SEC	2	0	0	2	2	100	0	100
			TOTAL	**22**	**0**	**4**	**24**	**27**	**440**	**460**	**900**

SEMESTER VII (Credits – 20)											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1	22CS7201	Information storage and Management	PCC	3	0	0	3	3	40	60	100
2	22CS7202	Deep Learning	PCC	3	1	0	4	4	40	60	100
3	22CS73XX	Professional Elective-6 / AI Analyst	PEC /ICC-9	3	0	0	3	3	40	60	100
4	22XX74XX	Open Elective – 3*	OEC	3	0	0	3	3	40	60	100
5	22XX74XX	Open Elective – 4*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
6	22CS7001	Deep Learning Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
7	22CS7701	Internship - II*	SEC	0	0	0	2	2	100	0	100
			TOTAL	**15**	**1**	**4**	**20**	**22**	**360**	**340**	**700**

* - Four weeks internship carries 2 credit and it will be done in before Semester VI summer vacation/placement training and same will be evaluated in Semester VII.

SEMESTER VIII (Credits – 10)											
S No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
EEC COURSES (SE/AE)											
1	22CS8901	Project Work/Granted Patent	SEC	0	0	20	10	20	100	100	200
			TOTAL	0	0	20	10	20	100	100	200

Note:

1. As per the AICTE guideline, in Semester I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students' who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extracredits printed in the Consolidated Mark sheet as per the regulation.
2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
3. The above-mentioned NCC Courses will be offered to the Students who are going to be admitted in the Academic Year 2022 – 23.

SEMESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH.PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	3	-	2	-	-	25
3	ESC	6	2	5	-	-	-	-	-	13
4	PCC	-	5	13	17	12	5	9	-	61
5	PEC	-	-	-	-	9	6	3	-	18
6	OEC	-	-	-	-	-	6	6	-	12
7	EEC	3	3	3	1	1	2	2	10	25
8	MC	✓	✓							
	Total	19	22	25	23	22	24	20	10	165

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3
4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3

6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Biorefinery	OEC	3	0	0	3	3

Note: Non Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
3	22CS7401	E-Commerce	OEC	3	0	0	3	3

OPEN ELECTIVE IV

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Data Science	Vertical II Creative Media	Vertical III CLOUD COMPUTING	Vertical IV Cyber Security and Data Privacy	Vertical V Computer Vision And Virtual Reality	Vertical VI Artificial Intelligence and Machine Learning
22CS5301 Data Engineering	**22CS5304** Multimedia Data Compression and Storage	**22CS5307** Principles of Cloud Computing	**22CS5310** Ethical Hacking	**22CS5313** Computer Graphics	**22CS5316** Soft Computing
22CS5302 Information Retrieval	**22CS5305** Multimedia and Animation	**22CS5308** Virtualization	**22CS5311** Digital and Mobile Forensics	**22CS5314** Image and video analytics	**22CS5317** Natural Language Processing
22CS5303 Data Security	**22CS5306** Video Creation and Editing	**22CS5309** Cloud Architecture	**22CS5312** Cyber forensics and investigation	**22CS5315** Game Programming	**22CS5318** Quantum Computing
22CS6301 Information Science and Ethics	**22CS6303** UI and UX Design	**22CS6305** Cloud Services Management	**22CS6307** Engineering Secure software systems	**22CS6309** Computer Vision	**22CS6311** Cognitive Science and Analytics
22CS6302 Fuzzy logic and Neural Networks	**22CS6304** Digital marketing	**22CS6306** Cloud Application Development	**22CS6308** Social Network Security	**22CS6310** Introduction to Augmented Reality	**22CS6312** Pattern Recognition

22CS7301 Recommender Systems	22CS7302 Visual Effects	22CS7303 Cloud Security	22CS7304 Data privacy preservation	22CS7305 Virtual Reality	22CS7306 Ethics and AI

Note:
Students are permitted to choose all professional electives from any of the verticals.

Vertical I
Data Science

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5301	Data Engineering	PEC	3	0	0	3	3
2	22CS5302	Information Retrieval	PEC	3	0	0	3	3
3	22CS5303	Data Security	PEC	3	0	0	3	3
4	22CS6301	Information Science and Ethics	PEC	3	0	0	3	3
5	22CS6302	Fuzzy logic and Neural Networks	PEC	3	0	0	3	3
6	22CS7301	Recommender Systems	PEC	3	0	0	3	3

Vertical II
Creative Media

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5304	Multimedia Data Compression and Storage	PEC	3	0	0	3	3
2	22CS5305	Multimedia andAnimation	PEC	3	0	0	3	3
3	22CS5306	Video Creation and Editing	PEC	3	0	0	3	3
4	22CS6303	UI and UX Design	PEC	3	0	0	3	3
5	22CS6304	Digital marketing	PEC	3	0	0	3	3
6	22CS7302	Visual Effects	PEC	3	0	0	3	3

Vertical III
CLOUD COMPUTING

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5307	Principles of Cloud Computing	PEC	3	0	0	3	3
2	22CS5308	Virtualization	PEC	3	0	0	3	3

3	22CS5309	Cloud Architecture	PEC	3	0	0	3	3
4	22CS6305	Cloud Services Managment	PEC	3	0	0	3	3
5	22CS6306	Cloud Application Development	PEC	3	0	0	3	3
6	22CS7303	Cloud Security	PEC	3	0	0	3	3

Vertical IV
Cyber Security and Data Privacy

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5310	Ethical Hacking	PEC	3	0	0	3	3
2	22CS5311	Digital and Mobile Forensics	PEC	3	0	0	3	3
3	22CS5312	Cyber forensics and investigation	PEC	3	0	0	3	3
4	22CS6307	Engineering Secure software systems	PEC	3	0	0	3	3
5	22CS6308	Social NetworkSecurity	PEC	3	0	0	3	3
6	22CS7304	Data privacy preservation	PEC	3	0	0	3	3

Vertical V
COMPUTER VISION AND VIRTUAL REALITY

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5313	Computer Graphics	PEC	3	0	0	3	3
2	22CS5314	Image and video analytics	PEC	3	0	0	3	3
3	22CS5315	Game Programming	PEC	3	0	0	3	3
4	22CS6309	Computer Vision	PEC	3	0	0	3	3
5	22CS6310	Introduction to Augmented Reality	PEC	3	0	0	3	3
6	22CS7305	Virtual Reality	PEC	3	0	0	3	3

Vertical VI
Artificial Intelligence and Machine Learning

S	Course	Course Title	Category	Periods Per	Total	Credits

No	Code			week			Contact Periods	
				L	T	P		
1	22CS5316	Soft Computing	PEC	3	0	0	3	3
2	22CS5317	Natural Language Processing	PEC	3	0	0	3	3
3	22CS5318	Quantum Computing	PEC	3	0	0	3	3
4	22CS6311	Cognitive Science and Analytics	PEC	3	0	0	3	3
5	22CS6312	Pattern Recognition	PEC	3	0	0	3	3
6	22CS7306	Ethics And AI	PEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honors) or Minor Degree. For B.E. / B. Tech. (Honors), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For a minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

VERTICALS FOR MINOR DEGREE

Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.

COMPUTER SCIENCE AND ENGINEERING OFFERING MINOR DEGREE

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5601	Sem 5: Data structures and Design	MDC	3	0	0	3	3
2	22CS6601	Sem 6: Databases and SQL	MDC	3	0	0	3	3
3	22CS6602	Sem6: Introduction to Internet Of Things	MDC	3	0	0	3	3
4	22CS7601	Sem 7: Introduction to	MDC	3	0	0	3	3

		Machine Learning						
5	22CS7602	Sem 7: Introduction to Cyber Security	MDC	3	0	0	3	3
6	22CS8601	Sem 8: Data Analytics	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I

Fintech and Block Chain

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5601	Financial Management	MDC	3	0	0	3	3
2	22XXXX	Fundamentals of Investment	MDC	3	0	0	3	3
3	22XXXX	Banking, Financial Services and Insurance	MDC	3	0	0	3	3
4	22XXXX	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	22XXXX	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	22XXXX	Introduction to Fintech	MDC	3	0	0	3	3

Vertical II

Entrepreneurship

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22BA5601	Foundations of Entrepreneurship	MDC	3	0	0	3	3
2	22BA6601	Introduction to Business Venture	MDC	3	0	0	3	3
3	22 BA6602	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
4	22 BA7601	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
5	22 BA7602	Principles of Marketing Management for Business	MDC	3	0	0	3	3
6	22 BA8601	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
7	22BA8602	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical III

Environment and Sustainability

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CE5602	Sustainable infrastructure Development	MDC	3	0	0	3	3
2	22XXXX	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	22XXXX	Sustainable Bio Materials	MDC	3	0	0	3	3
4	22XXXX	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	22XXXX	Green Technology	MDC	3	0	0	3	3
6	22XXXX	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

B.E (HONS) COMPUTER SCIENCE AND ENGINEERING

Vertical I IOT	Vertical II BLOCK CHAIN TECHNOLOGY	Vertical III FULL STACK DEVELOPMENT
22CS5204 Fundamentals Of IOT	22CS5205 Public Key Infrastructure and Trust Management	22CS5206 Web Technology
22CS6203 IoT Design	22CS6205 Introduction to block chain	22CS6207 React JS with Spring boot 2
22CS6204 Introduction Of Raspberry Pi and Arduino	22CS6206 Cryptocurrency	22CS6208 Back End Development with NodeJS
22CS7203 IoT for smart cities	22CS7205 Smart Contracts and Solidity	22CS7207 No Sql Databases with Mongo DB
22CS7204 Internet Of Medical Things	22CS7206 Block chain and distributed ledger technology	22CS7208 DevOps
22CS8201 Iot Cloud and Data Analytics	22CS8202 Bitcoin Essentials and Use-Cases	22CS8203 Web Application Security

B.E (HONS) COMPUTER SCIENCE AND ENGINEERING SPECIALIZATION IN IOT

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5204	Sem 5: Fundamentals Of IOT	PC	3	0	0	3	3
2	22CS6203	Sem 6: IoT Design	PC	3	0	0	3	3
3	22CS6204	Sem 6: Introduction Of Raspberry Pi and Arduino	PC	3	0	0	3	3
4	22CS7203	Sem 7: IoT for smart cities	PC	3	0	0	3	3
5	22CS7204	Sem 7: Internet Of Medical Things	PC	3	0	0	3	3
6	22CS8201	Sem 8: Iot Cloud and Data Analytics	PC	3	0	0	3	3

B.E (HONS) COMPUTER SCIENCE AND ENGINEERING SPECIALIZATION IN BLOCK CHAIN TECHNOLOGY

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5205	Sem 5: Public Key Infrastructure and Trust Management	PC	3	0	0	3	3
2	22CS6205	Sem 6: Introduction to block chain	PC	3	0	0	3	3
3	22CS6206	Sem 6: Cryptocurrency	PC	3	0	0	3	3
4	22CS7205	Sem 7: Smart Contracts and Solidity	PC	3	0	0	3	3
5	22CS7206	Sem 7: Block chain and distributed ledger technology	PC	3	0	0	3	3
6	22CS8202	Sem 8: Bitcoin Essentials and Use-Cases	PC	3	0	0	3	3

B.E (HONS) COMPUTER SCIENCE AND ENGINEERING SPECIALIZATION IN FULL STACK DEVELOPMENT

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CS5206	Sem 5: Web Technology	PC	3	0	0	3	3
2	22CS6207	Sem 6: React JS with Spring boot 2	PC	3	0	0	3	3
3	22CS6208	Sem 6: Back End Development with NodeJS	PC	3	0	0	3	3
4	22CS7207	Sem 7: No Sql Databases with Mongo DB	PC	3	0	0	3	3
5	22CS7208	Sem 7: DevOps	PC	3	0	0	3	3
6	22CS8203	Sem 8: Web Application Security	PC	3	0	0	3	3

The Industry Core Courses (ICC) which will be offered as choice-based course in the semester.

ICC. No.	Sem .No	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
ICC1	I	22CS1152	Object oriented programming using Python	2	0	2	3	50	50	100
ICC2	II	22CS2253	Java Fundamentals	2	0	2	3	50	50	100
ICC3	III	22CS3253	Clean Coding and Devops	3	0	2	4	50	50	100
ICC4	IV	22CS4204	Data Visualization	3	0	0	3	40	60	100
ICC5	IV	22CS4003	Data Visualization Laboratory	0	0	4	2	60	40	100
ICC6	V	22CS5252	Introduction to Design Thinking	2	0	2	3	50	50	100
ICC7	VI	22CS6352	Predictive Modeling	3	0	0	3	40	60	100
ICC8	VI	22CS6314	Development of Machine Learning Models	3	0	0	3	40	60	100
ICC9	VII	22CS7307	AI Analyst	3	0	0	3	40	60	100

Credit Distribution R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	25	23	22	24	20	10	165

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SYLLABUS
I SEMESTER

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	22MA1101	MATRICES AND CALCULUS (Common to all Branches)	3	1	0	4

Course Objective

The learner should be able to

1. Construct the characteristic polynomial of a matrix and use it to identify eigen values and Eigenvectors
2. Impart the knowledge of sequences and series.
3. Analyseanddiscussthemaximaandminimaofthefunctionsofseveralvariables.
4. Evaluate the multiple integrals and apply in solving problems.
5. Apply vector differential operator for vector function and theorems to solve engineering problems.

Unit	Description	Instructional Hours
I	**Matrices** 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	**Single Variate Calculus** Rolle's Theorem–Lagrange's Mean Value Theorem-Maxima and Minima–Taylor's and Maclaurin's Series.	12
III	**Functions of Several Variables** Partial derivatives-Total derivative, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers	12
IV	**Integral Calculus** 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	**Vector Calculus** Gradient, divergence and curl; Green's theorem, Stoke's and Gauss divergence theorem (statement only) for cubes only.	12
	Total Instructional Hours	**60**

Course Outcome

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

CO1: Compute Eigen values and Eigen vectors of the given matrix and transform given quadratic form into canonical form.

CO2: Apply the concept of differentiation to identify the maximum and minimum values of curve.

CO3: Compute partial derivatives of function of several variables and write Taylor's series for functions with two variables.

CO4: Evaluate multiple integral and its applications in finding area, volume.

CO5: Apply the concept of vector calculus in two and three dimensional spaces.

TEXTBOOKS:

T1:G.B.ThomasandR.L.Finney,"CalculusandAnalyticalGeometry",9thEditionAddisonWesleyPublishing Company,2016.

T2:ErwinKreyszig,"AdvancedEngineeringMathematics",JohnWiley&Sons,2019.

T3:K.P.UmaandS.Padma,"EngineeringMathematicsI(MatricesandCalculus) ",PearsonLtd,2022.

REFERENCEBOOKS:

R1-JerroldE.Marsden,AnthonyTromba,"VectorCalculus",W.H.Freeman,2003

R2-StraussM.J,G.L.BradleyandK.J.Smith,"Multivariablecalculus",PrenticeHall,2002.

R3-VeerarajanT,"EngineeringMathematics",McGrawHillEducation(India)PvtLtd,NewDelhi,2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	22CY1151	**Chemistry for Circuit Engineering** (ECE, EEE, EIE, BME,CSE, IT, AIML)	2	0	2	3

The learner should be able to

Course Objective

1. Acquire knowledge on the concepts of chemistry involved in day today life.
2. Identify the water related problems and water treatment techniques.
3. Enhance the fundamental knowledge on electrochemistry and the mechanism of corrosion and its control.
4. Gain knowledge on the nuclear energy source and batteries.
5. Extend the knowledge on the concepts of spectroscopy and its applications.

Unit	Description	Instructional Hours
I	**CHEMISTRY IN EVERYDAY LIFE** 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.	6
II	**WATER TECHNOLOGY** 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 & Ion-Exchange Methods)- Desalination of Brackish Water - Reverse Osmosis, Potable water and treatment. **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.**	6+9
III	**ELECTROCHEMISTRY AND CORROSION** 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. **Conductometric titration of strong acid vs strong base (HClvsNaOH). Estimation of Ferrous iron by Potentiometry.**	6+6
IV	**ENERGY SOURCES AND STORAGE DEVICES** 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_2 -O_2 fuel cell applications.	6
V	**SPECTROSCOPY** 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.	6
	Total Instructional Hours	**45**

Course Outcome

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.

TEXT BOOKS

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).

REFERENCES

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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B.Tech	22HE1151	ENGLISH FOR ENGINEERS (Common to all Branches)	L	T	P	C
			2	0	2	3

The student should be able

Course Objective

1. To improve the communicative proficiency of learners.
2. To help learners use language effectively in professional writing.
3. To advance the skills of maintaining the suitable one of communication.
4. To introduce the professional life skills.
5. To impart official communication etiquette.

Unit	Description	Instructional Hours
I	**Language Proficiency:** Types of Sentences, Functional Units, Framing question. **Writing:** process description, Writing Checklist Vocabulary – words on environment. **Practical Component: Listening-** Watching short videos and answer the questions, **Speaking-** Self introduction ,formal & semi-formal,Reading- Purpose of Reading - Planning & Annotation, Interpreting Ideas - Interpreting Graphs in Technical Writing	7+2
II	**Language Proficiency:** Tenses, Adjectives and adverbs. **Writing:** Formal letters (letters conveying positive and negative news), Formal and informal email writing (using emoticons, abbreviations& acronyms), reading comprehension. Vocabulary – words on entertainment. **Practical Component: Listening-**Comprehensions based on TED talks **Speaking-** Narrating a short story or an event happened in their life. Reading - Skimming – Scanning – Reading Scientific Texts – Literary Texts .	7+2
III	**Language Proficiency:** Prepositions, phrasal verbs. **Writing:** Formal thanks giving, Congratulating, warning and apologizing letters, cloze test. **Vocabulary –** words on sports.**PracticalComponent:Listening-**Listen to songs and answer the questions **Speaking-** JustaminuteReading- Reading feature articles (from newspapers and magazines) -Reading to identify point of view and perspective (opinion pieces, editorials etc.)	5+4
IV	**Language Proficiency:** Subject verb concord, Prefixes & suffixes. **Writing:** Preparing agenda &minutes, writing an event report. **Vocabulary–** words on engineering process. **Practical Component: Listening-** Comprehensions based on Talk of orators or interview shows **Speaking-** Presentation on a general topic with ppt. **Reading-** Reading Comprehension – Techniques for Good Comprehension – Sequencing of Sentences	5+4
V	**Language Proficiency:** Modal Auxiliaries, Active & passive voice, **Writing:** Project report (proposal & progress) ,sequencing of sentences Vocabulary –words on engineering material.**Practical Component: Listening-** Listening Comprehensions based on Nat Geo/Discovery channel videos **Speaking-** Preparing posters and presenting as a team.Reading- Biographies,travelogues,technical blogs.	6+3
	Total Instructional Hours	**45**

Course Outcome

After completion of the course the learner will be able

CO1:Tocommunicateinaprofessional forum

CO2:Tospeakorwriteacontentintheproficientlanguage

CO3: To maintain and use appropriate one of the communication.

