Bachelor of Technology

Computer Science & Engineering

(Artificial Intelligence & Machine Learning)

Four-Year Graduate Programme

Learning Outcomes based Curriculum Framework

(LOCF)

For

Curriculum for 4thYear

(7^{th}& 8^{th} Semester)

For 2022-23 Batch Only

Department ofComputer Science & Engineering

Faculty of Engineering and Technology

Chaudhary Devi Lal University

Sirsa-125055

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Program Specific Outcomes (PSOs)

PSO1 **Developing Computational Systems**: Use principles of various programming languages, data structures, database management systems, computer algorithms, theory of computation, networking and software engineering for designing and implementing computational systems.

PSO2 **Designing Intelligent Machine Learning Systems:** Utilize the principles and tools of artificial intelligence, soft computing, data mining and machine learning, data analytics, robotics, IoT, augmented reality etc. for designing and working with intelligent systems that learn from their environment.

Course Code	**Definition/ Category**
HSMC	Humanities, Social Sciences and Management Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PC	Program Core Courses (Branch specific)
PE	Professional Elective Courses (Branch specific)
OE	Open Elective Courses (from Humanities, Technical Emerging or other Subjects)
EEC	Employability Enhancement Courses (Project work/ Summer Training/ Industrial Training/ Practical Training/ Internship/Seminar, etc.)
AU	Audit Courses [Environmental Sciences, Indian Constitution]

SEMESTER VII

Sr. No.	Course Codes	Nomenclature of the Courses		Workload/Credits				Marks		
				L	T	P	Total	Internal	External	Marks
1.	PC/CSEAIML/15-T	Internet of Things		4/4	-	-	4/4	30	70	100
2.	PE/CSEAIML/1-T	Professional Elective-I		4/4	-	-	4/4	30	70	100
3.	PC/CSEAIML/15-P	Lab- Internet of Things		-	-	4/2	4/2	25	25	50
4.	OEC2	Open Elective Course		3/3	-	-	3/3	-	-	--
5.	EEC/CSEAIML/4	Project 1	Project Documentation	-	-	2/2	2/2	-	50	50
			Project Viva	-	-	4/4	4/4	-	100	100
			Internal Assessment	-	-	2/2	2/2	50	-	50
		Total		11/11	-	12/10	23/21	135	315	450

Note: A 4-6 weeks industrial training/internship is mandatory after the completion of the VIIth semester.

SEMESTER VIII

Sr. No.	Course Codes	Nomenclature of the Courses		Workload/Credits				Marks		
				L	T	P	Total	Internal	External	Total
1.	PE/CSEAIML/2-T	Professional Elective-II		4/4	-	-	4/4	30	70	100
2.	PE/CSEAIML/3-T	Professional Elective-III		4/4	-	-	4/4	30	70	100
3.	PE/CSEAIML/3-P	Lab- Professional Elective-III		-	-	4/2	4/2	25	25	50
4.	OEC3	Open Elective Course		3/3	-	-	3/3	-	-	--
5.	EEC/CSEAIML/5	Project 2	Project Documentation	-	-	2/2	2/2		50	50
			Project Viva	-	-	4/4	4/4		100	100
			Internal Assessment	-	-	2/2	2/2	50	-	50
		Total		11/11	-	12/10	23/21	135	315	450

Note: A 4-6 weeks industrial training/internship is mandatory after the completion of the VIIIth semester.

List of Electives for VII and VIII Semester

1. Deep Learning
2. Natural Language Processing
3. Embedded System
4. Robotics
5. Quantum Computing
6. Cyber Security

SEMESTER VII

PC/CSEAIML/15-T: Internet of Things								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Program Core	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment / Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to studythe fundamental concepts of cloudcomputing, its enablingtechnologies, cloud service models and security concerns, to learn core issues of Internet of Things, IOT communication protocols and security concerns.

