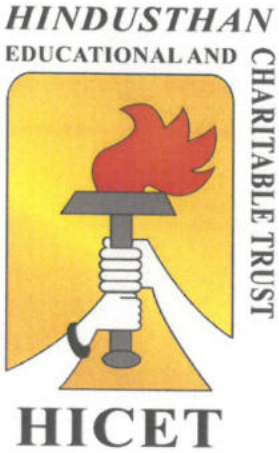
HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(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



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.

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Chairman, Board Of Studies

Chairman - BoS
AIML - HiCET

Dean-Academics

Dean (Academics)
HiCET

VISION AND MISSION OF THE DEPARTMENT

VISION

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

MISSION

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

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

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

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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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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**

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Principal

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PRINCIPAL
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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 AIl, 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)
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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

Dean – Academics

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HINDUSTHAN COLLEGE OF ENGG. & TECH. ACADEMIC Chairman

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 & TECHNOLOGY
ACADEMIC COUNCIL
Chairman

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
	DESIGN THINKING HISTORY AND OVERVIEW	
I	Understand what came before Design thinking-Identify who did what to bring it about-Learn how it built upon previous approaches-How design thinking is introduced in an organization-Understand the transformation required-What outcomes are possible-Understand the whole approach to design thinking-Determine what is most important.*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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(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

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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

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Principal

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

The learner should be able to

Course Objective

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**

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

Course Outcome

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 - Explanation 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

Chairman, Board of Studies

Chairman - BoS
AIML - HiCET

Dean-Academics

Dean (Academics)
HiCET

ACADEMIC COUNCIL
HINDUSTHAN COLLEGE OF ENGG & TECH
Chairman

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

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)

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

The learner should be able to

Course Objective

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 - Churning & Assimilation, 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 tools .**PracticalComponent:Listening-**Listen to songs and answer the questions **Speaking-** Justaminute **Reading-** 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"-4thedition CambridgeUniversityPress,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

COI : 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 — 9

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

BINARY INPUT / OUTPUT

V — 9

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.

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

The learner should be able

Course Objective

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**

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

Course Outcome

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

Course Objectives

The student should be made

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

The learner should be able to

Course Objective

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**

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

Course Outcome

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	L T P C 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**

Semester – VII

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