CO4:To read ,write and present in a professional way.

CO5:To follow the etiquettes in formal communication.

TEXTBOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press,2016.T2- Raymond Murphy, "Essential English Grammar", Cambridge UniversityPress,2019.

REFERENCEBOOKS:

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.

R2-RaymondMurphy, "English GrammarinUse"-4theditionCambridgeUniversityPress,2004.

R3-KamaleshSadanan"AFoundationCoursefortheSpeakersofTamil-Part-I&II",Orient Blackswan,2010.

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Programme	CourseCode	Name of the Course	L	T	P	C
B.Tech	22IT1152	Introduction to Web Application Development (IT/CSE/AIML)	2	0	2	3

Course Objective

The learner should be able to

1. To discuss the essence of software development methods
2. To gain knowledge about basic HTML Tags.
3. To create static websites using HTML.
4. To impart knowledge about Cascading Style sheet.
5. To design a front end web application using HTML and CSS

Unit	Description	Instructional Hours
I	Unit-1 Software Development Life Cycle Software Development Model -Waterfall Model- Incremental Process Models- Evolutionary Process Models- Spiral Model-Agile Software Development –Agile process-Agility principles-Introduction Github.	5
II	Unit-2 Hyper Text Markup Language-1 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. Illustrative problems: 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)
III	Unit-3 Hyper Text Markup Language-II 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. Illustrative problems: Designing the Login form with username, password and submit field, Designing a course registration form.	(6+4)
IV	Unit-4 Cascading Style Sheet-I 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. Illustrative problems: Developing a web application using internal, external and embedded style sheet, Applying style specification in HTML page using CSS.	(6+4)
V	Unit-5 Cascading Style Sheet-II 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. Illustrative problems:Developingan web application using CSS Positioning.	(6+4)
	TotalInstructionalHours	45

Course Outcome

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

CO1 : Basic understanding of development of software life cycle.
CO2: Understanding the basic HTML Tags.
CO3:Designing a simple web application using HTML.
CO4: Understanding about the usage of Cascading Style Sheet.
CO5:Creating a front end Web application using HTML and CSS

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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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22CS1151	PROBLEM SOLVING USING C PROGRAMMING (EEE, EIE, CSE, IT)	2	0	2	3

The learner should be able

Course Objective

1. To develop simple algorithms for arithmetic and logical problems.
2. To understand and implement the fundamental concepts in a program.
3. To enable how to implement conditional branching, iteration and recursion.
4. To understand how to decompose a problem into functions and synthesize a complete program and to enable them to use arrays, pointers, strings and structures in solving problems.
5. To understand the use files to perform read and write operations

Unit	Description	Instructional Hours
I	**INTRODUCTION TO COMPUTERS** Computer Systems – Computing Environments – Computer Language – Creating and Running programs – Computer Numbering System – Storing Integers and Real Numbers – Algorithms - Flowchart. **INTRODUCTION TO C LANGUAGE** Character set - C Tokens, Identifiers and Keywords - Constants, Variables - Data types – Text Input / Output – Operators - Expressions – Precedence and Associativity – Evaluating Expressions – Type Conversions. Illustrative program: 1) Josh went to the market to buy N apples. He found two shops, shop A and B, where apples were being sold in lots. He can buy any number of the complete lot(s) but not loose apples. He is confused with the price and wants you to figure out the minimum cost to buy exactly N apples. Write an algorithm for Josh to calculate the minimum cost to buy exactly N apples. (Wipro 2022) **Input Format:** • The first line of the input consists of an integer – N, representing the total number of apples that Josh wants to buy. • The second line consists of two space-separated positive integers – M1 and P1, representing the number of apples in a lot and the lot's price at shop A, respectively. • The third line consists of two space-separated positive integers-M2 and P2, representing the number of apples in a lot and lot's price at shop B, respectively. **Output Format:** Print a positive integer representing the minimum price at which Josh can buy the apples. 2) Chaman planned to choose a four digit lucky number for his car. His lucky numbers are 3,5 and 7. Help him find the number, whose sum is divisible by 3 or 5 or 7. Provide a valid car number, Fails to provide a valid input then display that number is not a valid car number. (Cognizant) Note : The input other than 4 digit positive number[includes negative and 0] is considered as invalid.	7
II		10
III	**DECISION MAKING, ARRAYS, STRINGS AND POINTERS** Two-way collection – Multi-way Collection – Concept of a Loop – Pre-test and Post-test Loops – Initialization and Updating – Controlled Loops – Other Statements Related to Looping – Looping Application - Arrays - Strings - Pointers – Pointer Applications – Processor Commands. Illustrative program: 1) You are playing an online game. In the game, a list of N numbers is given. The player has to arrange the numbers so that all the odd numbers of the list come after the even numbers. Write an algorithm to arrange the given list such that all the odd numbers of the list come after the even numbers. (Wipro 2022) **Input** • The first line of the input consists of an integer numbers, representing the size of the list(N). • The second line of the input consists of N space-separated integers representing the values of the list **Output** Print N space-separated integers such that all the odd numbers of the list come after the even numbers 2) Given an integer matrix of size N x N. Traverse it in a spiral form. (Wipro 2022) Input: The first line contains N, which represents the number of rows and columns of a matrix. The next N lines contain N values, each representing the values of the matrix. Output: A single line containing integers with space, representing the desired traversal. Constraints: $0 < N < 500$ 3) A digital machine generates binary data which consists of a string of 0s and 1s. A maximum signal M, in the data, consists of the maximum number of either 1s or 0s appearing consecutively in the data but M can't be at the beginning or end of the string. Design a way to find the length of the maximum signal. (Wipro 2022) **Input** The first line of the input consists of an integer N, representing the length of the binary string. The second line consists of a string of length N consisting of 0s and 1s only. **Output**	10

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Print an integer representing the length of the maximum signal.
4) Given a string S(input consisting) of '*' and '#'. The length of the string is variable. The task is to find the minimum number of '*' or '#' to make it a valid string. The string is considered valid if the number of '*' and '#' are equal. The '*' and '#' can be at any position in the string. (TCS NQT 2022)
Note : The output will be a positive or negative integer based on number of '*' and '#' in the input string.
(*>#): positive integer
(#>*): negative integer
(#=*): 0

FUNCTIONS, STRUCTURES AND UNION

IV — Designing Structured Programs – Functions in C – User defined functions – Inter-Function Communication – Standard Function – Passing Arrays to Functions – Passing Pointers to Function – Recursion – Passing an array to a function – typedef – Enumerated types - Structure – Union – Programming Application. Illustrative program: 1) The Caesar cipher is a type of substitution cipher in which each alphabet in the plaintext or messages is shifted by a number of places down the alphabet. For example, with a shift of 1, P would be replaced by Q, Q would become R, and so on. To pass an encrypted message from one person to another, it is first necessary that both parties have the 'Key' for the cipher, so that the sender may encrypt and the receiver may decrypt it. Key is the number of OFFSET to shift the cipher alphabet. Key can have basic shifts from 1 to 25 positions as there are 26 total alphabets. As we are designing custom Caesar Cipher, in addition to alphabets, we are considering numeric digits from 0 to 9. Digits can also be shifted by key places. For Example, if a given plain text contains any digit with values 5 and keyy =2, then 5 will be replaced by 7, "-"(minus sign) will remain as it is. Key value less than 0 should result into "INVALID INPUT". Write a function CustomCaesarCipher(int key, String message) which will accept plaintext and key as input parameters and returns its cipher text as output. (TCS NQT 2022) — 9

Enter your PlainText: All the best
Enter the Key: 1
The encrypted Text is: BmmuifCftu

BINARY INPUT / OUTPUT

V — Defining and Opening a file, closing a file - input/output operations on files - error handling during I/O operations - random access to files - Text versus Binary Streams – Standard Library Functions for Files – Converting File type. Illustrative program: 1) Write a C Program to merge contents of two files into a third file. 2) Write a program in C to delete a specific line from a file. — 9

Total Instructional Hours **45**

Course Outcome

At the end of the course, the learner will be able to
CO1: Develop simple algorithms for arithmetic and logical problems.
CO2: Test and execute the programs and correct syntax and logical errors.
CO3: Implement conditional branching, iteration and recursion.
CO4: Decompose a problem into functions and synthesize a complete program and use arrays, pointers, strings and structures to formulate algorithms and programs.
CO5: Use files to perform read and write operations.

TEXT BOOKS:

T1: Byron Gottfried, "Programming with C", Schaum's Outlines Series, McGraw Hill Education, 3rd edition, 2017.

REFERENCE BOOKS:

R1: Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4th edition, 2014.
R2: R. S. Bichkar, "Programming with C", Universities Press, 2nd edition 2012.
R3: YashvantKanetkar, "Exploring C", BPB Publishers, 2nd edition, 2003.
R4: W. Kernighan Brian, Dennis M. Ritchie, "The C Programming Language", PHI Learning, 2nd edition, 1988

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22CS1152	OBJECT ORIENTED PROGRAMMING USING PYTHON (CSE, IT, ECE & AIML)	2	0	2	3

Course Objective

The learner should be able

1. To read and write simple Python programs.
2. To develop Python programs with conditionals and loops.
3. To define Python functions and call them.
4. To understand OOP concepts and write programs using classes and objects.
5. To do input/output with files in Python.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO PYTHON** 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 acard in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.	7+2
II	**DATA TYPES, STATEMENTS,CONTROL FLOW** Data Types(List,Tuple,string,dicionary,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 aPython 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	**PYTHON FUNCTIONS** Introduction to functions-Global and local variable in python-Decorators in python-Python lamda 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 s um of the digits of a given n umber, b) A recursive function Sum_DigR( ) to find the same.	5+4
IV	**PYTHON OOPS** 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. Thecharges 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	**FILES, PACKAGES** 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 thesame, not exceeding 10 lines of code, Creating Modules and Packages for arithmetic Operations.	5+4
	Total Instructional Hours	**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.

TEXT BOOKS:

T1: Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised andupdated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOKS:

R1: Charles Dierbach, —Introduction to Computer Science using Python: A ComputationalProblem-Solving Focus, Wiley India Edition, 2013.
R2: Timothy A. Budd, —Exploring Pythonl, Mc-Graw Hill Education (India) Private Ltd., 2015.
R3: Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming inPython: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

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MANDATORY COURSES

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22MC1095	UNIVERSAL HUMAN VALUES (COMMON TO ALL BRANCHES)	2	0	0	0

Course Objectives

Thestudentshould bemade

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. TofacilitatethedevelopmentofaHolisticperspectiveamongstudentstowardslifeandprofession 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.
3. To highlight plausible implication sofsuchaHolisticunderstanding Interms ofethicalhumanconduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Unit	Description	Instructional Hours
I	**Introduction to Value Education** 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	**Harmony in the Human Being and Harmony in the Family** 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	**Harmony in the Family and Society** 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 RightEvaluation Understanding Harmony in the Society	6
IV	**Harmony in the Nature / Existence** 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	**Implications of the Holistic Understanding – a Look at Professional Ethics** 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 CaseStudiesStrategies for Transition towards Value-based Life and Profession	6
	Total Instructional Hours	**30**

Course Outcome

At the end of the course, the learner will be able

CO1: To become more aware of holistic vision of life - themselves and their surroundings.

CO2: To become more responsible in life, in the Society and in handling problems with sustainable Solutions.

CO3: To sensitive towards their commitment towards what they understood towards environment and Socially responsible behavior.

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.

CO5: To develop competence and capabilities for maintaining Health and Hygiene.

Reference Books:

R1.A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

R2.Teachers'ManualforAFoundationCourseinHumanValuesandProfessionalEthics,RRGaur, R Asthana,G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-53-2

R3.JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak,1999.

R4.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

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rogramme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22HE1072	ENTREPRENEURSHIP & INNOVATION (Common for all Branches)	1	0	0	1

The student should be made

Course Objectives

1. To acquire the knowledge and skills needed to manage the development of innovation.
2. To recognize and evaluate potential opportunities to monetize these innovations.
3. To plan specific and detailed method to exploit these opportunities.
4. To acquire the resources necessary to implement these plans.
5. To make students understand organizational performance and its importance.

Module	Description
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**

TOTAL INSTRUCTIONAL HOURS 15

Course Outcome

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

CO1: Understandthenatureofbusinessopportunities,resources,andindustriesincriticalandcreative 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:Developabusiness model for a new venture, including revenue. Margins, operations, Working capital, and investment

TEXTBOOKS

T1:AryaKumar"Entrepreneurship–CreatingandleadinganEntrepreneurialOrganization",Pearson,SecondEdition(2012).
T2:EmrahYayici"DesignThinkingMethodology", Artbiztech,FirstEdition(2016).

REFERENCEBOOKS

R1: Christopher Golis "Enterprise & Venture Capital", Allen &Unwin Publication, Fourth Edition (2007).
R2: ThomasLockWood&EdgerPapke"InnovationbyDesign",Career Press.com,SecondEdition(2017).
R3: Jonathan Wilson "Essentials of Business Research", Sage Publication, FirstEdition(2010).

WEBRESOURCES

W1:https://blof.forgeforward.in/tagged/startup-lessons
W2:https://blof.forgeforward.in/tagged/entrepreurship
W3:https://blof.forgeforward.in/tagged/minimum-viable-product
W4:https://blof.forgeforward.in/tagged/minimum-viable-product
W5:https://blof.forgeforward.in/tagged/innovation

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22MC1094	HERITAGE OF TAMIL	2	0	0	1

Course Objective

The learner should be able to

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
I	**Language and Literature** 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
II	**Heritage _ Rock Art Paintings to Modern Art – Sculpture** 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
III	**Folk and Martial Arts** Therukoothu, Karagattem, Villupattu, Kaniyan koothu, Oyilattam, Leather puppertry, Silambattam., Valari Tiger dance – Sports and Games of Tamils.	6
IV	**Thinai Concept of Tamils** 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 – Exporot and Import during Sangam age – Overseas conquest of Cholas.	6
V	**Contribution of Tamils to Indian National Movement and Indian Culture** 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
	Total Instructional Hours	**30**

Course Outcome

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

CO1: Learn about the works pertaining to Sangam age
CO2: Aware of our Heritage in art from Stone sculpture to Modern Sculpture.
CO3Appreciate 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).

REFERENCEBOOKS:

R1-The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
R2- Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
R3-Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE1073	INTRODUCTION TO SOFT SKILLS	1	0	0	1

Course Objectives:

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	**Lessons on excellence** Skill introspection, Skill acquisition, consistent practice	2
II	**Logical Reasoning** Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles - Attention to detail	11
III	**Quantitative Aptitude** 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	**Recruitment Essentials** Resume Building - Impression Management	2
V	**Verbal Ability** Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement - Punctuations	4
	Total Instructional Hours	30

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.

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GE3152 தமிழர் மரபு LTPC 1 0 0 1

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 திருவள்ளுவர் 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 இணைக் கோட்பாடுகள் 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, கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

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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. பொருநை – 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 ofArchaeology & 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) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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CO'S, PO'S & PSO'S MAPPING - AIML

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 – III

Course Code & Name: 22MA3106 Discrete Mathematics

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: 22AI3201 / Data Structures

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	2		3	3	3	2	
CO2	3	2	2	2	2				2					2
CO3	2	2	2	2			2			3	3	3	2	2
CO4	3	3	2		2			2					2	
CO5	3	3	2	2	3					3	3	3		3
Avg	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

Course Code & Name: 22AI3202 / 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
Avg	2	1.6	2.8	1	1.6	1.6	0.2	0	2	1.6	1.4	2	2.4	2

Course Code & Name: 22AI3203/ Microprocessor and Embedded Systems

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	3	3	2	2	2	2	0	1	0	1	1	2	0	1

Course Code & Name: 22AI3253/Clean Coding and Devops

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	3	2
CO2	3	3	2	2	2	2	0	1	0	1	0	1	3	2
CO3	3	3	2	2	2	2	0	1	0	1	0	2	3	2
CO4	3	3	2	2	2	2	0	1	0	1	1	1	3	2
CO5	3	3	2	2	2	2	0	1	0	1	1	1	2	2
Avg	3	3	2	2	2	2	0	1	0	1	1	2	2.8	2

Course Code & Name: 22AI3001/ Microprocessor and Embedded 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	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	3	3	2	2	2	2	0	1	0	1	1	2	0	1

Course Code & Name: 22AI3002 / Foundations of 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	1	0	0	1	1	1	1	2	2
CO4	1	1	3	1	1	1	0	0	1	2	1	2	2	3
CO5	1	2	2	1	3	1	1	0	1	3	2	2	2	3
Avg	3	2	2.8	0	1	1	1	0	1	2	1.2	1.4	2	2.4

Course Code & Name: 22AI3003 /Data Structures Laboratory

PO&	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO	PO	PO		

PSO										10	11	12	PSO 1	PSO 2
CO1	3	0	0	0	1	0	0	0	0	0	1	1	1	0
CO2	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	0.4

Semester – V

Course Code & Name: 21AI5201/ 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	3	3	2.8	2.8	0.4	1	0	0	2	2	0.6	3	2	1.2

Course Code & Name: 21AI5202/ 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	3	2	1	3	2	2	0	1	2	0	0	1	1	1

Course Code & Name: 21HE5181/ Management Information System

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO	PSO

													1	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: 21CS5251/ 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: 21AI5252 / 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: 21AI5001 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
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: 21AI5002/Data Analytics 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	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: 21AI5301 AI for Cyber Security

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	1		2	3		3	2	
CO2	3	3	3	3	2	2	1			3		3		2
CO3	3	3	3	3	2	1	1		1	3		3	2	2
CO4	3	3	3	3	2	1			1	3		3		3
CO5	3	3	3	3	2	1			1	3		3	2	
Avg	**3**	**3**	**3**	**3**	**2**	**1.4**	**0.6**	**0**	**1**	**3**	**0**	**3**	**1.2**	**1.4**

Course Code & Name: 21AI5302 Internet of things

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

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

Course Code & Name: 21AI5303 Advanced Machine Learning

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

Course Code & Name: 21AI5304 Introduction to Robotics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	0	0	0	1	0	0	0	0	0	1	1	1	0
CO2	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: 21AI5305 Bioinformatics