Course Outcomes	At the end of this course, the student will be able to
CO1	define:framework,architecture,design,communication challenges,applications, principles of web connectivity.
CO2	understand and describe:framework, architecture, design, communication challenges, applications, principles of web connectivity.
CO3	use:forWirelessTechnologiesandApplicationsofIoTinvariousfields
CO4	classify: framework, architecture, physical and logical design.
CO5	compare: communication challenges, security issues, enabling technologies, application areas, and protocols.
CO6	create: IoT applications using different types of resources and development platforms

CO-PO Mapping Matrix for Course PC/CSEAIML/15-T

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	1	-	2	-	-
CO2	2	1	1	3	1	-	3	2	-	2	-	-
CO3	3	1	1	3	3	-	3	3	-	2	-	-
CO4	2	1	1	3	1	-	3	3	-	2	-	-
CO5	2	1	3	1	3	-	3	3	-	2	-	-
CO6	3	3	1	2	3	-	3	3	-	2	-	-
Average	2.1	1.4	1.4	2.2	1.8	-	3	2.4	-	2	-	-

Course Content PC/CSEAIML/15-T: Internet of Things	
Unit I	Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.
Unit II	Sensors Networks : Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.
Unit III	Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols
Unit IV	Data Handling& Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications, Applications of IoT, Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.

Recommended Books

1. Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN: 978-1- 84821-140-7, Wiley Publications
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", Wiley Publications
3. Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)", First Edition, VPT, 2014.
4. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016

<table>
<tr><th colspan="8">PE/CSEAIML/1-T:Professional Elective I (to be opted from the electives list)</th></tr>
<tr><td rowspan="2">Course Type</td><td rowspan="2">Course Credit</td><td rowspan="2">Contact Hours/ Week</td><td rowspan="2">Delivery Mode</td><td colspan="4">Maximum Marks</td><td rowspan="2">Exam Duration</td><td rowspan="2">Assessment Methods</td></tr>
<tr><td>External</td><td colspan="3">Internal</td></tr>
<tr><td rowspan="2">Professional Elective</td><td rowspan="2">04</td><td rowspan="2">04</td><td rowspan="2">Lecture</td><td rowspan="2">70</td><td colspan="3">30</td><td rowspan="2">3 Hours</td><td rowspan="2">TEE/MTE/ Assignment/ Attendance</td></tr>
<tr><td>20</td><td>5</td><td>5</td></tr>
<tr><td colspan="8">Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.</td></tr>
<tr><td colspan="8">List of Electives for VIIth Semester

a. Deep Learning
b. Natural Language Processing
c. Embedded System
d. Robotics
e. Quantum Computing
f. Cyber Security</td></tr>
</table>

PE/CSEAIML/1-T (a): Deep Learning								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: A typical course objective in Deep Learning aims to equip students with the theoretical knowledge and practical skills to understand, design, implement, and apply deep learning techniques to solve real-world problem.

Course Outcomes	By the end of this course, the student will be able to
CO1	define: the terms of machine learning: deep learning, regression, classification, regression, neurons, CNN and RNN.
CO2	explain: architecture of ANN and deep learning, variants of the basic convolution function, Long short-term memory.
CO3	apply: classification, regression, clustering techniques, Feed forward multilayer neural network, CNN, RNN according to their problem.
CO4	Classify: regression, classification, Convolutional Neural networks, RNN
CO5	compare: Single-layer and Multi-layer Perceptron, CNN and RNN

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (a)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

Course Content PE/CSEAIML/1-T (a): Deep Learning	
Unit I	**Introduction:** Introduction to Machine learning, Deep learning and AI , Historical trends in Deep learning ,Architecture of deep learning, Significance of Deep learning, application of deep learning, challenges of Deep learning. **Neural Network**: Introduction, architecture, difference between Biological Neuron Network and Artificial Neuron Network
Unit II	**Foundation of Deep Learning:** Vector, scalars, matrix, statistics, probability. Regression, classification, underfitting, overfitting, gradient descent, logistic regression, confusion matrix. Activation functions of Neural Network (liner, sigmoid, tanh, softmax).
Unit III	**Fundamental of Deep Learning:** common architectural principles of deep learning, Single-layer and Multi-layer Perceptron, Cross-entropy loss functions for Neural net, Matrix representation of Neural nets. **Building block of deep network**: Feed forward multilayer neural network, RBMs, Autoencoders.
Unit IV	**Convolutional Neural networks:** Deep Learning and Neural Networks Perceptrons, Convolutional networks, variants of the basic convolution function, efficient convolution algorithms. **Recurrent Neural networks:** Bidirectional RNNs, Deep recurrent networks, recursive neural networks, The Long short-term memory and other gated RNNs.