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	0	0	0	0	2	3	3	3	3
CO2	2	3				0	0	0	0	1	3	1		3
CO3	1		3		2	0	0	0	0	2	0	2	2	
CO4		1		3		0	0	0	0	1	1	1	3	
CO5			3	3	2	0	0	0	0	2	1	1		3
Avg	1.7	2.3	3	3	2	0	0	0	0	2	2	2	2.3	2.8

Course Code & Name: 21AI5306/ 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**

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Course Code & Name: 19AI7201/Cloud Computing

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2										3	2
CO2	3		2			2							3	2
CO3		1	2	2										3
CO4	3		2									2		3
CO5	1	3	3	3								2		3
Avg	2	1.2	2.2	1	0	0.4	0	0	0	0	0	0.8	1.2	2.6

Course Code & Name: 19AI7202/ AI Analyst

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	1			2	2	1		1	2	2	3
CO2	3	2	3	1			2	2	1		1	2	2	3
CO3	3	2	3	2			2	2	1		2	2	2	3
CO4	3	2	3	1			2	2	1		1	2	2	3
CO5	3	2	3	1			2	2	1		1	2	2	3
Avg	3	2	3	1.2	0	0	2	2	1	0	1.2	2	2	3

Course Code & Name: 19AI7251 Deep Learning Techniques

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	1	1	1	1	3	3	3	3
CO2	3	3	2	3	3	1		1	1	1	3	3	3	3
CO3	3	3	2	3	3	1		1	1	1	3	3	3	3
CO4	3	3	2	3	2	1		1	1	1	3	3	3	3
CO5	3	3		3	1	1	1	1	1	1	3	3	3	3
Avg	3	3	2	3	2.25	1	1	1	1	1	3	3	3	3

Course Code & Name: 19AI7203/Ethics and Policy Issues in AI Computing

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	2	3	3	1	1	1		2	2	3	2
CO2	3	3	2	2	3	3	1	1	3		2	3	3	2
CO3	3	3	2	2	3	3	1	1	3		2	3	2	2
CO4	2	3	2	2	2	3	1	1	3		2	3	1	2
CO5	3	2	1	2	3	2	1	2	1		2	2	1	1
Avg	2.8	2.8	1.6	2	2.8	2.8	1	1.2	2.2	0	2	2.6	2	1.8

Course Code & Name: 19CS7001 Cloud Computing 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	1	2	0	0	0	0	0	0	1	1	0
CO2	3	2	1	1	2	0	0	1	0	0	0	2	1	1
CO3	3	3	1	1	2	0	0	1	0	0	0	1	1	1
CO4	3	2	1	1	0	0	0	1	0	0	0	2	1	1
CO5	3	1	1	1	2	0	0	0	0	0	0	1	1	0
Avg	3	2	1	1	2	0	0	1	0	0	0	1	1	1

Course Code & Name: 19AI7901 Project Phase - I

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: 19AI7301 Computer Vision

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	0	2	0	0	0	2	0	0	1	1	0
CO2	3	2	1	0	2	0	0	1	2	0	0	2	1	1
CO3	3	3	1	0	2	0	0	1	2	0	0	1	1	1
CO4	3	2	1	0	0	0	0	1	0	0	0	2	1	1
CO5	3	1	1	0	2	0	0	0	2	0	0	1	1	0
Avg	**3**	**2**	**1**	**0**	**2**	**0**	**0**	**1**	**2**	**0**	**0**	**1**	**1**	**1**

Course Code & Name: 19AI7302 Intelligent Multi Agent and Expert 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	0	0	0	0	0	0	2	3	3	2	1
CO2	3	2	1	2	1	0	0	0	0	1	3	1	3	0
CO3	3	2	1	1	1	0	0	0	0	2	0	2	1	0
CO4	3	2	1	0	0	0	0	0	0	1	1	1	2	1
CO5	3	2	1	0	0	0	0	0	0	2	1	1	1	0
Avg	**3**	**2**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**2**	**2**	**0**

Course Code & Name: 19AI7303 Cognitive Systems

PO&	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO	PO	PO		

PSO										10	11	12	PSO 1	PSO 2
CO1	3	3	1	0	1	0	0	0	0	1	3	0	1	1
CO2	2	2	1	0	1	1	0	1	0	0	3	1	3	0
CO3	3	3	1	0	1	1	0	1	0	0	0	2	1	1
CO4	1	2	1	0	0	1	0	1	0	0	1	1	2	1
CO5	3	2	1	0	0	0	0	0	0	0	1	1	1	0
Avg	**2**	**2**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**2**	**1**	**2**	**1**

Course Code & Name: 19AI7304 Quantum Computing

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: 19AI7305 Web and Social media mining

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	0	0	0	0	0	0	2	3	3	2	1
CO2	3	2	1	2	1	0	0	0	0	1	3	1	3	0
CO3	3	2	1	1	1	0	0	0	0	2	0	2	1	0
CO4	3	2	1	0	0	0	0	0	0	1	1	1	2	1
CO5	3	2	1	0	0	0	0	0	0	2	1	1	1	0
Avg	**3**	**2**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**2**	**2**	**0**

Course Code & Name: 19AI7401 Business Analytics

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

CO1	1	1	1		3							2	2	1
CO2	1	2	3	1	2							1	2	1
CO3	1	1		2	1							2	2	1
CO4	1	2	2									1		2
CO5	1	1		2	1							1	2	1
Avg	1.00	1.40	1.20	1.00	1.40	-	-	-	-	-	-	1.40	1.60	1.20

DEPARTMENT OF AIML

REGULATIONS 2022 & REGULATIONS 2019

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
I	I	22MA1101 - Matrices and Calculus	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2
		22HE1151- English for Engineers	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2
		22CY1151 - Chemistry for Circuit Engineers	2	2.6	2.6	1.4	1.4	1	1	-	1	-	1.2	2	0	1
		22CS1152 - Object Oriented Programming using Python	2	3	3	-	2	-	-	-	2	-	-	2	2	2
		22IT1152- Introduction to Web Application Development	3	2.8	3	1.2	1	0.6	2		0.6		0.8	2	1.8	2
		22HE1073- Introduction To Soft Skills														
		22HE1072Entrepreneurship & Innovation														

		22MC1093/ 22MC1094 - தமிழர்மரபு /HERITAGE OF TAMIL														
		22MC1095 - Universal Human Values														
II	III	22MA3106 – Discrete Mathematics	2.8	2.8	2.8	2.8	2.8	-	-	-	-	-	-	2.6	2.4	2.6
		22CS3201 - Data Structures	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
		22AI3202 - Foundations of Artificial Intelligence	2	1.6	2.8	1	1.6	1.6	0.2	0	2	1.6	1.4	2	2.4	2
		22AI3203 – Microprocessor and Embedded Systems	3	3	2	2	2	2	0	1	0	1	1	2	0	1
		22CS3253 / Clean Coding and Devops	3	3	2	2	2	2	0	1	0	1	1	2	2.8	2
		22AI3001 – Microprocessor and Embedded Systems Laboratory	3	3	2	2	2	2	0	1	0	1	1	2	0	1
		22AI3002 – Foundations of Artificial Intelligence Laboratory	3	2	2.8	0	1	1	1	0	1	2	1.2	1.4	2	2.4
		22AI3003 – Data Structures Laboratory	3	1	1	1	1	0	0	0	1	0	1	1	1	0.4
		22MC3191- Essence of Indian Traditional Knowledge														
		22HE3071 - Soft Skills And Aptitude -II														
III	V	21AI5201 – Computer Networks	3	3	2.8	2.8	0.4	1	0	0	2	2	0.6	3	2	1.2
		21AI5202 – Data Analytics	3	2	1	3	2	2	0	1	2	0	0	1	1	1

		21HE5181 – Management Information System	3	2	2	2	2	2	0	1	1	0	2	2	1	0
		21AI5252 - Introduction to Design Thinking	3	2.8	3	2	3	0	0	3	1	0	2	2	2	3
		21CS5252 – Object Oriented Analysis and Design	2	1.6	2	2.3	3	3	3				2	2	2	3
		19CS53XX -Professional Elective I														
		21AI5001 – Networks Lab	3	2	2	2	2	2	0	1	1	0	2	2	1	0
		21AI5002/ Data Analytics Lab	3	2	1	3	2	2	0	1	2	0	0	1	1	1
		21HE5071-Soft Skills - I														
		21HE5072-Design Thinking														
IV	VII	19AI7201/Cloud Computing	2	1.2	2.2	1	0	0.4	0	0	0	0	0	0.8	1.2	2.6
		19AI7202/ AI Analyst	3	2	3	1.2	0	0	2	2	1	0	1.2	2	2	3
		19XX7401 -Open Elective – II														
		19CSXXXX -Professional Elective-III														
		19AI7251 Deep Learning Techniques	3	3	2	3	2.25	1	1	1	1	1	3	3	3	3
		19CS7001 – Cloud Computing Laboratory	3	2	1	1	2	0	0	1	0	0	0	1	1	1
		19AI7203/Ethics and Policy Issues in AI Computing	2.8	2.8	1.6	2	2.8	2.8	1	1.2	2.2	0	2	2.6	2	1.8
		19AI7901 Project Phase - I	3	2	2	2	2	2	0	1	1	0	2	2	1	0

PROFESSIONAL ELECTIVE COURSES

Elective	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	V	21AI5301- AI for Cyber Security	3	3	3	3	2	1.4	0.6	0	1	3	0	3	1.2	1.4
		21AI5302 – Internet of things	3	1	2	0	2	0	0	0	0	0	1	2	1	1
		21AI5303 – Advanced Machine Learning	3	2	2	0	2	0	0	0	0	0	1	2	1	1
		21AI5304 – Introduction to Robotics	3	1	1	1	1	0	0	0	1	0	1	1	1	0
		21AI5305 – Bioinformatics	1.7	2.3	3	3	2	0	0	0	0	2	2	2	2.3	2.8
		21AI5306/ Computer Architecture anOrganization	3	2	2	2	2	2	0	1	1	0	2	2	1	0
III	VII	19AI7301-Computer Vision	3	2	1	0	2	0	0	1	2	0	0	1	1	1
		19AI7302-Intelligent Multi Agent and Expert systems	3	2	1	1	0	0	0	0	0	2	2	2	2	0
		19AI7303-Cognitive Systems	2	2	1	0	1	1	0	1	0	0	2	1	2	1
		19AI7304-Quantum Computing	3	2	2	2	2	2	0	1	1	0	2	2	1	0
		19AI7305 -Web and Social media mining	3	2	1	1	0	0	0	0	0	2	2	2	2	0

OPEN ELECTIVE COURSES

Elective	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	VII	19AI7401Business Analytics	1.00	1.40	1.20	1.00	1.40	-	-	-	-	-	-	1.40	1.60	1.20

1-Low, 2-Medium, 3-High, - No Correlation

Chairman - BoS
AIML - HiCET

Dean (Academics)
HiCET

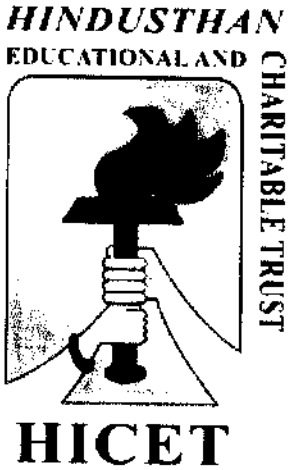
HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(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



CHOICE BASED CREDIT SYSTEM

Revised Curriculum and Syllabus for the Even semester

Academic year 2023-2024

(Academic Council Meeting Held on 26.12.2023)

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

SEMESTER I (Credit : 19)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22MA1101	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
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	2	0	2	3	4	50	50	100
5	22IT1152	Introduction to Web Application Development	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
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
MANDATORY COURSES											
8	22MC1091/ 22MC1092	அறிவியல் தமிழ் / Indian Constitution	MC	2	0	0	0	2	100	0	100
			TOTAL	**16**	**1**	**8**	**19**	**26**	**480**	**320**	**800**

SEMESTER II (Credits – 22)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22MA2103	Differential Equations And 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
THEORY WITH LAB COMPONENT											
4	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
5	22PH2151	Physics For Circuit Engineering Programme	BSC	2	0	2	3	4	50	50	100
6	22CS2253	Java Fundamentals	ICC	2	0	2	3	4	50	50	100
7	22IT2253	Dynamic Web Design	PCC	2	0	1	2	3	50	50	100
PRACTICAL											
7	22ME2001	Engineering Practices	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
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
MANDATORY COURSES											
10	22MC2091/ 22MC2092	தமிழர்மரபு/ *Heritage of Tamils*	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, inanyone of the personality and character development programmes and undergo training for about 80 hours							
			TOTAL	**18**	**1**	**12**	**22**	**29**	**630**	**370**	**1000**

SEMESTER III (Credits – 25)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22MA3106	Discrete Mathematics	BSC	3	1	0	4	4	40	60	100
2	22AI3201	Data Structures	PCC	3	0	0	3	4	40	60	100
3	22AI3202	Foundations of Artificial Intelligence	PCC	3	1	0	4	4	40	60	100
4	22AI3203	Microprocessor and Embedded Systems	ESC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5	22AI3253	Clean Coding and Devops	ICC	3	0	2	4	4	50	50	100
PRACTICAL											
6	22AI3001	Microprocessor and Embedded Systems Laboratory	ESC	0	0	4	2	4	60	40	100
7	22AI3002	Foundations of Artificial Intelligence Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	22HE3071	Soft Skills And Aptitude -2	SEC	1	0	0	1	1	100	0	100
9	22AI3003	Data Structures Laboratory	AEC	0	0	4	2	4	60	40	100
10	22MC3191	Essence of Indian Traditional Knowledge	MC	2	0	0	0	2	100	0	100
			TOTAL	**17**	**2**	**14**	**25**	**34**	**590**	**410**	**1000**

SEMESTER IV (Credits – 23)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2	22AI4201	Database ManagementSystems	PCC	3	0	0	3	3	40	60	100
3	22AI4202	Data Visualization	ICC	3	0	0	3	3	40	60	100
4	22AI4203	Software Design with UML	PCC	3	0	0	3	3	40	60	100
5	22MA4102	Applied Statistics and Queuing Theory	BSC	2	1	0	3	4	40	60	100
THEORY WITH LAB COMPONENT											
6	22AI4251	Operating Systems	PCC	3	0	2	4	4	50	50	100

PRACTICAL											
7	22AI4001	Database Management Systems Laboratory	PCC	0	0	4	2	4	60	40	100
8	22AI4002	Data Visualization Laboratory	ICC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9	22HE4071	Soft Skills -3	SEC	1	0	0	1	1	100	0	100
			TOTAL	**17**	**0**	**12**	**23**	**31**	**480**	**420**	**900**

SEMESTER V (Credits – 22)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22AI5201	Machine Learning Techniques-1	PCC	3	1	0	4	4	40	60	100
2	22AI5202	Computer Networks	PCC	3	0	0	3	3	40	60	100
3	22AI53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4	22AI53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5	22AI53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6	22AI5251	Introduction to Design Thinking	ICC	2	0	2	3	4	50	50	100
PRACTICAL											
7	22AI5001	Machine Learning Techniques-1 Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
			TOTAL	**18**	**1**	**6**	**22**	**25**	**410**	**390**	**800**

SEMESTER VI (Credits – 24)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22AI6201	Machine Learning Techniques-2	PCC	3	0	0	3	3	40	60	100
2	22HE6101	Professional Ethics	HSC	3	0	0	3	3	40	60	100
3	22AI63XX	Professional Elective-4/ AI ANALYST	PEC/ICC	3	0	0	3	3	40	60	100

4	22AI63XX	Professional Elective-5/ BUSINESS INTELLIGENCE	PEC/ICC	3	0	0	3	3	40	60	100
5	22AI64XX	Open Elective – 1*	OEC	3	0	0	3	3	40	60	100
6	22AI64XX	Open Elective – 2*	OEC	3	0	0	3	3	40	60	100
7	22CY6101	Environmental Studies	BSC	2	0	0	2	3	40	60	100
PRACTICAL											
8	22AI6001	Machine Learning Techniques-2 Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9	**22HE6071**	Soft Skills - 5	SEC	2	0	0	2	2	100	0	100
			TOTAL	**22**	**0**	**4**	**24**	**27**	**440**	**460**	**900**

SEMESTER VII (Credits – 20)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
THEORY											
1	22AI7201	Big Data Analytics	PCC	3	0	0	3	3	40	60	100
2	22AI7202	Deep Learning	PCC	3	1	0	4	4	40	60	100
3	22AI73XX	Professional Elective-6 /Predictive Modeling	PEC/ICC	3	0	0	3	3	40	60	100
4	22XX74XX	Open Elective – 3*	OEC	3	0	0	3	3	40	60	100
5	22XX74XX	Open Elective – 4*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
6	22AI7001	Deep Learning Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
7	22AI7701	Internship - II*	SEC	0	0	0	2	2	100	0	100
			TOTAL	**15**	**1**	**4**	**20**	**22**	**360**	**340**	**700**

*** - Four weeks internship carries 2 credit and it will be done in before Semester VI summer vacation/placement training and same will be evaluated in Semester VII.**

SEMESTER VIII (Credits – 10)											
S No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**TCP**	**CIA**	**ESE**	**Total**
EEC COURSES (SE/AE)											
1	22AI8901	Project Work/Granted Patent	SEC	0	0	20	10	20	100	100	200
			TOTAL	**0**	**0**	**20**	**10**	**20**	**100**	**100**	**200**

Note:

1. As per the AICTE guideline, in Semester I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students' who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extracredits printed in the Consolidated Mark sheet as per the regulation.
2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
3. The above-mentioned NCC Courses will be offered to the Students who are going to be admitted in the Academic Year 2022 – 23.

SEMESTER WISE CREDIT DISTRIBUTION

B.E. / B.TECH.PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	**11**
2	BSC	7	9	4	3	-	2	-	-	**25**
3	ESC	6	2	5	-	-	-	-	-	**13**
4	PCC	-	5	13	17	12	5	9	-	**61**
5	PEC	-	-	-	-	9	6	3	-	**18**
6	OEC	-	-	-	-	-	6	6	-	**12**
7	EEC	3	3	3	1	1	2	2	10	**25**
8	MC	✓	✓							
	Total	**19**	**22**	**25**	**23**	**22**	**24**	**20**	**10**	**165**

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Blockchain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3

4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE
I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Space Science	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3

10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Biorefinery	OEC	3	0	0	3	3

Note: Non Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
3	22AI7401	Fundamentals Of Management For Engineers	OEC	3	0	0	3	3

OPEN ELECTIVE IV

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3

3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Data Science	Vertical II Full Stack Development	Vertical III Network And Cloud Computing	Vertical IV Cyber Security and Data Privacy	Vertical V Computer Vision And Virtual Reality	Vertical VI Emerging Technologies
22AI5301 Data Engineering	**22AI5304** Internet and Web Development	**22AI5307** Wireless Sensor Networks	**22AI5310** Ethical Hacking	**22AI5313** Computer Graphics and Multimedia	**22AI5316** Soft Computing
22AI5302 Information Retrieval Techniques	**22AI5305** UI and UX Design	**22AI5308** Cloud Computing	**22AI5311** Web and Android Security	**22AI5314** Image and video analytics	**22AI5317** Natural Language Processing
22AI5303 Data Science Tools And Techniques	**22AI5306** Mobile Application Development	**22AI5309** Cloud Storage infrastructure	**22AI5312** Modern Cryptography and Network Security	**22AI5315** Game Programming	**22AI5318** Quantum Computing
22AI6301 R Programming For Data Science	**22AI6303** Dev-ops	**22AI6305** Social and Information Networks	**22AI6307** Application of AI in Cyber Security	**22AI6309** Computer Vision	**22AI6311** Stream Analytics
22AI6302 Fuzzy logic and Neural Networks	**22AI6304** Web Application Security	**22AI6306** 5G Network	**22AI6308** Cyber Forensic & investigation	**22AI6310** Introduction to Augmented Reality	**22AI6312** 3D Printing and Design
22AI7301 Recommender Systems	**22AI7302** Middleware framework	**22AI7303** Cloud Security	**22AI7304** Digital and Mobile Forensics	**22AI7305** Virtual Reality	**22AI7306** Intelligent Multi Agent and Expert Systems

Note:

Students are permitted to choose all professional electives from any of the verticals.

Vertical I

Data Science

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	**22AI5301**	Data Engineering	PEC	3	0	0	3	3
2	**22AI5302**	Information Retrieval Techniques	PEC	3	0	0	3	3

3	**22AI5303**	Data Science Tools And Techniques	PEC	3	0	0	3	3
4	**22AI6301**	R Programming For Data Science	PEC	3	0	0	3	3
5	**22AI6302**	Fuzzy logic and Neural Networks	PEC	3	0	0	3	3
6	**22AI7301**	Recommender Systems	PEC	3	0	0	3	3

Vertical II
Full Stack Development

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	**22AI5304**	Internet and Web Development	PEC	3	0	0	3	3
2	**22AI5305**	UI and UX Design	PEC	3	0	0	3	3
3	**22AI5306**	Mobile Application Development	PEC	3	0	0	3	3
4	**22AI6303**	Devops	PEC	3	0	0	3	3
5	**22AI6304**	Web Application Security	PEC	3	0	0	3	3
6	**22AI7302**	Middleware Framework	PEC	3	0	0	3	3

Vertical III
Network And Cloud Computing

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	**22AI5307**	Wireless Sensor Networks	PEC	3	0	0	3	3
2	**22AI5308**	Cloud Computing	PEC	3	0	0	3	3
3	**22AI5309**	Cloud Storage infrastructure	PEC	3	0	0	3	3
4	**22AI6305**	Social and information Networks	PEC	3	0	0	3	3
5	**22AI6306**	5G Network	PEC	3	0	0	3	3
6	**22AI7303**	Cloud Security	PEC	3	0	0	3	3

Vertical IV
Cyber Security and Data Privacy

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	**22AI5310**	Ethical Hacking	PEC	3	0	0	3	3

2	**22AI5311**	Web and Android Security	PEC	3	0	0	3	3
3	**22AI5312**	Modern Cryptography and Network Security	PEC	3	0	0	3	3
4	**22AI6307**	Application of AI in Cyber Security	PEC	3	0	0	3	3
5	**22AI6308**	Cyber Forensic & investigation	PEC	3	0	0	3	3
6	**22AI7304**	Digital and Mobile Forensics	PEC	3	0	0	3	3

Vertical V

Computer Vision And Virtual Reality

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	**22AI5313**	Computer Graphics and Multimedia	PEC	3	0	0	3	3
2	**22AI5314**	Image and video analytics	PEC	3	0	0	3	3
3	**22AI5315**	Game Programming	PEC	3	0	0	3	3
4	**22AI6309**	Computer Vision	PEC	3	0	0	3	3
5	**22AI6310**	Introduction to Augmented Reality	PEC	3	0	0	3	3
6	**22AI7305**	Virtual Reality	PEC	3	0	0	3	3

Vertical VI

Emerging Technologies

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	**22AI5316**	Soft Computing	PEC	3	0	0	3	3
2	**22AI5317**	Natural Language Processing	PEC	3	0	0	3	3
3	**22AI5318**	Quantum Computing	PEC	3	0	0	3	3
4	**22AI6311**	Stream Analytics	PEC	3	0	0	3	3
5	**22AI6312**	3D Printing and Design	PEC	3	0	0	3	3
6	**22AI7306**	Intelligent Multi Agent and Expert Systems	PEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honors) or Minor Degree. For B.E. / B. Tech. (Honors), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For a minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

VERTICALS FOR MINOR DEGREE

Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.

AIML OFFERING MINOR DEGREE

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5231	Sem 5: Datastructures using C Programming	MDC	3	0	0	3	3
2	22AI6231	Sem 6: Introduction to Databases	MDC	3	0	0	3	3
3	22AI6232	Sem6: Foundation of Artificial Intelligence & Machine Learning	MDC	3	0	0	3	3
4	22AI7231	Sem 7: Introduction to Robotics	MDC	3	0	0	3	3
5	22AI7232	Sem 7: Natural Language Processing	MDC	3	0	0	3	3
6	22AI8231	Sem 8: Deep Learning -Principles& Practices	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I
Fintech and Block Chain

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22MB5231	Financial Management	MDC	3	0	0	3	3
2	22MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	22MB6232	Banking, Financial Services and Insurance	MDC	3	0	0	3	3
4	22MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	22MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	22MB8231	Introduction to Fintech	MDC	3	0	0	3	3

Vertical II
Entrepreneurship

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22MB5232	Foundations of Entrepreneurship	MDC	3	0	0	3	3
2	22MB6233	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
3	22MB6234	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
4	22MB7233	Principles of Marketing Management For Business	MDC	3	0	0	3	3
5	22MB72334	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
6	22MB8232	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical III
Environment and Sustainability

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22CE5232	Sustainable infrastructure Development	MDC	3	0	0	3	3
2	22AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3

3	22BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3
4	22ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	22CE7233	Green Technology	MDC	3	0	0	3	3
6	22CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

B. TECH (HONS) AI & ML

Vertical I ROBOTICS	Vertical II BLOCK CHAIN TECHNOLOGY	Vertical III CYBER PHYSICAL SYSTEMS
22AI5204 Foundations of Robotics	22AI5205 Public Key Infrastructure and Trust Management	22AI5206 Cyber Physical Systems
22AI6203 Sensors and Actuators	22AI6205 Introduction to block chain	22AI6207 Communication for CPS
22AI6204 Robots, bots and communication	22AI6206 Cryptocurrency	22AI6208 CPS System Design
22AI7203 Human-Robot Interaction	22AI7205 Smart Contracts and Solidity	22AI7207 CPS for Internal and External Security
22AI7204 Medical Robotics	22AI7206 Block chain and distributed ledger technology	22AI7208 Biomedical Instrumentation for Cyber Physical Systems
22AI8201 Fundamentals of Autonomous Systems	22AI8202 Bitcoin Essentials and Use-Cases	22AI8203 Security and Privacy of CPS

B. TECH (HONS) AI & ML SPECIALIZATION WITH ROBOTICS

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5204	Sem 5: Foundations of Robotics	PC	3	0	0	3	3
2	22AI6203	Sem 6: Sensors and Actuators	PC	3	0	0	3	3
3	22AI6204	Sem 6: Robots, bots and communication	PC	3	0	0	3	3
4	22AI7203	Sem 7: Human-Robot Interaction	PC	3	0	0	3	3
5	22AI7204	Sem 7: Medical Robotics	PC	3	0	0	3	3
6	22AI8201	Sem 8: Fundamentals of Autonomous Systems	PC	3	0	0	3	3

B. TECH (HONS) AI & ML SPECIALIZATION WITH BLOCK CHAIN TECHNOLOGY

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5205	Sem 5: Public Key Infrastructure and Trust Management	PC	3	0	0	3	3
2	22AI6205	Sem 6: Introduction to block chain	PC	3	0	0	3	3
3	22AI6206	Sem 6: Cryptocurrency	PC	3	0	0	3	3
4	22AI7205	Sem 7: Smart Contracts and Solidity	PC	3	0	0	3	3
5	22AI7206	Sem 7: Block chain and distributed ledger technology	PC	3	0	0	3	3
6	22AI8202	Sem 8: Bitcoin Essentials and Use-Cases	PC	3	0	0	3	3

B. TECH (HONS) AI & ML SPECIALIZATION WITH CYBER PHYSICAL SYSTEMS

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	22AI5206	Sem 5: Cyber Physical Systems	PC	3	0	0	3	3
2	22AI6207	Sem 6: Communication for CPS	PC	3	0	0	3	3
3	22AI6208	Sem 6: CPS System Design	PC	3	0	0	3	3
4	22AI7207	Sem 7: CPS for Internal and External Security	PC	3	0	0	3	3
5	22AI7208	Sem 7: Biomedical Instrumentation for Cyber Physical Systems	PC	3	0	0	3	3
6	22AI8203	Sem 8: Security and Privacy of CPS	PC	3	0	0	3	3

Credit Distribution R2022

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

Chairman BoS | **Dean Academics** | **Principal**

Chairman - BoS
AIML - RICET

Dean (Academics)
RICET

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22AI4201	DATABASE MANAGEMENT SYSTEMS	3	0	0	3

Course Objective

1. To learn the fundamentals of data models, and to represent a database system using ER diagrams
2. To understand the relational algebra and SQL and to learn normalization techniques
3. To understand the fundamental concepts of transaction, concurrency and recovery processing
4. To understand the internal storage structures using different file and indexing techniques which will help in physical DB design
5. To have an introductory knowledge about NOSQL and database

Unit	Description	Instructional Hours
I	**INTRODUCTION TO DATABASES** Purpose of Database - Database System Architecture - Views of Data– Schema architecture – Data Independence – Schema and instance- Data Models– Benefits of Data Model – Phases of Data Model.ER Diagram - Extended ER Diagram – Examples.	9
II	**RELATIONAL DATABASE AND DESIGN** Relational Data Model – Keys - Relational Algebra - SQL Fundamentals – Advanced SQL Features - Embedded SQL- Dynamic SQL. Normalization - Functional Dependency - First, Second, Third Normal Form - BCNF, Non Loss Decomposition - 4NF - Multi valued Dependency - 5NF - Join Dependency	9
III	**TRANSACTION AND CONCURRENCY CONTROL** Transaction processing - ACID Properties - failure and recovery – Schedules – Serializability - Concurrency Control - Lock based protocol - Two Phase Commit - Isolation levels - SQL Facilities for concurrency and recovery - Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm -Database integrity and security	9
IV	**IMPLEMENTATION TECHNIQUES** RAID – File Organization – Organization of Records in Files – Data dictionary Storage – Column Oriented Storage– Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files– Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for Selection,Sorting and join operations – Query optimization using Heuristics - Cost Estimation.	9
V	**ADVANCED TOPICS** NO SQL Databases: Need for NO SQL – Characteristics of NOSQL - Comparison of relational databases to new NoSQL stores - CAP Theorem – Key-value database - Apache Cassandra – Columnar Databases – MongoDB – CRUD operations with MongoDB - Document Databases – Graph Databases. Database Security: Security issues –Access control based on privileges – Role Based access control – SQL Injection – Statistical Database security – Flow control – Encryption and Public Key infrastructures – Challenges	9
	Total Instructional Hours	**45**

Course Outcome

Upon completion of this course, the students will be able to
CO1: Design database using ER model
CO2 Construct SQL Queries using relational algebra and normalize the database
CO3: Construct queries to handle transaction processing and maintain consistency of the database
CO4: Compare and contrast various indexing strategies and apply the knowledge to tune the performance of the database.
CO5: Appraise how advanced databases differ from Relational Databases and find a suitable database for the given requirement

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020.

2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017

REFERENCE BOOKS::

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	-	-	-	-	-	2	-	2	2
CO2	3	-	2	-	3	-	-	-	1	-	1	-	2	2
CO3	3	3	3	2	3	-	-	-	1	-	2	-	2	2
CO4	3	3	3	2	2	-	-	-	1	-	3	-	2	-
CO5	3	3	3	2	2	-	-	-	1	-	1	-	2	2

Chairman

Chairman, Board Of Studies

Dean-Academics

Chairman - BoS

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22AI4203	SOFTWARE DESIGN WITH UML	3	0	0	3

Course Objective

1.To understand the basic concepts of software engineering, life cycle models and project management concepts
2.To understand in detail about the requirement analysis and requirement engineering processes
3. Learn the basics of OO analysis and design skills..
4. Learn the UML design diagrams.
5. Learn to map design to code.

Unit	Description	Instructional Hours
I	**SOFTWARE PROCESS AND PROJECT MANAGEMENT** Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Software Project Management: Estimation – LOC and FP Based Estimation, COCOMO Model – Project Scheduling – Scheduling, Earned Value Analysis - Risk Management.	9
II	**REQUIREMENTS ANALYSIS AND SPECIFICATION** Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary	9
III	**UML DIAGRAMS** Introduction to OOAD – Unified Process – UML diagrams – Use Case – Class Diagrams– Interaction Diagrams – State Diagrams – Activity Diagrams – Package, component and Deployment Diagrams	9
IV	**DESIGN PATTERNS** GRASP: Designing objects with responsibilities – Creator – Information expert – Low Coupling – High Cohesion – Controller – Design Patterns – creational – factory method – structural – Bridge – Adapter – behavioral – Strategy – observer.	9
V	**CASE STUDY** Case study – the Next Gen POS system, Inception -Use case Modeling – Relating Use cases – include, extend and generalization – Elaboration – Domain Models – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Findir g conceptual class Hierarchies – Aggregation and Composition.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand and gain knowledge to implement projects using OO concepts.
CO2: Understand the functional requirements of UML analysis and design diagrams.
CO3: Apply the UML diagrams to understand the conceptual classes and class hierarchies
CO4: Apply appropriate design patterns.
CO5: Understand the concepts of use case modeling.

TEXT BOOKS:

T1 Roger S. Pressman, —Software Engineering – A Practitioner"s Approachl, Seventh Edition, Mc Graw-Hill International Edition, 2010.

T2 Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", Third Edition, Pearson Education, 2005.

REFERENCE BOOKS:

R1: Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.
R2: Simon Bennett, Steve Mc Robb and Ray Farmer, "Object Oriented Systems Analysis and Design Using UML", Fourth Edition, Mc-Graw Hill Education, 2010.
R3: Erich Gamma, and Richard Helm, Ralph Johnson, John Glissades, "Design patterns-Addison-Wesley, 1995.
R4: Stephen R.Schach, —Software Engineering‖, Tata McGraw-Hill Publishing Company Limited,2007.

PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	2	-	3	2	-	3	1	2	-	3	2	2
CO3	3	3	3	2	3	3	2	3	1	3	2	3	2	2
CO4	3	3	3	2	2	3	2	2	1	3	2	2	2	-
CO5	3	3	3	2	2	3	2	2	1	3	2	2	2	2

Chairman

Chairman, Board Of Studies

Chairman - BoS
ACEL - HiCET

Dean-Academics

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22AI4001	DATABASE MANAGEMENT SYSTEMS LABORATORY	0	0	4	2

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

Example 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

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	Brindha	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)

Ticketdetail
Tick_no (Foreign key)

Sex (Check constraint for accepting either M of F)

5.

Busdiv	**Journey**
Buscode (primary key)	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 totfare in the ticket table by 100 update the table. Create a trigger that ensures no changes to the records on specified days.

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.

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

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22AI4003	DATA VISUALIZATION	3	0	0	3

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
I	**INTRODUCTION TO STATISTICS** Data collection methods, Descriptive Statistics Mean, Median, Mode, Inferential Statistics, Random Variables, Probability Distributions, Normal Distribution, Sampling and Sampling Distribution.	9
II	**VISUALIZATION USING R** 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).	9
III	**WATSON STUDIO** Data visualization in Watson studio, Adding data to data refiner, Visualization of data in Watson studio.	9
IV	**DATA ANALYSIS USING PYTHON** 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).	9
V	**VISUALIZATION USING PYTHON** 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.	9
	Total Instructional Hours	**45**

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:

:IBM CE-Data visualization. T1

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.

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22AI4002	DATA VISUALIZATION LABORATORY	0	0	4	2

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

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	22AI4251	OPERATING SYSTEMS	2	0	2	3

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
I	**OPERATING SYSTEMS OVERVIEW** 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
II	**PROCESS MANAGEMENT** Processes - Process concepts - Process scheduling - Operations on processes - Cooperating processes - CPU scheduling - Basic concepts - Scheduling criteria - Scheduling algorithms - Preemptive strategies - Non-preemptive strategies. *Illustrative Programs: Implementation of process scheduling mechanism (Round Robin, SJF, FCFS).*	5+4(P)
III	**SYNCHRONIZATION AND DEADLOCKS** The critical section problem - Semaphores - Classic problems of synchronization - Critical regions - Monitors-Dead locks - Deadlock characterization - Prevention - Avoidance - Detection - Recovery. *Illustrative Programs: Producer Consumer Problem using Semaphores, Bankers Algorithm.*	5+4(P)
IV	**MEMORY MANAGEMENT** 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. *Illustrative Programs: Simulate Paging Technique of Memory Management, Simulate Page Replacement Algorithms (FIFO, LRU, LFU).*	6+4(P)
V	**I/O SYSTEM, LINUX & SHELL PROGRAMMING** 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 - *Case Study (Linux) - Shell Programming - Variable, Arithmetic Operations, Control Structures, Handling Date, Time & System Information.*	6+4(P)
	Total Instructional Hours	**45(29+16)**

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.

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", 4th Edition, Pearson Publications, 2019.

R2: D M Dhamdhere, "Operating Systems: A Concept-Based Approach", 3rd 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", 9th Edition, Pearson Publications, 2018.