Recommended Books

1. David Foster, Generative Deep Learning, O'Reilly, 2019. 2. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.
2. Patterson, Josh, and Adam Gibson. *Deep learning: A practitioner's approach*. " O'Reilly Media, Inc.", 2017.
3. Charu, C. Aggarwal. Neural networks and deep learning: a textbook. 2018.
4. Buduma, Nithin, Nikhil Buduma, and Joe Papa. *Fundamentals of deep learning*. " O'Reilly Media, Inc.", 2022.
5. Weidman, Seth. *Deep learning from scratch: building with python from first principles*. O'Reilly Media, 2019.
6. Ian Goodfellow, YoshuaBengio and Aaron Courville. Deep learning, The MIT Press, 2016.

PE/CSEAIML/1-T (b): Natural Language Processing								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: Natural Language processing (NLP) has a wide scope of application sentiment analysis, opinion mining, chatbots, summarization and question answering. This objective of course is to give exposure to students about basic tasks and principles in natural language processing. The course covers pre-processing of text, language models and sentiment analysis using Bayesian and Logistic regression frameworks.

Course Outcomes	By the end of this course, the student will be able to
CO1	Definethe basic vocabulary and terminology used in NLP.
CO2	describe regular expressions, text processing, N-grams, sentiment analysis, NLP applications and challenges.
CO3	solve problems pertaining to NLP tasks.
CO4	compare the various language models and NLP algorithms.
CO5	evaluate language models andNLP algorithms.

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (b)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

Course Content PE/CSEAIML/1-T (b): Natural Language Processing	
Unit I	Introduction to NLP, Ambiguity, Models and Algorithms, Language thought and understanding, Historical perspective and Latest developments in NLP. Regular expressions: Basic regular expression patterns, Disjunction, grouping and precedence, Examples, Advanced operators, Regular expression substitution, Finite state automata, Formal languages, Nondeterministic FSAs, Using NFSAs to accept strings, Regular languages and FSAs. Text Processing and Tokenisation: English morphology, Finite-state morphological parsing, Building a finite state lexicon, Finite state transducers, FSTs for morphological parsing, Combining FST lexicon and rules, Lexicon-free FSTs.
Unit II	Words and sentence tokenization, detecting and correcting spelling errors, Words, Corpora, Text normalization, Minimum edit distance. N-Grams: Counting words in corpora, Simple N-grams, Training and test sets, Evaluating language models, Smoothing, advanced topics in language modelling. Vector Semantics and Embeddings: Lexical semantics, Vector semantics, Words and vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in vector, Pointwise mutual information, Applications of TF-IDF, Word2vec, Visualizing embeddings, Semantic properties of embeddings, Bias and embeddings, Evaluating vector models.
Unit III	Naïve Bayesian and Sentiment Classification: Training the Naïve Bayes classifier, Optimizing for sentiment analysis, Naïve Bayes as a language model, Evaluation, test set and cross-validation, Statistical significance testing. Classification with logistic regression, Multinomial logistic regression, Learning in logistic regression, The cross-entropy loss function, Regularization, Learning in multimodal logistic regression, Interpreting models.
Unit IV	NLP Applications: Machine Translation: Machine translation using Encoder-Decoder, Details of Encoder-Decoder model, Machine Translation evaluation, Biases and ethical issues, Text classification for sentiment analysis. Question answering and Information Retrieval: Information retrieval, IR-based factoid question answering, Entity linking, Knowledge based question answering, Using language models to do question answering, Classic QA models, Evaluation of Factoid answers.
Recommended Books	
1. Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 2nd Edition, Prentice Hall, Second Edition, 2009. 2. Dan Jurafsky and James Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 3rd Edition, 2023. 3. Yoav Goldberg, Neural Network Methods for Natural Language Processing, Morgan and Claypool, 2017. 4. Chris Manning and Hinrich Schütze,Foundations of Statistical Natural Language Processing, MIT Press, Cambridge, MA, 1999.	