PO&PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	-	-	-	-	-	2	-	2	2
CO2	3	-	2	-	3	-	-	-	1	-	1	-	2	2
CO3	3	3	3	2	3	-	-	-	1	-	2	-	2	2
CO4	3	3	3	2	2	-	-	-	1	-	3	-	2	-
CO5	3	3	3	2	2	-	-	-	1	-	1	-	2	2

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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

HINDUSTHAN
EDUCATIONAL AND CHARITABLE TRUST
HICET

CHOICE BASED CREDIT SYSTEM

Revised Curriculum and Syllabus for the even semester

Academic year 2023-24

(Academic Council Meeting Held on 26.12.2023)

CURRICULUM
R2019

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS
CBCS PATTERN
UNDERGRADUATE PROGRAMMES
B.TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (UG)
REGULATION-2019
For the students admitted during the academic year 2021-2022 and onwards

SEMESTER I -20 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE1101	Technical English	HS	2	1	0	3	40	60	100
2	21MA1101	Calculus	BS	3	1	0	4	40	60	100
THEORY & LAB COMPONENT										
3	21PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	21CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	21CS1152	Object oriented programming using Python	IC	2	0	2	3	50	50	100
6	21EC1154	Basics of Electron devices and Electric Circuits	ES	2	0	2	3	50	50	100
PRACTICAL										
7	21HE1001	Language Competency Enhancement Course - I	HS	0	0	2	1	100	0	100
MANDATORY										
8	21MC1191	Induction Program	MC	0	0	0	0	0	0	0
9	21HE1072	Career Guidance – Level I	EEC	2	0	0	0	100	0	100
10	21HE1073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
Total Credits				**16**	**2**	**10**	**20**	**580**	**320**	**900**

SEMESTER II – 22 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE2101	Business English for Engineers	HS	2	1	0	3	40	60	100
2	21MA2104	Differential Equations And Linear Algebra	BS	3	1	0	4	40	60	100
THEORY & LAB COMPONENT										
3	21PH2151	Material Science	BS	2	0	2	3	50	50	100
4	21CY2151	Environmental Studies	BS	2	0	2	3	50	50	100

5	21CS2153	Java Fundamentals	IC	2	0	2	3	50	50	100
6	21ME2154	Engineering Graphics	ES	1	0	4	3	50	50	100
PRACTICAL										
7	21ME2001	Engineering Practices	ES	0	0	4	2	60	40	100
8	21HE2001	Language Competency Enhancement Course - II	HS	0	0	2	1	100	0	100
MANDATORY										
9	21HE2072	Career Guidance – Level II	EEC	2	0	0	0	100	0	100
Total Credits				14	2	16	22	540	360	900

SEMESTER III -21 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
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
THEORY & LAB COMPONENT										
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
PRACTICAL										
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
MANDATORY										
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
THEORY										
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
THEORY & LAB COMPONENT										
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	Valuc 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

SEMESTER V -24 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21AI5201	Computer Networks	PC	3	0	0	3	40	60	100
2	21AI5202	Data Analytics	PC	3	0	0	3	40	60	100
3	21HE5181	Management Information System	HS	3	0	0	3	40	60	100
4	21AI53**	Professional Elective- I	PE	3	0	0	3	40	60	100
THEORY & LAB COMPONENT										
5	21AI5251	Object Oriented Analysis and Design	PC	2	0	2	3	50	50	100
6	21AI5252	Introduction to Design Thinking	IC	2	0	2	3	50	50	100
PRACTICAL										
7	21AI5001	Networks Lab	PC	0	0	3	1.5	60	40	100
8	21AI5002	Data Analytics Lab	PC	0	0	3	1.5	60	40	100
9	21AI5701	MOOC / Industrial Training / Seminar	EEC	0	0	2	1	100	0	100
10	21HE5071	Soft Skills-I	EEC	1	0	0	1	100	0	100
11	21HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
Total Credits				18	0	12	24	680	420	1100

SEMESTER VI-24 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21AI6201	Theory of Computation	PC	3	0	0	3	40	60	100
2	21AI6202	Development of Machine Learning Models	IC	3	0	0	3	40	60	100
3	21AI6203	Natural Language Processing	PC	3	0	0	3	40	60	100
4	21AI63**	Professional Elective- II	PE	3	0	0	3	40	60	100
5	21**64**	Open Elective I	OE	3	0	0	3	40	60	100
THEORY & LAB COMPONENT										
6	21AI6251	Predictive Modeling	IC	3	0	2	4	50	50	100

PRACTICAL										
7	21AI6001	Natural Language Processing Lab	PC	0	0	3	1.5	60	40	100
8	21AI6801	Mini Project	EEC	0	0	3	1.5	50	50	100
9	21HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
10	21HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
Total Credits				20	0	8	24	560	380	1000

SEMESTER VII-21 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21AI7201	Cloud Computing	PC	3	0	0	3	40	60	100
2	21AI7202	AI Analyst	IC	3	0	0	3	40	60	100
3	21AI7203	Ethics and Policy Issues in AI Computing	PC	2	0	0	2	40	60	100
3	21AI73**	Professional Elective- III	PE	3	0	0	3	40	60	100
4	21**74**	Open Elective II	OE	3	0	0	3	40	60	100
THEORY & LAB COMPONENT										
5	21AI7251	Deep Learning Techniques	PC	3	0	2	4	50	50	100
PRACTICAL										
6	21AI7001	Cloud Computing Lab	PC	0	0	3	1.5	60	40	100
7	21AI7002	Data Visualization Lab	IC	0	0	3	1.5	60	40	100
Total Credits				17	0	8	21	370	370	800

SEMESTER VIII-14 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21AI83**	Professional Elective- IV	PE	3	0	0	3	40	60	100
2	21AI83**	Professional Elective- V	PE	3	0	0	3	40	60	100
PRACTICAL										
3	21AI8901	Project Work	EEC	0	0	16	8	100	100	200
Total Credits				6	0	16	14	180	220	400

Total Credits:165

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE I

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI5301	AI for Cyber Security	3	0	0	3	40	60	100
21AI5302	Internet of things	3	0	0	3	40	60	100
21AI5303	Advanced Machine Learning	3	0	0	3	40	60	100
21AI5304	Introduction to Robotics	3	0	0	3	40	60	100
21AI5305	Bioinformatics	3	0	0	3	40	60	100
21AI5306	Computer Architecture and Organization	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE II

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI6301	Neural Networks	3	0	0	3	40	60	100
21AI6302	Big data Computing	3	0	0	3	40	60	100
21AI6303	AI in Blockchain	3	0	0	3	40	60	100
21AI6304	Human Machine Interaction	3	0	0	3	40	60	100
21AI6305	Social Networks	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE III

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI7301	Computer Vision	3	0	0	3	40	60	100
21AI7302	Intelligent Multi Agent and Expert systems	3	0	0	3	40	60	100
21AI7303	Cognitive Systems	3	0	0	3	40	60	100
21AI7304	Quantum Computing	3	0	0	3	40	60	100
21AI7305	Web and Social media mining	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE IV

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI8301	Computational Neuroscience	3	0	0	3	40	60	100
21AI8302	Data Science	3	0	0	3	40	60	100
21AI8303	Network Science and Modeling	3	0	0	3	40	60	100
21AI8304	Reinforcement Learning	3	0	0	3	40	60	100
21AI8305	Stream Analytics	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE V

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI8306	Soft Computing in Medical Diagnostics	3	0	0	3	40	60	100
21AI8307	Pattern Recognition Algorithms	3	0	0	3	40	60	100
21AI8308	Graph Analytics for Big Data	3	0	0	3	40	60	100
21AI8309	Optimization in ML	3	0	0	3	40	60	100
21AI8310	5G Network	3	0	0	3	40	60	100

OPEN ELECTIVE

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21AI6401	Cyber Security and Intelligence	3	0	0	3	40	60	100
21AI7401	Business Analytics	3	0	0	3	40	60	100

List of Life Skill Courses under Open Elective

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
21LSX401	General Studies for Competitive Examinations	3	0	0	3	40	60	100
21LSX402	Human Rights, Women Rights and Gender Equality	3	0	0	3	40	60	100
21LSX403	Indian Ethos and Human Values	3	0	0	3	40	60	100
21LSX404	Indian Constitution and Political System	3	0	0	3	40	60	100
21LSX405	Yoga for Human Excellencc	3	0	0	3	40	60	100

As per the AICTE guideline, in Semester I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Students who will be enrolled his name in HICET NCC are eligible to undergo these subjects. Earned extra credits printed in the Consolidated Mark sheet as per the regulation. NCC course level 1 & Level 2 will be added in the open elective subject in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.

Semester	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	NCC General and National Integration	1	0	0	1	100	0	100
2	Social services and community development	1	0	0	1	100	0	100
3	General awareness, communication and Aero engines	1	0	0	1	100	0	100

VERTICALS FOR MINOR DEGREE

Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.

AIML OFFERING MINOR DEGREE

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21AI5601	Sem 5: Data structures using C Programming	MDC	3	0	0	3	3
2	21AI6601	Sem 6: Introduction to Databases	MDC	3	0	0	3	3
3	21AI6602	Sem6: Foundation of Artificial Intelligence & Machine Learning	MDC	3	0	0	3	3
4	21AI7601	Sem 7: Introduction to Robotics	MDC	3	0	0	3	3
5	21AI7602	Sem 7: Natural Language Processing	MDC	3	0	0	3	3
6	21AI8601	Sem 8: Deep Learning -Principles& Practices	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I
Fintech and Block Chain

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21MB5231	Financial Management	MDC	3	0	0	3	3
2	21MB6231	Fundamentals of Investment	MDC	3	0	0	3	3
3	21MB6232	Banking, Financial Services and Insurance	MDC	3	0	0	3	3
4	21MB7231	Introduction to Blockchain and its Applications	MDC	3	0	0	3	3
5	21MB7232	Fintech Personal Finance and Payments	MDC	3	0	0	3	3
6	21MB8231	Introduction to Fintech	MDC	3	0	0	3	3

Vertical II
Entrepreneurship

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21MB5232	Foundations of Entrepreneurship	MDC	3	0	0	3	3
2	21MB6233	Team Building & Leadership Management for Business	MDC	3	0	0	3	3
3	21MB6234	Creativity & Innovation in Entrepreneurship	MDC	3	0	0	3	3
4	21MB7233	Principles of Marketing Management For Business	MDC	3	0	0	3	3
5	21MB72334	Human Resource Management for Entrepreneurs	MDC	3	0	0	3	3
6	21MB8232	Financing New Business Ventures	MDC	3	0	0	3	3

Vertical III Environment and Sustainability

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21CE5232	Sustainable infrastructure Development	MDC	3	0	0	3	3
2	21AG6233	Sustainable Agriculture and Environmental Management	MDC	3	0	0	3	3
3	21BM6233	Sustainable Bio Materials	MDC	3	0	0	3	3
4	21ME7233	Materials for Energy Sustainability	MDC	3	0	0	3	3
5	21CE7233	Green Technology	MDC	3	0	0	3	3

6	21CE8232	Environmental Quality Monitoring and Analysis	MDC	3	0	0	3	3

B. TECH (HONS) AI & ML

Vertical I ROBOTICS	Vertical II BLOCK CHAIN TECHNOLOGY	Vertical III CYBER PHYSICAL SYSTEMS
Sem 5: 21AI5203 Foundations of Robotics	Sem 5: 21AI5204 Public Key Infrastructure and Trust Management	Sem 5: 21AI5205 Principles of Cyber Physical Systems
Sem 6: 21AI6204 Sensors and Actuators	Sem 6: 21AI6206 Introduction to block chain	Sem 6: 21AI6208 Communication for CPS
Sem 6: 21AI6205 Robots, bots and communication	Sem 6: 21AI6207 Cryptocurrency	Sem 6: 21AI6209 Security in cyber physical system
Sem 7 21AI7204 Human-Robot Interaction	Sem 7 21AI7206 Smart Contracts and Solidity	Sem 7 21AI7208 CPS for Internal and External Security
Sem 7: 21AI7205 Medical Robotics	Sem 7 21AI7207 Block chain and distributed ledger technology	Sem 7 21AI7209 Biomedical Instrumentation for Cyber Physical Systems
Sem 8: 21AI8201 Fundamentals of Autonomous Systems	Sem 8: 21AI8202 Bitcoin Essentials and Use-Cases	Sem 8: 21AI8203 Privacy of CPS

B. TECH (HONS) AI & ML SPECIALIZATION WITH ROBOTICS

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21AI5203	Sem 5: Foundations of Robotics	PC	3	0	0	3	3
2	21AI6204	Sem 6: Sensors and Actuators	PC	3	0	0	3	3
3	21AI6205	Sem 6: Robots, bots and communication	PC	3	0	0	3	3
4	21AI7204	Sem 7: Human-Robot Interaction	PC	3	0	0	3	3
5	21AI7205	Sem 7: Medical Robotics	PC	3	0	0	3	3
6	21AI8201	Sem 8: Fundamentals of Autonomous Systems	PC	3	0	0	3	3

B. TECH (HONS) AI & ML SPECIALIZATION WITH BLOCK CHAIN

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21AI5204	Sem 5: Public Key Infrastructure and Trust Management	PC	3	0	0	3	3
2	21AI6206	Sem 6: Introduction to block chain	PC	3	0	0	3	3
3	21AI6207	Sem 6: Cryptocurrency	PC	3	0	0	3	3
4	21AI7206	Sem 7: Smart Contracts and Solidity	PC	3	0	0	3	3
5	21AI7207	Sem 7: Block chain and distributed ledger technology	PC	3	0	0	3	3
6	21AI8202	Sem 8: Bitcoin Essentials and Use-Cases	PC	3	0	0	3	3

B. TECH (HONS) AI & ML SPECIALIZATION WITH CYBER PHYSICAL SYSTEMS

S No	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1	21AI5205	Sem 5: Principles of Cyber Physical Systems	PC	3	0	0	3	3
2	21AI6208	Sem 6: Communication for CPS	PC	3	0	0	3	3
3	21AI6209	Sem 6: Security in Cyber Physical Systems	PC	3	0	0	3	3
4	21AI7208	Sem 7: CPS for Internal and External Security	PC	3	0	0	3	3
5	21AI7209	Sem 7: Biomedical Instrumentation for Cyber Physical Systems	PC	3	0	0	3	3
6	21AI8203	Sem 8: Security and Privacy of CPS	PC	3	0	0	3	3

CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	21	19	24	24	21	14	165

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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech	21AI6201	Theory of Computation	3	0	0	3

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	**Introduction to Automata theory** Introduction-Need of automata theory-Formal proof- Additional Forms of Proof-Inductive Proofs-Central Concepts of Automata Theory-DFA and NDFA-Finite Automaton with Є- Transitions-Equivalence of DFA and NFA-Case Study: Finite Automata for Artificial Intelligence, Compilers, Probability	9
II	**Regular Expressions** 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	**Context Free Grammars** 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	**PushDown Automata and Turing Machines** 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	**Undecidability** 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
	Total Instructional Hours	**45**

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", ThirdEdition, 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.

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

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	2	3
CO2	3	1	2	2	2	3	0	1	2	0	3	2	2	2
CO3	3	3	2	2	2	3	0	1	2	0	2	2	1	2
CO4	3	1	2	2	0	3	0	1	0	0	2	2	1	2
CO5	3	1	2	1	2	0	0	0	0	0	2	3	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI6203	NATURAL LANGUAGE PROCESSING	3	0	0	3

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.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO NLP** 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	**TEXT PREPROCESSING AND MORPHOLOGY** 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	**LANGUAGE MODELLING** 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	**WORD SENSE DISAMBIGUATION** 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	**SYNTAX AND SEMANTICS** 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
	Total Instructional Hours	**45**

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.

TEXT BOOKS:

T1: Christopher D. Manning and Hinrich Schutze, " 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: NitinIndurkhya, 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 HinrichSchütze, "Foundations of Statistical Natural Language Processing",2nd edition, MITPress 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 Arumugam, Rajalingappa Shanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application". PACKT publisher, 2018.

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	2	2	2	1	1	2	2	3	3	2
CO2	3	3	3	2	2	2	2	1	1	2	1	2	3	2
CO3	3	3	3	2	2	2	2	1	1	2	1	2	3	3
CO4	3	3	2	2	2	2	2	1	2	2	1	3	3	2
CO5	3	3	2	2	2	2	2	1	2	2	2	3	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI6001	NATURAL LANGUAGE PROCESSING LAB	0	0	3	1.5

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
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

Course Outcome

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

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.

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	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

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DEAN-ACADEMICS

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21AI6202	DEVELOPMENT OF MACHINE LEARNING MODELS	3	0	0	3

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)‖, The MIT Press 2004.

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

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	3	3	3	1	3	1	-	1	3	3
CO2	3	3	3	1	3	3	3	1	3	1	1	1	3	3
CO3	3	2	3	2	2	2	3	2	2	2	2	2	2	3
CO4	3	3	3	2	3	3	3	2	3	2	-	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3	1	3	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	21AI6251	PREDICTIVE MODELING	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
I	**INTRODUCTION TO PREDICTIVE MODELLING** 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**). *Illustrative program: Collect and understand the data*	9+2(p)
II	**INTRODUCTION TO SPSS MODELER** 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. *Illustrative program: Set the unit of analysis for the data* *a) Remove duplicate records* *b) Aggregate transactional data* *c) Create flag fields and aggregate the data* *Integrate data* *a) Appending Report* *b) Merge field*	9+4(p)
III	**USING FUNCTIONS IN SPSS** 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. *Illustrative program:* *Identify relationships in the data* *a) Examine the relationship between categorical fields* *b) Examine the relationship between a categorical and continuous field* *Predict customer churn in telecom dataset* *a) Build Model using CHAID* *b) Examine the CHAID Model* *c) Apply the model to new data*	9+3(p)
IV	DATA FIELD TRANSFORMATION	9+3(p)

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. *Illustrative program: Create a Segmentation Model*

Create homogeneous groups (clusters) of customers based on usage patterns.
Using functions in IBM SPSS Modeler

a) *Date and Time Functions*
b) *String Functions*
c) *Statistical Functions*
d) *Missing Value Function*

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). . *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*	9+3(p)
	Total Instructional Hours	**(45+15) 60**

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

TEXT BOOKS:

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

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

CO3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
CO4	2	3	3	2	2	3	2	2	2	2	-	2	3	2
CO5	3	3	3	3	3	3	3	3	3	3	1	3	3	3

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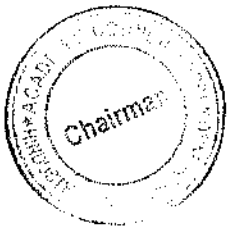

Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI6301	Neural Networks	3	0	0	3

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
I	**INTRODUCTION TO NEURAL NETWORKS** 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
II	**ESSENTIALS OF ARTIFICIAL NEURAL NETWORKS** 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
III	**SINGLE LAYER FEED FORWARD NETWORKS** Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Limitations of the Perceptron Model.	9
IV	**MULTI-LAYER FEED FORWARD NETWORKS** Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.	9
V	**ASSOCIATIVE MEMORIES** 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
	Total Instructional Hours	**45**

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.