PE/CSEAIML/1-T (c): Embedded System								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to equip the students with the basic concepts of embedded system, applications in which they are used, 8051 microcontroller programming concepts and various aspects of embedded system design from Hardware and Software points of view and it describes tools and methodologies needed for embedded system design. It provides RTOS concepts for coding the embedded system software routines. It tells what makes a system a real-time system and describes the characteristics of latency in real-time systems.

Course Outcomes	By the end of this course, the student will be able to
CO1	understand the microprocessor architecture and its components used in embedded systems
CO2	Write the 8051 assembly language code for specific purposes
CO3	implement code for interfacing various devices.
CO4	Develop simple embedded systems for real time operations
CO5	Compose simple embedded system with error free software to obtain target system

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (c)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

Course Content PE/CSEAIML/1-T (c): Embedded System	
Unit I	Embedded Systems Basics: Introduction to Embedded systems, Examples of embedded systems, TypicalHardware,Gates,TimingDiagrams,Memory, Microprocessors, Buses, DirectMemoryAccess, Interrupts, Microprocessor Architecture, and Interrupt Basics.
Unit II	The 8051 Architecture: Introduction, 8051 Micro controller Hardware, Input/output Pin Ports and Circuits, External Memory, Serial data Input/output, Interrupts. Basic Assembly Language Programming Concepts: The Assembly Language Programming Process, Programming Tools and Techniques, Programming the 8051.
Unit III	Moving Data: Introduction, Addressing Modes, External Data Moves, Code Memory ReadOnly Data Moves, Push and Pop Opcodes, Data Exchanges. Basic Design Using a Real-Time Operating System: Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment
Unit IV	Applications: Introduction, keyboards, Human Factor, Key Switch Factors, Keyboard Configurations, Displays, Seven-Segment Numeric Display, D/A and A/D Conversions. Embedded Software Development Tools: Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine, Using Laboratory Tools, An Example System.

Recommended Books

1. An Embedded Software Primer, David E. Simon, Pearson Education.
2. The 8051 Microcontroller, Third Edition, Kenneth J.Ayala, Thomson.
3. 8051 Microcontrollers, Satish Shah, Oxford Higher Education.
4. Embedded Microcomputer Systems Real Time Interfacing, Jonathan W.Valvano, Cengage Learning.
5. Micro Controllers, Ajay V Deshmukhi, TMH.
6. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley.
7. Microcontrollers, Raj kamal, Pearson Education.
8. http://nptel.ac.in/courses.php
9. http://jntuk-coeerd.in/

PE/CSEAIML/1-T (d): Robotics								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: To introduce the functional elements of Robotics, impart knowledge on the direct and inverse kinematics, introduce the manipulator differential motion and control, educate on various path planning techniques.

Course Outcomes	By the end of this course, the student will be able to
CO1	Ability to understand basic concept of robotics.
CO2	Analyze Instrumentation systems and their various applications.
CO3	Know about the differential motion add statics in robotics
CO4	Know about the various path planning techniques.
CO5	Know about the dynamics and control in robotics industries

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (d)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

Course Content
PE/CSEAIML/1-T (d): Robotics

Unit I	Basic Concepts:Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.
Unit II	Direct and Inverse Kinematics:Mathematical representation of Robots - Position and orientation – Homogeneous transformation-Various joints- Representation using the Denavit Hattenberg parameters - Degrees of freedom-Direct kinematics- Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution.

Unit III	Manipulator Differential Motion and Statics: Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse - Wrist and arm singularity - Static analysis - Force and moment Balance.
Unit IV	Path Planning: Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

Recommended Books

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2017.
2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. Mikell P Groover, Mitchell Weiss, Roger N Nagel, Nicholas Odrey, Ashish Dutta "Industrial Robotics (SIE): Technology, Programming and Applications, McGraw Hill Education India, 2012
4. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
5. K. K.Appu Kuttan, Robotics, I K International, 2007.
6. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
7. R.D.Klafter, T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
8. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers,Chennai, 1998.
9. S.Ghoshal, " Embedded Systems & Robotics" – Projects using the 8051 Microcontroller", Cengage Learning, 2009.

PE/CSEAIML/1-T (e): Quantum Computing								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course to understand the basic concept of quantum computing it's relation to mathematics and physics, quantum circuits, quantum information and cryptography, quantum algorithms.

Course Outcomes	By the end of this course, the student will be able to
CO1	define quantum computation:mechanics, circuit, multiple,teleportation, cryptography and programming languages
CO2	understand and describe quantum computation: mechanics, circuit,multiple, teleportation, quantum algorithms cryptography and programming languages.interpret: error correction and computation of fault-tolerant.
CO3	determine the relationship of quantum with: mathematics, physics. Illustrate the relationship between quantum and classical complexityclasses.
CO4	analyze: quantum programming languages, quantum computations,error correction, fault-tolerant computation.
CO5	compare: quantum algorithms, classical and quantum information theory,classical gates and quantum gates. evaluate: classical computation on quantum computers.

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (e)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	-	-	-	-	1	3
CO2	2	1	1	3	1	-	-	-	-	-	2	3
CO3	3	1	1	3	3	-	-	-	-	-	3	3
CO4	3	3	1	3	1	-	-	-	-	-	3	3
CO5	3	1	1	3	3	-	-	-	-	-	3	3
Average	2.4	1.8	1	2.6	1.8	-	-	-	-	-	2.4	3

Course Content PE/CSEAIML/1-T (e): Quantum Computing	
Unit I	Introduction to Quantum Computation: Concept and need of quantum computing, Quantum bits and quantum operations, Postulates of quantum mechanics, Bloch sphere representation of a qubit, multiple qubits, classical gates versus quantum gates.
Unit II	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. Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum circuits.
Unit III	Quantum Information and Cryptography: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem, Quantum programming languages, Probabilistic and Quantum computations.
Unit IV	Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search. Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation.

Recommended Books

1. An Introduction to Quantum Computing Algorithms, Pittenger A. O., 2000.
2. Quantum computing explained, David McMahon, John Wiley & Sons, Inc. Publication 2008
3. Quantum computation and quantum information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press 2010
4. Introduction to Quantum Mechanics, 2e, David J. Griffiths, Prentice Hall New Jersey 1995
5. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008
6. Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, Benenti G., Casati G. and Strini G., World Scientific, 2004.

PE/CSEAIML/1-T (f): Cyber Security							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Professional Elective	04	04	Lecture	70	30 (20 / 5 / 5)	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The course has been designed to givestudentsanextensiveoverviewofcybersecurityissues,toolsand techniquesthatare criticalin solvingproblemsincybersecuritydomains.

Course Outcomes	By the end of this course, the student will be able to
CO1	definethevariouschallengesandconstraintsincyber security.
CO2	discussITACT(Cyberlaw) to thegivencase/problemandanalyseit.
CO3	understand the need for Computer Cyber forensics.
CO4	analysethedesignofIntellectualPropertyLaw.
CO5	demonstratethenetworkdefencetoolstoprovidesecurityofinformation.

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (f)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

Course Content
PE/CSEAIML/1-T (f): Cyber Security

Unit I	IntroductiontoCyberSecurity:OverviewofCyberSecurity,InternetGovernance:Challenges Constraints, Threats, Cyber and Warfare, Cyber Crime, Cyber terrorism,CyberEspionage,needforaComprehensiveCyberSecurityPolicy,NeedforaNodalAuthority,InternationalconventiononCyberspace.
Unit II	IntroductiontoCybercrimeandLaws:OriginsofCybercrime,ClassificationsofCybercrimes, information Cybercriminals, Criminals Plan