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

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

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Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI6302	Big data Computing	3	0	0	3

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	**INTRODUCTION TO BIG DATA** Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.	9
II	**HADOOP FRAMEWORK** Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN	9
III	**DATA ANALYSIS** Statistical Methods:Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods,Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.	9
IV	**MINING DATA STREAMS** Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.	9
V	**BIG DATA FRAMEWORKS** Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. 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
	Total Instructional Hours	**45**

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, 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.

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	0	2	0	0	1	0	1	1	3	1	0
CO2	3	2	2	0	1	0	0	1	0	1	0	1	0	0
CO3	3	2	1	0	3	0	0	1	0	1	0	2	1	0
CO4	3	2	3	0	2	0	0	1	0	1	1	1	1	1
CO5	3	2	3	0	1	0	0	1	0	1	1	1	1	0

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AIML - [illegible]

DEAN-ACADEMICS

Dean (Academics)
H

Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI6303	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.
5. To understand the Future of AI with Blockchain

Unit	Description	Instructional Hours
I	**INTRODUCTION TO BLOCKCHAIN:** 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 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	9
II	**BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE:** 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 - 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	9
III	**CRYPTOCURRENCY AND ARTIFICIAL INTELLIGENCE:** The role of AI in cryptocurrency Cryptocurrency trading - Making price predictions with AI - Market making - Development Life Cycle of a DIApp Technical requirement.	9
IV	**IMPLEMENTING DI APPS:** Evolution of decentralized applications - Building a sample DIApp - Testing the sample DIApp - Deploying the sample DIApp - Retrospecting the sample DIApp	9
V	**THE FUTURE OF AI WITH BLOCKCHAIN:** The convergence of AI and blockchain - 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.	9
	Total Instructional Hours	**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.

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.

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

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DEAN-ACADEMICS

Programme	Course Code	Name of the Course	L	T	P	C
B. Tech.	21AI6304	Human Machine Interaction	3	0	0	3

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
	BASICS OF HML	
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
	DESIGN & SOFTWARE PROCESS	
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
	MODELS AND THEORIES	
III	HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.	9
	MOBILE HMI	
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
	WEB INTERFACE DESIGN	
V	Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies	9
	Total Instructional Hours	**45**

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 Interactionl, 3rd Edition, Pearson Education, 2004 (UNIT I, II & III)

T2: Brian Fling, —Mobile Design and Developmentl, First Edition, O'Reilly Media Inc., 2009 (UNIT – IV)

T2: Bill Scott and Theresa Neil, —Designing Web Interfacesl, First Edition, O'Reilly, 2009. (UNIT-V)

REFERENCE BOOKS:

R1:Stuart K. Card, Thomas P. Moran, Allen Newell,The Psychology of Human-Computer Interaction,CRC Press,2017
R2: Bhatacharia ,Human Computer Interaction MC GRAW HILL INDIA
R3: Benyon David, Designing Interactive Systems, Pearson, 2013

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	0	0	0	0	0	0	2	3	3	2	1
CO2	3	2	1	2	1	0	0	0	0	1	3	1	3	0
CO3	3	2	1	1	1	0	0	0	0	2	0	2	1	0
CO4	3	2	1	0	0	0	0	0	0	1	1	1	2	1
CO5	3	2	1	0	0	0	0	0	0	2	1	1	1	0

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DEAN-ACADEMICS

Programme	Course Code	Name Of The Course	L	T	P	C
B. Tech.	21AI6305	Social Networks	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	**INTRODUCTION** 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	**MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION** Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - 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	**MINING COMMUNITIES AND SOCIAL MEDIA MINING** 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	**EVOLUTION** 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	**TEXT, OPINION AND MULTIMEDIA DATA MINING** 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
	TOTAL INSTRUCTIONAL HOURS	**45**

Course Outcome

CO1: Work on the internals 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, 1st 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

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

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DEAN-ACADEMICS

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Programme	Course Code	Name Of The Course	L	T	P	C
B. Tech.	21AI6401	Cyber Security and Intelligence	3	0	0	3

Course Objective

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.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO CYBER SECURITY** 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	**CYBERSPACE AND THE LAW & CYBER FORENSIC** 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	**CYBERCRIME: MOBILE AND WIRELESS DEVICES** Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones ,Organizational security Policies and Measures in Mobile Computing Era, Laptops	9
IV	**CYBER SECURITY: ORGANIZATIONAL IMPLICATIONS** Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.	9
V	**PRIVACY ISSUES** 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
	TOTAL INSTRUCTIONAL HOURS	**45**

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 SunitBelpure, Cyber Security Understanding Cyber Crimes,Computer Forensics and Legal Perspectives,Wiley

2.B.B.Gupta,D.P.Agrawal,HaoxiangWang,ComputerandCyberSecurity:Principles,Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018.

REFERENCES BOOKS:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRCPress.

2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&FGroup.

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	3	2	3	3	2	0	3	2
CO2	3	1	2	2	2	3	2	2	2	2	2	2	2	2
CO3	3	3	2	2	2	3	2	2	2	2	2	2	2	2
CO4	3	1	2	2	0	3	2	0	0	2	0	2	2	0
CO5	3	1	2	1	2	0	1	2	0	1	2	3	1	2

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DEAN-ACADEMICS

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DEPARTMENT OF AIML

HONOURS WITH SPECIALIZATION

(ROBOTICS)

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	21AI6204	Sensors and Actuators	3	0	0	3

Course Objective

1. To understand the fundamental concepts of Measurements And Sensors
2. To Design measuring equipment's for the measurement of pressure force, temperature and flow.
3. To Generate new ideas in designing the sensors and actuators for automotive application
4. To Understand the operation of the sensors, actuators and electronic control.
5. To Design temperature control actuators for vehicles.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO MEASUREMENTS AND SENSORS** Sensors: Functions- Classifications- Main technical requirement and trends Units and standardsCalibration methods- Classification of errors- Error analysis- Limiting error- Probable errorPropagation of error- Odds and uncertainty- principle of transduction-Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers Dynamic characteristics of first and second order transducers for standard test inputs.	9
II	**VARIABLE RESISTANCE AND INDUTANCE SENSORS** Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT	9
III	**VARIABLE AND OTHER SPECIAL SENSORS** Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.	9
IV	**AUTOMOTIVE ACTUATORS** Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc	9
V	**AUTOMATIC TEMPERATURE CONTROL ACTUATORS** Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system	9
	Total Instructional Hours	**45**

Course Outcome		
	CO1:	List common types of sensor and actuators used in vehicles.
	CO2:	Design measuring equipment's for the measurement of pressure force, temperature and flow.
	CO3:	Generate new ideas in designing the sensors and actuators for automotive application

	CO4:	Understand the operation of thesensors, actuators and electronic control.
	CO5:	Design temperature control actuators for vehicles.

TEXT BOOKS:

1. Doebelin's Measurement Systems: 7th Edition (SIE),Ernest O. Doebelin DhaneshN.Manik McGraw Hill Publishers, 2019.

2. Robert Brandy, " Automotive Electronics and Computer System", Prentice Hall,2001

3. William Kimberley," Bosch Automotive Handbook", 6th Edition. Robert Bosch GmbH, 2004.

4. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5.

REFERENCE BOOKS:

1. James D Halderman, " Automotive Electrical and Electronics" , Prentice Hall, USA, 2013

2. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International.

3. Patranabis.D, " Sensors and Transducers", 2nd Edition, Prentice Hall India Ltd.2003

4. William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.

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	3	3
CO2	3	1	2	2	2	3	0	1	2	0	3	2	2	2
CO3	3	3	2	2	2	3	0	1	2	0	2	2	2	2
CO4	3	1	2	2	0	3	0	1	0	0	2	2	0	2
CO5	3	1	2	1	2	0	0	0	0	0	2	3	0	1

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	21AI6205	Robots, bots and communication	3	0	0	3

Course Objective

1. To Learn and understand the basic concepts, history, evolution and anatomy of Bots and its applications.
2. To know the difference between robots, bots and robotic process automation.
3. To Understand the various communication protocols used in Industrial robots.
4. To Understand the operation of the sensors, actuators and electronic control.
5. To Design temperature control actuators for vehicles.

Unit	Description	Instructional Hours
I	**Introduction and Major Platforms** Bots, Difference between bots and RPA, The Bot Revolution and Evolution, Stages of Bot adoption, Bot Types – Personal Vs Team Bots, Super Bots Vs Domain Specific Bots, Business Bots Vs Consumer Bots, Voice Vs Text Bots, Net New Bots Vs Integrations Exposing Legacy Systems The Business Bot Platform: Slack, The Consumer Bot Platform: Facebook Messenger, The Voice Bot Platform: Alexa, The Teens' Bot Platform: Kik, The Legacy Bot Platforms: Email, SMS, How to Choose a Platform	9
II	**Bot Anatomy** Bot Anatomy – Breaking Down Bots – Core Purpose and Functionality, Branding, Personality, and Human Involvement: Branding – Visual Branding, Logo, Stickers, Images, Naming; Personality –WordsBot, Poncho, Expressing Your Personality; Human Intervention	9
III	**Conversation** Onboarding, Functionality Scripting, Decoration, Acknowledgment and Confirmation,Consistency, Reciprocity, Team Versus Private Interactions, Error Handling - Course Correction, Human Intervention, Restarting the Conversation, Redirecting to Another Bot, Keeping It Consistent, Learning from Your Bot's Mistakes, Help and Feedback	9
IV	**Designing and Testing** Designing a Bot with Botsociety, User Testing - Prototyping a Mockup Bot, Planning the Test,Creating Tasks and Discussion Guides, Recruiting Participants, Setting Up the Environment,Moderating the Sessions, Analyzing the Data, Improving and Iterating.	9
V	**Bot Building Overview** Bot Architecture, Bot Building Technologies – Visual Authoring Tools and Integrated Development Environments (IDEs), Artificial Intelligence (AI) Services, Software Development Kits and Bot Frameworks, Picking the Right Tool-Case study (Bots to book tickets to Events/Shows, Use Chatbots to find products, check inventory and recommend items)	9
	Total Instructional Hours	**45**

Course Outcome	CO1:	To understand the difference between robots, bots and robotic process automation.
	CO2:	Learn and understand the basic concepts of Bots and its applications

	CO3:	Understand the history, evolution and anatomy of bots.
	CO4:	To understand how to plan, implement, test, and deploy bots
	CO5:	Understand the various communication protocols used in Industrial robots

TEXT BOOKS:

1. Amir Shevat, Designing Bots: Creating Conversational Experiences, O'Reilly, 2017

2. Deon Reynders, Steve Mackay, Edwin Wright, Practical Industrial Data Communications, 1st Edition ELSEVIER, 2005

Reference Books

1. Craig J.J., Introduction to Robotics Mechanics and Control, Pearson Education, 2008

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

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DEPARTMENT OF AIML

HONOURS WITH SPECIALIZATION

(CYBER PHYSICAL SYSTEMS)

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	21AI6208	Communication for CPS	3	0	0	3

Course Objective

1. To infer the basics of cyber physical systems.
2. To understand the communication capacity requirements of CPS.
3. To study the network topology design in CPS.
4. To gain insights about the communication network operation in CPS..
5. To study the physical layer design in CPS.

Unit	Description	Instructional Hours
I	**Basics of CPS** Elements of a CPS. Basics of Communication: Information measures, comm. Channels,source coding, modulation, networking and typical comm. systems. Modelling of controlled dynamical systems, Observability, controllability and optimal control. Typical cyber physical systems: power networks and robot networks	9
II	**Communication Capacity Requirements** Methodologies for communication. Basic Models. Deterministic Models: Stability.Stochastic systems: Estimation. Stochastic systems: Stability. Stochastic systems: reduction of Shannon entropy. Networked stochastic systems. Control communication complexity	9
III	**Network Topology Design** WDM networks and design constraints. Optimization procedure. Optimization based on topology design, Formulation of objective function, Optimization of topology, Team decision theory and its application in optimal control.	9
IV	**Communication Network Operation for CPS** Hybrid system modelling for CPS. Optimization of scheduling policy. Mode provisioning, Model scheduling, Information based scheduling. Estimation oriented routing. System dynamics-aware multicast routing	9
V	**Physical Layer Design for CPS** Physical layer in CPS. Adaptive modulation. Source coding in CPS: point-to-point case and distributed case. Physical dynamics-aware channel decoding. Control-oriented channel coding. Channel coding for interactive communication in computing	9
	Total Instructional Hours	**45**

Course Outcome		
	CO1:	Characterize the basics of communication in cyber physical systems
	CO2:	Elaborate the communication capacity requirements in CPS framework
	CO3:	Illustrate the network topology in CPS
	CO4:	Investigate the operation of communication network in CPS
	CO5:	Determine the physical layer requirements in CPS.

TEXT BOOKS:

1. Li, Husheng, "Communications for control in cyber physical systems: theory, design and applications in smart grids", Morgan Kaufmann, 2016.
2. Ferrari, Silvia, and Thomas A, Wettergren, "Information-driven Planning and Control", MIT Press, 2021.

Reference Books

1. Hu, Fei., "Cyber-physical systems: integrated computing and engineering design", CRC Press, 2013.
2. Rodrigues, Joel JPC, and Amjad Gawanmeh, eds., "Cyber-Physical Systems for NextGeneration Networks", IGI Global, 2018.

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	0	2	1	2	1	1	3	2	3
CO2	3	2	2	1	1	1	1	1	1	1	2	1	1	1
CO3	3	2	1	3	3	3	3	1	3	1	3	2	3	2
CO4	3	2	3	2	2	2	2	1	2	1	1	1	2	1
CO5	3	2	3	1	1	0	1	1	1	1	1	1	1	1

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	**21AI6209**	**Security in Cyber Physical Systems**	**3**	**0**	**0**	**3**

Course Objective
To introduce mathematical framework for Cyber Physical System attacks.
To introduce centralized and decentralized techniques of attack detection

Unit	Description	Instructional Hours
I	Review of graph theory based models; some examples from infrastructure system modelling Descriptor system; Unified modelling of CPS attack; case of undetectable attacks.	9
II	Graph theoretic characterization of attacks and its limitations; Centralized and Distributed monitors; examples from power system, water distribution networks	9
III	Security issues of Industrial Control Systems; Integrity attacks on SCADA systems.	9
IV	Model based technique to detect integrity attacks on sensors; threat model and its effect on Control scheme; countermeasure for detecting such attacks; watermarking scheme.	9
V	Design of observers under sensor and actuator attacks; design of observer for distributed environment under different attacks; applications of swarms of UAVs; Control design with denial service attack; case studies	9
	Total Instructional Hours	**45**

Course Outcome	CO1:	Develop understanding about the cyber security and its criticalities in CPS.
	CO2:	Analyze the need of Graph theoretic characterization,andthe Centralized and Distributed monitors.
	CO3:	Analyze the role of security issues of CPS in industrial control and electrical power systems applications.
	CO4:	Analyze model base techniques in security issues.
	CO5:	Develop understanding of real world needs by studding the different case studies.

TEXT BOOKS:

1. F. Pasqualetti, F. Dörfler and F. Bullo, "Attack Detection and Identification in CyberPhysicalSystems," in IEEE Transactions on Automatic Control, vol. 58, no. 11, pp.2715-2729, Nov.2013.

2. H. Fawzi, P. Tabuada and S. Diggavi, "Secure Estimation and Control for Cyber Physical Systems Under Adversarial Attacks," in IEEE Transactions on Automatic Control, vol. 59, no.6, pp. 1454-1467, June 2014.

Reference Books:

1. Yilin Mo, Rohan Chabukswar and Bruno Sinopoli "Detecting Integrity Attacks on SCADA Systems" in IEEE Transactions on Control System Technology, Vol. 22, No. 4, 2014.

2. F. Pasqualetti, F. Dörfler and F. Bullo "Control Theoretic methods for Cyber

Physical Security", in IEEE Control System Magazine, pp. 110-127, Feb. 2015

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	0	1	2	2	1	2	3	1	2
CO2	3	2	2	1	1	1	2	1	1	2	1	1	2	1
CO3	3	2	1	3	3	3	1	3	3	1	3	2	1	3
CO4	3	2	3	2	2	2	3	2	2	3	2	1	3	2
CO5	3	2	3	1	1	0	3	1	1	3	1	1	3	1

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DEPARTMENT OF AIML

MINOR DEGREE

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	21AI6602	Foundation of Artificial Intelligence & Machine Learning	3	0	0	3

Course Objective

1. To Study about uninformed and Heuristic search techniques.
2. To Learn techniques for reasoning under uncertainty
3. To Introduce Machine Learning and supervised learning algorithms
4. To Study about ensembling and unsupervised learning algorithms
5. Learn the basics of deep learning using neural networks

Unit	Description	Instructional Hours
I	**PROBLEM SOLVING** Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems –adversarial search – constraint satisfaction problems (CSP)	9
II	**PROBABILISTIC REASONING** Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning –Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.	9
III	**SUPERVISED LEARNING** Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression. Probabilistic generative model Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests	9
IV	**ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING** Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization	9
V	**NEURAL NETWORKS** Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout	9
	Total Instructional Hours	**45**

Course Outcome		
	CO1:	Use appropriate search algorithms for problem solving
	CO2:	Apply reasoning under uncertainty
	CO3:	Build supervised learning models
	CO4:	Build ensembling and unsupervised models
	CO5:	Build deep learning neural network models

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.

2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.

REFERENCE BOOKS

1. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education,2007

2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008

3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006

4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013

(http://nptel.ac.in/)

5. Christopher M. Bishop, "Pattern Recognition and Machine Learning

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	21AI6601	Introduction to Databases	3	0	0	3

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

Unit	Description	Instructional Hours
I	**INTRODUCTION TO DATABASE SYSTEMS** 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
II	**RELATIONAL DATABASE** 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
III	**CONCEPTUAL DATA MODELING** 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: Subclasses, Superclasses, and Inheritance, Specialization and Generalization.	9
IV	**NORMALIZATION THEORY** 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
V	**TRANSACTION MANAGEMENT** 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
	Total Instructional Hours	45

Course Outcome

CO1: Understand the functional components of DBMS and datamodels

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.

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.

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

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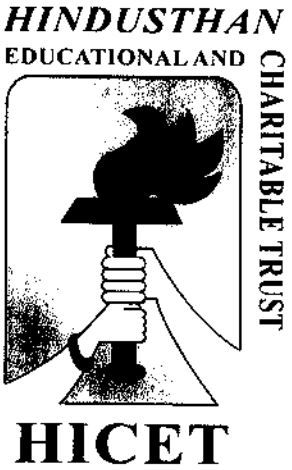
HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(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



CHOICE BASED CREDIT SYSTEM

Revised Curriculum and Syllabus for the even semester

Academic year 2023-24

(Academic Council Meeting Held on 19.06.2023)

CURRICULUM
R2019

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS
CBCS PATTERN
UNDERGRADUATE PROGRAMMES
B.TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (UG)
REGULATION-2019
For the students admitted during the academic year 2020-2021 and onwards

SEMESTER I -20 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE1101	Technical English	HS	2	1	0	3	25	75	100
2	19MA1101R	Calculus	BS	3	1	0	4	25	75	100
THEORY & LAB COMPONENT										
3	19PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	19CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	19CS1152	Object oriented programming using Python	IC	2	0	2	3	50	50	100
6	19EC1154	Basics of Electron devices and Electric Circuits	ES	2	0	2	3	50	50	100
PRACTICAL										
7	19HE1071	Language Competency Enhancement Course - I	HS	0	0	2	1	100	0	100
MANDATORY										
8	19MC1191	Induction Program	MC	0	0	0	0	0	0	0
9	19HE1072	Career Guidance – Level I	EEC	2	0	0	0	100	0	100
10	19HE1073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
Total Credits				16	2	10	20	550	350	900

SEMESTER II – 22 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE2101	Business English for Engineers	HS	2	1	0	3	25	75	100
2	19MA2104	Differential Equations And Linear Algebra	BS	3	1	0	4	25	75	100
THEORY & LAB COMPONENT										
3	19PH2151	Material Science	BS	2	0	2	3	50	50	100
4	19CY2151	Environmental Studies	BS	2	0	2	3	50	50	100

5	19CS2153	Java Fundamentals	IC	2	0	2	3	50	50	100
6	19ME2154	Engineering Graphics	ES	1	0	4	3	50	50	100
PRACTICAL										
7	19ME2001	Engineering Practices	ES	0	0	4	2	50	50	100
8	19HE2071	Language Competency Enhancement Course - II	HS	0	0	2	1	100	0	100
MANDATORY										
9	19HE2072	Career Guidance – Level II	EEC	2	0	0	0	100	0	100
Total Credits				14	2	16	22	500	400	900

SEMESTER III -21 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19AI3201	Data Structures and Algorithms	PC	3	0	0	3	25	75	100
2	19AI3202	Foundations of Artificial Intelligence	PC	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
3	19MA3152	Probability and Applied Statistics	BS	3	0	2	4	50	50	100
4	19AI3251	Digital Principles and System Design	PC	3	0	2	4	50	50	100
5	19AI3252	Clean Coding and Devops	IC	3	0	2	4	50	50	100
PRACTICAL										
6	19AI3001R	Data Structures and Algorithms Laboratory	PC	0	0	3	1.5	50	50	100
7	19AI3002	Artificial Intelligence Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY										
8	19MC3191	Indian Constitution	MC	2	0	0	0	0	0	0
9	19HE3072	Career Guidance- Level III	EEC	2	0	0	0	100	0	100
10	19HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
Total Credits				20	0	12	21	500	400	900

SEMESTER IV -19 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA4105	Discrete Mathematical Structures	BS	2	1	0	3	25	75	100
2	19AI4201	Database Management System	PC	3	0	0	3	25	75	100
3	19AI4202	Data Visualization	IC	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
4	19AI4251	Operating Systems	PC	2	0	2	3	50	50	100
5	19AI4252	Introduction to Machine Learning	PC	3	0	2	4	50	50	100

PRACTICAL										
6	19AI4001R	Database Management System Laboratory	PC	0	0	3	1.5	50	50	100
7	19AI4002	Data Visualization Laboratory	IC	0	0	3	1.5	50	50	100
MANDATORY										
8	19MC4191	Value Education - Essence of Indian Traditional Knowledge	MC	2	0	0	0	0	0	0
9	19HE4072	Career Guidance- Level IV	EEC	2	0	0	0	100	0	100
10	19HE4073	Ideation Skills	EEC	1	0	0	0	100	0	100
Total Credits				18	1	10	19	475	425	900

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

SEMESTER VII-21 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19AI7201	Cloud Computing	PC	3	0	0	3	25	75	100
2	19AI7202	AI Analyst	IC	3	0	0	3	25	75	100
3	19AI7203	Ethics and Policy Issues in AI Computing	PC	3	0	0	2	25	75	100
3	19AI73**	Professional Elective- III	PE	3	0	0	3	25	75	100
4	19**74**	Open Elective II	OE	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
5	19AI7251	Deep Learning Techniques	PC	3	0	2	4	50	50	100
PRACTICAL										
6	19AI7001	Cloud Computing Laboratory	PC	0	0	3	1.5	50	50	100
7	19AI7901	Project Phase - I	PC	0	0	3	1.5	50	50	100
Total Credits				17	0	8	21	275	525	800

SEMESTER VIII-14 Credits

S.No	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19AI83**	Professional Elective- IV	PE	3	0	0	3	25	75	100
2	19AI83**	Professional Elective- V	PE	3	0	0	3	25	75	100
PRACTICAL										
3	19AI8901	Project Phase - II	EEC	0	0	16	8	100	100	200
Total Credits				6	0	16	14	150	250	400

Total Credits:165

LIST OF PROFESSIONAL ELECTIVES

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

PROFESSIONAL ELECTIVE III

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19AI7301	Computer Vision	3	0	0	3	25	75	100
19AI7302	Intelligent Multi Agent and Expert systems	3	0	0	3	25	75	100
19AI7303	Cognitive Systems	3	0	0	3	25	75	100
19AI7304	Quantum Computing	3	0	0	3	25	75	100
19AI7305	Web and Social media mining	3	0	0	3	25	75	100
19IT7307	Web Development - II	0	0	3	3	50	50	100

PROFESSIONAL ELECTIVE IV

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19AI8301	Computational Neuroscience	3	0	0	3	25	75	100
19AI8303	Network Science and Modeling	3	0	0	3	25	75	100
19AI8304	Reinforcement Learning	3	0	0	3	25	75	100
19AI8305	Stream Analytics	3	0	0	3	25	75	100
19AI8311	Advanced Social Networks	3	0	0	3	25	75	100
19IT8314	Web Development - III	0	0	3	3	50	50	100

PROFESSIONAL ELECTIVE V

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19AI8306	Soft Computing in Medical Diagnostics	3	0	0	3	25	75	100
19AI8307	Pattern Recognition Algorithms	3	0	0	3	25	75	100
19AI8308	Graph Analytics for Big Data	3	0	0	3	25	75	100
19AI8309	Optimization in ML	3	0	0	3	25	75	100
19AI8310	5G Network	3	0	0	3	25	75	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

List of Life Skill Courses under Open Elective

Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
19LSX401	General Studies for Competitive Examinations	3	0	0	3	25	75	100
19LSX402	Human Rights, Women Rights and Gender Equality	3	0	0	3	25	75	100
19LSX403	Indian Ethos and Human Values	3	0	0	3	25	75	100
19LSX404	Indian Constitution and Political System	3	0	0	3	25	75	100
19LSX405	Yoga for Human Excellence	3	0	0	3	25	75	100

CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	21	19	24	24	21	14	**165**

*** Student can earn extra credit 35 over and above the total credits**

Chairman BoS

Dean Academics

Principal

Chairman - BoS
HICET

Dean (Academics)
HICET

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI8301	COMPUTATIONAL NEUROSCIENCE	3	0	0	3

Course Objective	1. Understand how the brain processes information. 2. Learn the models and the importance of plasticity mechanisms in cognitive brain processing. 3. Understand the brain organization using networks and some learning algorithms. 4. Acquire the knowledge of information representation and related competitive dynamics in neuronal tissue. 5. Make the learners familiar with system-level models of the brain.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Computational Neuroscience, model, brain theory, computational theory of the brain, The Neuron, the Circuit, and the Brain Neurons and conductance-based models: Biological background, Basic synaptic mechanisms and dendritic processing, The generation of action potentials: Hodgkin–Huxley equations, Including neuronal morphologies: compartmental models.	9
II	**POPULATION MODELS, ASSOCIATORS AND SYNAPTIC PLASTICITY** Basic spiking neurons, pike-time variability, The neural code and the firing rate hypothesis, Population dynamics: modelling the average behavior of neurons, Networks with non-classical synapses: the sigma–pi node, Associative memory and Hebbian learning, The physiology and biophysics of synaptic plasticity, Mathematical formulation of Hebbian plasticity, Synaptic scaling and weight distributions	9
III	**CORTICAL ORGANIZATION AND NETWORKS** Organization in the brain, Information transmission in random networks, More physiological spiking networks, The simple perceptron, The multilayer perceptron, Advanced MLP concepts, Support vector machines.	9
IV	**CORTICAL FEATURE MAPS AND RECURRENT ASSOCIATIVE NETWORKS** Competitive feature representations in cortical tissue, Self-organizing maps, Dynamic neural field theory, 'Path' integration and the Hebbian trace rule, Distributed representation and population coding, The auto-associative network and the hippocampus, Point-attractor neural networks (ANN), Sparse attractor networks and correlated patterns, Chaotic networks: a dynamic systems view.	9
V	**SYSTEM-LEVEL MODELS** **Modular networks, motor control, and reinforcement learning** : Modular mapping networks, Coupled attractor networks, Sequence learning, Complementary memory systems, Motor learning and control, Reinforcement learning, **The cognitive brain:** Hierarchical maps and attentive vision, An interconnecting workspace hypothesis, The anticipating brain, Adaptive resonance theory	9
	Total Instructional Hours	**45**

After completion of course, students would be able to:

Course Outcome	CO1:	Explore the brain processes information.
	CO2:	Explain the models and the importance of plasticity mechanisms in cognitive brain processing.

	CO3:	Demonstrate the brain organization using networks and some learning algorithms
	CO4:	Discuss information representation and related competitive dynamics in neuronal tissue
	CO5:	Apply the system-level models to explore the brain process.

TEXT BOOKS:	
T1:	Fundamentals of Computational Neuroscience, Thomas Trappenberg, OUP Oxford; 2nd edition, 2009.
T2:	An Introductory Course in Computational Neuroscience, Paul Miller, The MIT Press; 1st edition, 2018.

REFERENCE BOOKS:	
R1	P. Dayan and L.F. Abbott, "Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems", MIT Press, 2001.
R2	E. Kandel, "Principles of Neural Science", McGraw-Hill, 2000.
R3	F. Rieke, D. Warland, R. de Ruyter van Steveninck, and W. Bialek, "Spikes: Exploring the Neural Code", MIT Press, 1997.
R4	https://www.coursera.org/learn/computational
R5	https://www.edx.org/course/computational

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Programme	Course Code	Name of the Course	L	T	P	C
B .TECH	19AI8303	NETWORK SCIENCE AND MODELING	3	0	0	3

Course Objective	1. Be familiar with the Network science and modelling. 2. Have described the foundation of Graph theory and network modeling. 3. Have gained knowledge in Random networks by using scaling factors. 4. Have gained exposure to scientific and measuring approach. 5. To be familiar with the applications of network modeling.

Unit	Description	Instructional Hours
I	Introduction : The characteristics of network science--Interdisciplinary Nature-Empirical Data Driven Nature, Quantitative and Mathematical Nature,Computational Nature- Societal Impact- Scientific Impact.	9
II	Graph theory, Networks and Graphs, Degree, Average Degree and Degree Distribution- Weighted Networks- Bipartite Networks- Paths and Distances Connectedness- Clustering Coefficient	9
III	Random networks- Binomial and poison distribution -Real Networks are Not Poisson-Small Worlds-Six Deegree of Separation- Clustering Coefficient-the scale free property- Power Laws and Scale-Free Networks- The Meaning of Scale-Free- Universality- Generating Networks with Arbitrary Degree Distribution	9
IV	The Bianconi-Barabási Model-Measuring Fitness-The Fitness of a Web Document-The Fitness of a Scientific Publication-Bose-Einstein Condensation-Scale-free Phase-Evolving Networks-Initial Attractiveness-Internal Links-Node Deletion	9
V	Modeling Cascading Failures- Failure Propagation Model- Branching Model-Building Robustness- Optimizing Attack and Failure Tolerance- Case Study: Estimating Robustness	9
	Total Instructional Hours	**45**

Course Outcome	CO1:	Understanding of the theoretical aspects of network science.
	CO2:	Understand the foundation of various network modeling.
	CO3:	Understand the common methods for robust network matching and analysis.
	CO4:	Exploring the scaling measuring details of various network models
	CO5:	Understanding of various applications of Computer network and model.

TEXT BOOKS:	
T1:	Albert-László Barabási"Network Science" 21 July 2016.
T2:	TED G.Lewis "Network Science" –Theory and Applications"Wiley Publicatiions,2008

REFERENCE BOOKS:	
R1:	"Network Science: Analysis and Optimization Algorithms for Real-World Applications" Carlos Andre Reis Pinheiro,Wiley, 2022
R2:	Henry Hexmoor "Computational Network Science-An Algorithmic Approach"-2014

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Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19AI8304	Reinforcement Learning	3	0	0	3

Course Objective	1. Learn how to define RL tasks and the core principles behind the RL and Implement common algorithms following code standards and libraries used in RL 2. Understand and work with tabular methods to solve classical control problems approximate solutions 3. Learn the policy gradient methods from vanilla to more complex cases 4. Explore imitation learning tasks and solutions. 5. Recognize current advanced techniques and applications in RL

Unit	Description	Instructional Hours
I	Introduction: Introduction and Basics of Reinforcement Learning, Defining RL Framework and Markov Decision Process, Polices, Value Functions and Bellman Equations , Exploration vs. Exploitation, Code Standards and Libraries used in RL (Python/Keras/Tensorflow)	9
II	Probability Primer: Probability concepts - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions. Correlation and independence.	9
III	Tabular methods and Q-networks Monte Carlo Methods : Overview of Monte Carlo methods for model free RL, First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importance sampling. Temporal Difference Methods: Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants.	9
IV	Policy optimization Introduction to policy-based methods, Vanilla Policy Gradient, REINFORCE algorithm and stochastic policy search, Actor-critic methods (A2C, A3C), Advanced policy gradient (PPO, TRPO, DDPG)	9
V	Recent Advances and Applications Meta-learning, Multi-Agent Reinforcement Learning, Partially Observable Markov Decision Process, Ethics in RL, Applying RL for real-world problems	9
	Total Instructional Hours	**45**

Course Outcome	CO1:	Understand the RL Framework and implement common algorithms following code standards and libraries used in RL
	CO2:	Ability to Understand and work with tabular methods to solve classical control problems approximate solutions
	CO3:	Explore imitation learning tasks and solutions.
	CO4:	Familiarize about the policy gradient methods from vanilla to more complex cases
	CO5:	Recognize current advanced techniques and applications in RL

TEXT BOOKS:	
T1:	Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019
T2:	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective".

REFERENCE BOOKS:	
R1:	Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018).
R2:	Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012)
R3:	Alberto Leon-Garcia "Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition . Pearson Education

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	19AI8306	Soft Computing In Medical Diagnostics	3	0	0	3

Course Objective	1. To be familiar with the theoretical aspects of soft computing. 2. To have knowledge on neural networks. 3. To understand fuzzy networks. 4. To gain exposure on soft computing in medical diagnostics. 5. To be familiar with various applications of soft computing.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SOFT COMPUTING** Soft computing Constituents and Conventional Artificial Intelligence – Neural Networks and its advantages – Application Scope of Neural Networks – Hybrid Systems – Genetic Algorithm - Soft Computing	9
II	**NEURAL NETWORKS AND ITS TYPES** Artificial Neural Network -Terminologies of ANN – Supervised Learning Networks – Perceptron Networks – Back Propagation Network – Radial Basis Network – Unsupervised Learning Networks – Kohonen Self-organizing Feature Maps	9
III	**FUZZY NETWORKS** Fuzzy Logic – Extension Principles and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Inference Systems - Mamdami Fuzzy models – Adaptive Neuro-Fuzzy Inference Systems(Architecture, Algorithm, Learning methods) – CART Algorithm for Tree Induction	9
IV	**SOFT COMPUTING IN MEDICAL DIAGNOSTICS** Healthcare Data – Examples of AI in Healthcare – Virtual Assistants in Drug Development – Risk Assessment of Cervical Cancce in Women-Based on Convolutional Neural Network – Diagnosis of Depression using Neuro-Fuzzy Model of Soft Computing	9
V	**APPLICATIONS OF SOFT COMPUTING** A Fusion Approach of Multispectral Images with SAR Image for Flood Area Analysis – Genetic Algorithm Based Internet Search Technique – Issues in designing a genetic algorithm for internet search	9
	Total Instructional Hours	**45**

Course Outcome	CO1:	Understanding basic idea of soft computing.
	CO2:	Understanding neural networks.
	CO3:	Understanding of fuzzy networks.
	CO4:	Understanding the application of soft computing in medical diagnostics.
	CO5:	Understanding various applications of soft computing.

TEXT BOOKS:	
T1:	Principles of Soft Computing – SN Sivanandam, SN Deepa., 2008
T2:	Neuro- Fuzzy and Soft Computing – JSR Jang, CT Sun, E MIZUTANI, Original Edition

T3:	Online Resource: https://www.researchgate.net/publication/355966759

REFERENCE BOOKS:	
R1:	Advanced Soft Computing Techniques in Data Science, IoT and Cloud Computing, Springer Cham.
R2:	Introduction to Soft Computing- Neuro Fuzzy and Genetic Algorithms, Samir Roy, Udit Chakraborty

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	19AI8307	PATTERN RECOGNITION ALGORITHMS	3	0	0	3

Course Objective	1. To understand the Basic neural network architecture and algorithms 2. To analyse the fundamentals of pattern recognition and its application. 3. To understand several supervised and unsupervised algorithms suitable for pattern classification. 4. To Apply the Pattern and Neural Classifiers Concepts for classification applications. 5. To understand the various Graphical Approaches.