	Cybercafe,Botnets,AttackVector,TheIndianITACT2000andamendments. Cybercrime:Introduction,Proxy for Attacks, ServerandAnonymizers,Password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, DOSandDDOSattack,SQLinjection.
Unit III	PhishingandIdentityTheft:IntroductiontoPhishing,MethodsofPhishing,PhishingTechniques, Phishing Toolkits and Spy Phishing. Identity Theft: PII, Types of Identity TheftTechniques of ID Digital Forensics Science, andDigitalEvidence,DigitalForensicsLifeCycle. Need for Computer Cyber forensics IntroductiontoIntellectual PropertyLaw– TheEvolutionaryPast-TheIPRToolKit-Para - LegalTasksinIntellectualPropertyLawEthicalobligationsinParaLegalTasksinIntellectualPropertyLaw–types intellectualpropertyrights.
Unit IV	NetworkDefencetools:FirewallsandPacketFilters:FirewallBasics,Packet Filtervs Firewall, PacketCharacteristic to Filter, Stateless Vs. Stateful Firewalls, Network AddressTranslation (NAT) and Port Forwarding, Virtual Private Networks, SnortDetectionSystem, Introductiontoblockchaintechnologyanditsapplications.

Recommended Books

1. MikeShema,Anti-HackerToolKit(IndianEdition),McGrawHill.
2. NinaGodboleandSunit Belpure,CyberSecurity:UnderstandingCyberCrimes,ComputerForensicsand LegalPerspectives,Wiley.
3. MarjieT.Britz,ComputerForensicsandCyberCrime:AnIntroduction,PearsonEducation.
4. Chwan-Hwa(John)Wu,J.DavidIrwin,Introductionto ComputeNetworksandCybersecurity,CRC Press
5. BillNelson,AmeliaPhillips,ChristopherSteuart,GuidetoComputerForensicsandInvestigations,CengageLearning.
6. DebiragE.Bouchoux,IntellectualProperty, CengageLearning.

PC/CSEAIML/15-P: Soft Lab – Internet of Things							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Program Core	02	04	Practical	25	25	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final-Term Examination: The Final-Term examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated based on practical file, performance in practical exam and a viva voce exam.

Course Objectives: The objective of this course is to make the students familiar with the topics of python programming for machine learning, predictive models, supervised learning. Unsupervised learning.

Course Outcomes	At the end of this course, the student will able to:
CO1	define:framework,architecture,design,communication challenges,applications, principles of web connectivity.
CO2	understand and describe:framework, architecture, design, communication challenges, applications, principles of web connectivity.
CO3	use:forWirelessTechnologiesandApplicationsofIoTinvariousfields
CO4	classify: framework, architecture, physical and logical design.
CO5	compare: communication challenges, security issues, enabling technologies, application areas, and protocols.
CO6	create: IoT applications using different types of resources and development platforms

CO-PO Mapping Matrix for Course PC/CSEAIML/15-P

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	2	1	-	2	-
CO2	2	1	1	3	1	-	3	2	1	-	2	-
CO3	3	1	1	3	3	-	3	2	1	-	2	-
CO4	2	1	1	3	1	-	3	2	1	-	2	-
CO5	2	1	3	1	3	-	3	2	1	-	2	-
CO6	3	3	1	1	3	-	3	2	1	-	2	-
Average	2	1.4	1.4	2.2	1.8	-	3	2	1	-	2	-

EEC/CSEAIML/4: Project 1							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Employment Enhancement Courses	08	08	Presentation	150	50	3 Hours	Report Writing / Viva-Voce

Instructions: Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc
An internal evaluation is done by internal examiner/(s) appointed by the Chairperson.
Significance and originality of the problem addressed, and the solution provided: 10
Knowledge of the problem domain and tool used (VIVA-VOCE):15
Report Writing: 15
Judgement of the skill learnt, and system developed: 10

Course Objectives: Students will do an Industrial Training of 4 to 6 weeks after VIIth semester. They are expected to learn novel skills and develop some software application during the training period.

SEMESTER VIII

PE/CSEAIML/2-T: Professional Elective II (to be opted from the electives list)								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

List of Electives for VIIIth Semester

a. Deep Learning
b. Natural Language Processing
c. Embedded System
d. Robotics
e. Quantum Computing
f. Cyber Security

PE/CSEAIML/3-T: Professional Elective III (to be opted from the electives list)								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

List of Electives for VIIIth Semester

a. Deep Learning
b. Natural Language Processing
c. Embedded System
d. Robotics
e. Quantum Computing
f. Cyber Security

PE/CSEAIML/1-T (a): Deep Learning								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: A typical course objective in Deep Learning aims to equip students with the theoretical knowledge and practical skills to understand, design, implement, and apply deep learning techniques to solve real-world problem.