Unit	Description	Instructional Hours
I	**PATTERN RECOGNITION OVERVIEW** :Typical Pattern Recognition System, Patterns and Features Extraction, Training and Learning in Pattern Recognition system, Different types of Pattern Recognition Approaches – Statistical, Syntactic, Neural. Discriminant functions	9
II	**STATISTICAL PATTERN RECOGNITION** :Parametric estimation and supervised learning, Maximum likelihood estimation, Bayesian parameter estimation, Non-parametric approaches - Parzen window, k-NN estimation, Unsupervised Learning – Clustering Concepts.	9
III	**SYNTACTIC PATTERN RECOGNITION** :Grammar Based Approaches, Elements of Formal Grammars, Parsing Concepts – Parsing Algorithm, Transition Networks in Parsing, Higher Dimensional Grammars, Stochastic Grammars, Graphical Approaches – Graph Isomorphism, Attributed Graphs.	10
IV	**ARTIFICIAL INTELLIGENCE**: Introduction and historical perspective, Hard and Soft AI– disciplines and applications, Theories of Intelligence, Detecting and Measuring Intelligence, Knowledge based approach, the prepare-deliberate engineering trade-off, Procedural v/s Declarative knowledge, Criticism of symbolic AI, Knowledge representation, desirable properties of KR schemata, Use of predicate calculus in AI.	9
V	**EXPERT SYSTEMS:** Components of Expert Systems, Production rules, Backwards vs Forward reasoning, Statistical reasoning, Meta level knowledge, Introspection, Knowledge engineering case studies, Heuristic search of state space, DFS, BFS, UCS, choice of a search algorithm, Admissibility theorems, search performance metrics, AI programming environments. AI oriented language and architecture.	9
	Total Instructional Hours	**45**

Course Outcome	CO1:	A good knowledge of Pattern Recognition system
	CO2:	Fundamental understanding of classifiers such as linear discriminant function, quadratic discriminant function, nearest neighbor rule, neural network and SVM.
	CO3:	Ability to evaluate the performance of static pattern recognition.
	CO4:	A good understanding of feature selection algorithms.
	CO5:	Ability to evaluate the performance of various classifiers on real-world datasets.

TEXT BOOKS:	
T1:	O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.
T2:	S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009

REFERENCE BOOKS:	
R1:	C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006 .
R2:	P.A Devijver and J. Kittler, Pattern Recognition: A Statistical Approach, Prentice-Hall International, Englewood Cliffs, NJ, 1980.
R3:	K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Ed. Academic Press, New York, 1990.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	19AI8308	GRAPH ANALYTICS FOR BIG DATA	3	0	0	3

Course Objective	1.To have knowledge on the statistical techniques for Big data Analytics. 2.To acquire understanding in mining data streams. 3.To Enable the students to know about clustering techniques. 4.To Usage of graph analytics and thus to provide solutions. 5.To learn about Hadoop map, Reduce programming.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO BIG DATA** Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.	9
II	**DATA ANALYSIS, CLUSTERING AND CLASSIFICATION** Regression Modelling - Multivariate Analysis - Bayesian Modelling – Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction. Overview of Clustering - K-means – Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions. - Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes 'Theorem - Naïve Bayes Classifier.	9
III	**STREAM MEMORY** Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.	9
IV	**ASSOCIATION AND GRAPH MEMORY** Advanced Analytical Theory and Methods: Association Rules - Overview – Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Finding Association& finding similarity - Graph Analytics for Big Data: Graph Analytics - The Graph Model - Representation as Triples - Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases – Graph Analytics Algorithms and Solution Approaches - Technical Complexity of Analyzing Graphs- Features of a Graph Analytics Platform.	9

V	**FRAMEWORKS AND VISUALIZATION** MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 – Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques; Systems and Analytics Applications - Analytics using Statistical packages-Approaches to modeling in Analytics – correlation, regression, decision trees, classification, association-Intelligence from unstructured information-Text analytics-Understanding of emerging trends and Technologies-Industry challenges and application of Analytics- Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.	9
	Total Instructional Hours	**45**

Course Outcome	CO1:	Apply statistical techniques for Big data Analytics.
	CO2:	Analyze problems appropriate to mining data streams.
	CO3:	Apply the knowledge of clustering techniques in data mining.
	CO4:	Use Graph Analytics for Big Data and provide solutions
	CO5:	Apply Hadoop map Reduce programming for handing Big Data

TEXT BOOKS:	
T1:	David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
T2:	Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press.
T3:	Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.

REFERENCE BOOKS:	
R1:	EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
R2:	Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and Its Applications", Wiley Publishers, 2015.
R3:	Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers "CRC Press, 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	19AI8309	OPTIMIZATION TECHNIQUES IN ML	3	0	0	3

Course Objective	1.To learn about the basics of machine learning. 2.To learn about the optimization in ML. 3.To learn about unconstrained optimization in ML. 4.To learn about constrained optimization. 5.To learn about various algorithms optimization.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction: Basic principles, Applications, Challenges. Supervised learning: Linear Regression with one variable and multiple variables, Gradient Descent, Classification, Logistic Regression.	6
II	**OPTIMIZATION** Need for unconstrained methods in solving constrained problems, necessary conditions of unconstrained optimization, structure methods, quadratic models, methods of line search, steepest descent method; conjugate-direction methods: methods for sums of squares and nonlinear equations; linear programming: simplex methods, duality in linear programming, transportation problem.	10
III	**UNCONSTRAINED OPTIMIZATION** Line search method: Wolf condition, Goldstein condition, sufficient decrease and backtracking, Newtons method and Quasi Newton method; trust region method: the Cauchy point, algorithm based on Cauchy point, improving on the Cauchy point, the Dog-leg method, two-dimensional subspace reduction; nonlinear conjugate gradient method: the Fletcher Reeves method	10
IV	**CONSTRAINED OPTIMIZATION** Penalty method, quadratic penalty method, convergence, non-smooth penalty function, L1 penalty method, augmented Lagrangian method; quadratic programming, Schur complementary, null space method, active set method for convex QP; sequential quadratic programming, convex programming.	10
V	**ALGORITHMS OPTIMZATION** Gradient based techniques such as Adam, AdaGrad, AdaDelta, Gradient Descent (GD), Stochastic Gradient Descent (SGD) etc. Metaheuristic techniques such as Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Differential Evolution (DE).	9
	Total Instructional Hours	**45**

Course Outcome	CO1:	To understand the basics of machine learning
	CO2:	To understand the different types of optimization problems
	CO3:	To explain the working principles of optimization techniques
	CO4:	To use optimization techniques in various problems
	CO5:	To use optimization techniques in various algorithms

TEXT BOOKS:	
T1:	Chong, E. K. and Zak, S. H., An Introduction to Optimization, 2nd Ed., Wiley India (2001).
T2:	Luenberger, D. G. and Ye, Y., Linear and Nonlinear Programming, 3rd Ed., Springer (2008).

REFERENCE BOOKS:	
R1:	Kambo, N. S., Mathematical Programming Techniques, East-West Press (1997).
R2:	Boyd, S. and Vandenberghe, L., Convex Optimization, Cambridge Univ. Press (2004).
R3:	Nocedel, J. and Wright, S. Numerical Optimization, Springer (2006).

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	19AI8310	5G NETWORK	3	0	0	3

Course Objective	1. To understand the basic concept of 5G. 2. To learn the available 5G Channel access methods. 3. To understand the Radio Access Technologies for 5G. 4. To be familiar with Channel Models for 5G. 5. To Gain knowledge about Enabling Technologies in wireless Communication.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO 5G** Introduction to 5G – Use Cases - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization - 3GPP and IMT2020 - Spectrum for 5G – 5G deployment - Options, Challenges and Applications.	9
II	**5G CHANNEL ACCESS METHODS** OFDM and OFDMA – MIMO OFDM – Generalized Frequency Division Multiplexing(GFDM) – Non-Orthogonal Multiple Access (NOMA) - Universal Filtered OFDM –Filter bank multicarrier (FBMC)- Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods	9
III	**RADIO ACCESS NETWORK FOR 5G NR** 5G NR requirements - 5G Core Network Architecture - Radio-Access Network (RAN)-Radio Protocol Architecture -User Plane Protocols-Radio Link Control - Medium-Access Control – Physical Layer functions -Control Plane Protocols - Network Slicing- RAN virtualization-Spectrum Management in 5G	9
IV	**CHANNEL MODELS FOR 5G NR** Channel Hierarchy in 5G NR – Logical Channels and Transport Channels in 5G NR - Physical Layer Data Channels in 5G NR - Downlink Physical Channel and Uplink Physical Channels - Propagation Channel models for 5G	9
V	**ENABLING TECHNOLOGIES FOR 5G** Device-to-Device (D2D) Communication - 5G for Massive Machine Type Communication and Massive IoT- V2X Communication - Full Duplex and Green Communication -mmWave Communications -Massive MIMO and Beamforming Techniques	9
	Total Instructional Hours	**45**

Course Outcome	CO1:	Understanding the various 5G standards.
	CO2:	Analyse various channels access methods.
	CO3:	Understand the Radio Access Technologies in wireless Communication.
	CO4:	Exploring Channel models in 5G.
	CO5:	Understanding the various Communication Technologies.

TEXT BOOKS:	
T1:	Saad Z. Asif, "5G Mobile Communications Concepts and Technologies, CRC Press, 1st Edition, 2019.
T2:	Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", John Wiley & Sons, 1st Edition, 2015.

REFERENCE BOOKS:	
R1:	Erik Dahlman, Stefan Parkvall, Johan Skold "5G NR: The Next Generation Wireless Access Technology", Academic Press, 1st Edition, 2018.
R2:	D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.
R3:	Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.
R4:	R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, 1st Edition, 2017.

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Programme	Course Code	Name Of The Course / NPTEL	L	T	P	C
B. Tech.	19AI8311	ADVANCED SOCIAL NETWORKS	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	**INTRODUCTION** 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	**MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION** Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - 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	**MINING COMMUNITIES AND SOCIAL MEDIA MINING** 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	**EVOLUTION** 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	**TEXT, OPINION AND MULTIMEDIA DATA MINING** 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
	TOTAL INSTRUCTIONAL HOURS	**45**

Course Outcome

CO1: Work on the internals 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, 1st 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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SEMESTER - II
SYLLABUS

SEMESTER II

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E/B.TECH/ II	22MA2103	DIFFERENTIALEQUATIONSAND LINEAR ALGEBRA (AIML,CSE,IT)	3	1	0	4

Course Objective

The learner should be able to

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
I	**ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER** Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, Bernoulli equation.	12
II	**LINEAR DIFFERENTIAL EQUATIONS OF SECOND ORDER** Second order linear differential equations with constant with RHS of the form e^{ax},x^n , sinax, cosax- – Cauchy's linear equations– Method of variation of parameters.	12
III	**PARTIAL DIFFERENTIAL EQUATIONS** 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	**VECTOR SPACES** Definition and examples of vector spaces, subspaces of a vector space and the quotient space, Linearly dependence and linearly independence of a set of vectors, Linear span.	12
V	**INNER PRODUCT SPACES** 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

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

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 BOOKS:

T1 – Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2019

T2 - Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence; Linear Algebra, Pearson 5th edition,2022.

REFERENCE BOOKS:

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/ Sem	Course Code	Name of the Course	L	T	P	C
BE/B.Tech II	22PH2101	**BASICS OF MATERIAL SCIENCE (Common to all branches except MCT)**	2	0	0	2

Course Objective

The student should be able to

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
	CRYSTAL PHYSICS	
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
	ELECTRICAL PROPERTIES OF MATERIALS	
II	Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression – Widemann - Franz law – Success and failures –- Fermi- Dirac statistics – Density of energy states .	6
	SEMICONDUCTING MATERIALS	
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
	MAGNETIC MATERIALS	
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
	NEW ENGINEERING MATERIALS	
V	Metallic glasses: melt spinning process, Preparation and applications - shape memory alloys: phases, shape memory effect - Characteristics of SMA : Pseudoelastic effect, Super elasticity and Hystersis. Applications of SMA. Nanomaterials preparation (bottom up and top down approaches) – various techniques - pulsed laser deposition - Chemical vapor deposition	6
	Total Instructional Hours	**30**

Course Outcome

After completion of the course the learner will be able to

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 BOOKS:

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 Delhi 2022

REFERENCE BOOKS:

R1 – Charles Kittel "Introduction to Solid State Physics". Wiley., New Delhi 2017

R2 - Dr. M.Arumugam "Materials Science " Anuradha publications., 2019

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ II	22HE2151	EFFECTIVE TECHNICAL COMMUNICATION (Common to all Branches)	2	0	2	3

Course Objective

The learner should be able

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.

Unit	Description	Instructional Hours
I	Language Proficiency: Types of sentences in English according to structure Writing: writing definitions, Describing product, work place and service (purpose, appearance, function) Vocabulary – words on nature **Practical Component: Listening- Watching and interpreting advertisements/short films Speaking- Extempore speech**	9
II	Language Proficiency: Direct and Indirect speech. Writing: Formal memos, Job application and resume preparation Vocabulary - words on offense and ethics**Practical Component: Listening- Comprehensions based on telephonic conversation Speaking- Vote of thanks& welcome address**	9
III	Language Proficiency: Homophones and Homonyms, Writing: Preparing a detail plan for an official visit, schedule and Itinerary, reading comprehension, Vocabulary– words on society **Practical Component: Listening- Listening- paraphrasing the listened content Speaking- Group Discussion** with preparation	9
IV	Language Proficiency: Idioms Writing: Report writing (marketing, investigating) Vocabulary-words involved in business **Practical Component: Listening- Watching technical discussions and preparing MoM Speaking- On the spot Group Discussion**	9
V	Language Proficiency: spotting errors Writing: making /interpreting chart, sequencing of sentences Vocabulary- words involved in finance **Practical Component: Listening- Comprehensions based on announcements Speaking- Presentation on a technical topic with ppt.**	9
	Total Instructional Hours	45

Course Outcome

At the end of the course, learners will be able

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 BOOKS:

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

REFERENCE BOOKS :

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

BE/B.Tech/ II	22PH2151	PHYSICS FOR CIRCUIT ENGINEERING PROGRAMME (AIML,CSE,ECE,EEE,EIE,IT & BME)	2	0	2	3

Course Objective

The student should be able to

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 Theory Hours
I	**LASER AND FIBER OPTICS** 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. **Determination of Wavelength and particle size using Laser**	6
II	**PROPERTIES OF MATTER** 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 **Determination of Young's modulus by uniform bending method** **Determination of Rigidity modulus – Torsion pendulum**	6
III	WAVE OPTICS 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. **Determination of wavelength of mercury spectrum – spectrometer grating** **Determination of thickness of a thin wire – Air wedge method**	6
IV	**QUANTUM PHYSICS** 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
V	**ULTRASONICS** Production – Piezoelectric generator – Properties of Ultrasonic waves. Determination of velocity using acoustic grating – Cavitation. Industrial applications – Drilling and welding – Non destructive testing (pulse echo system). Medical applications – Ultrasound Scanner – A – mode – B- mode and C –mode.	6
	Total Instructional Hours	30
	Total Lab Instructional Hours	30

Course Outcome

After completion of the course the learner will be able to

CO1: Understand the advanced technology of LASER and optical communication in the field of engineering

CO2: Illustrate the fundamental properties of matter

CO3: Discuss the Oscillatory motions of particles

CO4: Understand the dual nature of matter and the Necessity of quantum mechanics.

CO5: Develop the Ultrasonics technology and its applications in NDT.

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Dean–Academics

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E/B.Tech/ II	22IT2251	PYTHON PROGRAMMING AND PRACTICES (IT, CSE)	2	0	2	3

Course Objective

The student should be able

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
I	**ALGORITHMIC PROBLEM SOLVING** 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)
II	**DATA, STATEMENTS, CONTROL FLOW** 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)
III	**FUNCTIONS, STRINGS** 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)
IV	**LISTS, TUPLES, DICTIONARIES** 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)
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages	(6+2)
	TOTAL INSTRUCTIONAL HOURS	**45**

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.
Course Outcome	At the end of the course, the learner will be able to CO1: Develop algorithmic solutions to simple computational problems CO2: Read, write, execute by hand simple Python programs 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 BOOKS:

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

REFERENCE BOOKS:

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

R2: Timothy A. Budd, —Exploring Pythonl, 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

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.Tech/B.E/II	22IT2253	DYNAMIC WEB DESIGN (IT, CSE & AIML)	2	0	2	2

Course Objective

The student should be able

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 bout Arrays and objects in Java Script
5. To have a knowledge in Event handling in JavaScript

Unit	Description	Instructional Hours
I	**INTRODUCTION TO JAVASCRIPT** Introduction-History of JavaScript -Simple Program: Displaying a dynamic Line of Text in a Web Page-Modifying Our First Program Obtaining –DataTip- Identifiers-Operators. *Conversion of Celsius to Fahrenheit using JavaScript. Java Script to perform Arithmetic Operations-Calculation of diameter, circumference and area of the circle.*	7+2
II	**DIALOG BOX AND FUNCTIONS** User Input with prompt Dialogs (alert, prompt, confirm) -Arithmetic operations using prompt(Detail)-Display Date and Time with Greeting -Functions-Function Expression-Arrow Function. *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.*	7+2
III	**CONTROL STATEMENTS** 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. *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.*	7+2
IV	**ARRAYS AND OBJECT** Arrays-Declaring and Allocation Arrays-Array Methods-Built in Object-Math –String-Date – Boolean – documents – window-using cookies. *Random Image Generator Using Arrays - Display current Date and Time in a Web page.*	7+2
V	**EVENT HANDLING AND REGULAR EXPRESSION** 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. *Form validation-Design Job Skills web page-what happens for a failing applicant and a successful applicant.*	7+2
	TOTAL INSTRUCTIONAL HOURS	**45**

Course Outcome

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

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 BOOKS:

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.

REFERENCE BOOKS:

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.E/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, planning 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:

- Fabricate wooden components and pipe connections including plumbing works.
- Fabricate simple weld joints.
- Fabricate different electrical wiring circuits and understand the AC Circuits.

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
BE/B.TECH II	22HE2071	DESIGN THINKING	2	0	0	2

The student should be able to

Course Objective

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
I	**DESIGN ABILITY** 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
II	**DESIGNING TO WIN** Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	5
III	**DESIGN TO PLEASE AND DESIGNING TOGETHER** Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	6
IV	**DESIGN EXPERTISE** 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
V	**DESIGN THINKING TOOLS AND METHODS** 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
	Total Instructional Hours	**30**

After completion of the course the learner will be able to

Course Outcome

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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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
BE/B.TECH II	22HE2072	SOFT SKILLS AND APPTITUDE I	1	0	0	1

The student should be able to

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	**Lessons on excellence** Skill introspection, Skill acquisition, consistent practice	2
II	**Logical Reasoning** Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles - Attention to detail	11
III	**Quantitative Aptitude** 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	**Recruitment Essentials** Resume Building - Impression Management	4
V	**Verbal Ability** Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement - Punctuations	4
	Total Instructional Hours	**30**

After completion of the course the learner will be able to

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

REFERENCE BOOKS:

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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