Course Outcomes	By the end of this course, the student will be able to
CO1	define: the terms of machine learning: deep learning, regression, classification, regression, neurons, CNN and RNN.
CO2	explain: architecture of ANN and deep learning, variants of the basic convolution function, Long short-term memory.
CO3	apply: classification, regression, clustering techniques, Feed forward multilayer neural network, CNN, RNN according to their problem.
CO4	Classify: regression, classification, Convolutional Neural networks, RNN
CO5	compare: Single-layer and Multi-layer Perceptron, CNN and RNN

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (a)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

Course Content PE/CSEAIML/1-T (a): Deep Learning	
Unit I	**Introduction:** Introduction to Machine learning, Deep learning and AI , Historical trends in Deep learning,Architecture of deep learning, Significance of Deep learning, application of deep learning, challenges of Deep learning. **Neural Network**: Introduction, architecture, difference between Biological Neuron Network and Artificial Neuron Network
Unit II	**Foundation of Deep Learning:** Vector, scalars, matrix, statistics, probability. Regression, classification, underfitting, overfitting, gradient descent, logistic regression, confusion matrix. Activation functions of Neural Network (liner, sigmoid, tanh, softmax).
Unit III	**Fundamental of Deep Learning:** common architectural principles of deep learning, Single-layer and Multi-layer Perceptron, Cross-entropy loss functions for Neural net, Matrix representation of Neural nets. **Building block of deep network**: Feed forward multilayer neural network, RBMs, Autoencoders.
Unit IV	**Convolutional Neural networks:** Deep Learning and Neural Networks Perceptrons, Convolutional networks, variants of the basic convolution function, efficient convolution algorithms. **Recurrent Neural networks:** Bidirectional RNNs, Deep recurrent networks, recursive neural networks, The Long short-term memory and other gated RNNs.

Recommended Books

1. David Foster, Generative Deep Learning, O'Reilly, 2019. 2. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.
2. Patterson, Josh, and Adam Gibson. *Deep learning: A practitioner's approach*. " O'Reilly Media, Inc.", 2017.
3. Charu, C. Aggarwal. Neural networks and deep learning: a textbook. 2018.
4. Buduma, Nithin, Nikhil Buduma, and Joe Papa. *Fundamentals of deep learning*. " O'Reilly Media, Inc.", 2022.
5. Weidman, Seth. *Deep learning from scratch: building with python from first principles*. O'Reilly Media, 2019.
6. Ian Goodfellow, YoshuaBengio and Aaron Courville. Deep learning, The MIT Press, 2016.

PE/CSEAIML/1-T (b): Natural Language Processing								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: Natural Language processing (NLP) has a wide scope of application sentiment analysis, opinion mining, chatbots, summarization and question answering. This objective of course is to give exposure to students about basic tasks and principles in natural language processing. The course covers pre-processing of text, language models and sentiment analysis using Bayesian and Logistic regression frameworks.

Course Outcomes	By the end of this course, the student will be able to
CO1	Definethe basic vocabulary and terminology used in NLP.
CO2	describe regular expressions, text processing, N-grams, sentiment analysis, NLP applications and challenges.
CO3	solve problems pertaining to NLP tasks.
CO4	compare the various language models and NLP algorithms.
CO5	evaluate language models andNLP algorithms.

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (b)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

Course Content PE/CSEAIML/1-T (b): Natural Language Processing	
Unit I	Introduction to NLP, Ambiguity, Models and Algorithms, Language thought and understanding, Historical perspective and Latest developments in NLP. Regular expressions: Basic regular expression patterns, Disjunction, grouping and precedence, Examples, Advanced operators, Regular expression substitution, Finite state automata, Formal languages, Nondeterministic FSAs, Using NFSAs to accept strings, Regular languages and FSAs. Text Processing and Tokenisation: English morphology, Finite-state morphological parsing, Building a finite state lexicon, Finite state transducers, FSTs for morphological parsing, Combining FST lexicon and rules, Lexicon-free FSTs.
Unit II	Words and sentence tokenization, detecting and correcting spelling errors, Words, Corpora, Text normalization, Minimum edit distance. N-Grams: Counting words in corpora, Simple N-grams, Training and test sets, Evaluating language models, Smoothing, advanced topics in language modelling. Vector Semantics and Embeddings: Lexical semantics, Vector semantics, Words and vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in vector, Pointwise mutual information, Applications of TF-IDF, Word2vec, Visualizing embeddings, Semantic properties of embeddings, Bias and embeddings, Evaluating vector models.
Unit III	Naïve Bayesian and Sentiment Classification: Training the Naïve Bayes classifier, Optimizing for sentiment analysis, Naïve Bayes as a language model, Evaluation, test set and cross-validation, Statistical significance testing. Classification with logistic regression, Multinomial logistic regression, Learning in logistic regression, The cross-entropy loss function, Regularization, Learning in multimodal logistic regression, Interpreting models.
Unit IV	NLP Applications: Machine Translation: Machine translation using Encoder-Decoder, Details of Encoder-Decoder model, Machine Translation evaluation, Biases and ethical issues, Text classification for sentiment analysis. Question answering and Information Retrieval: Information retrieval, IR-based factoid question answering, Entity linking, Knowledge based question answering, Using language models to do question answering, Classic QA models, Evaluation of Factoid answers.
Recommended Books	
1. Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 2nd Edition, Prentice Hall, Second Edition, 2009. 2. Dan Jurafsky and James Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 3rd Edition, 2023. 3. Yoav Goldberg, Neural Network Methods for Natural Language Processing, Morgan and Claypool, 2017. 4. Chris Manning and Hinrich Schütze,Foundations of Statistical Natural Language Processing, MIT Press, Cambridge, MA, 1999.	

PE/CSEAIML/1-T (c): Embedded System								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to equip the students with the basic concepts of embedded system, applications in which they are used, 8051 microcontroller programming concepts and various aspects of embedded system design from Hardware and Software points of view and it describes tools and methodologies needed for embedded system design. It provides RTOS concepts for coding the embedded system software routines. It tells what makes a system a real-time system and describes the characteristics of latency in real-time systems.

Course Outcomes	By the end of this course, the student will be able to
CO1	understand the microprocessor architecture and its components used in embedded systems
CO2	Write the 8051 assembly language code for specific purposes
CO3	implement code for interfacing various devices.
CO4	Develop simple embedded systems for real time operations
CO5	Compose simple embedded system with error free software to obtain target system

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (c)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

Course Content PE/CSEAIML/1-T (c): Embedded System	
Unit I	Embedded Systems Basics: Introduction to Embedded systems, Examples of embedded systems, TypicalHardware,Gates,TimingDiagrams,Memory, Microprocessors, Buses, DirectMemoryAccess, Interrupts, Microprocessor Architecture, and Interrupt Basics.
Unit II	The 8051 Architecture: Introduction, 8051 Micro controller Hardware, Input/output Pin Ports and Circuits, External Memory, Serial data Input/output, Interrupts. Basic Assembly Language Programming Concepts: The Assembly Language Programming Process, Programming Tools and Techniques, Programming the 8051.
Unit III	Moving Data: Introduction, Addressing Modes, External Data Moves, Code Memory ReadOnly Data Moves, Push and Pop Opcodes, Data Exchanges. Basic Design Using a Real-Time Operating System: Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment
Unit IV	Applications: Introduction, keyboards, Human Factor, Key Switch Factors, Keyboard Configurations, Displays, Seven-Segment Numeric Display, D/A and A/D Conversions. Embedded Software Development Tools: Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine, Using Laboratory Tools, An Example System.

Recommended Books

1. An Embedded Software Primer, David E. Simon, Pearson Education.
2. The 8051 Microcontroller, Third Edition, Kenneth J.Ayala, Thomson.
3. 8051 Microcontrollers, Satish Shah, Oxford Higher Education.
4. Embedded Microcomputer Systems Real Time Interfacing, Jonathan W.Valvano, Cengage Learning.
5. Micro Controllers, Ajay V Deshmukhi, TMH.
6. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley.
7. Microcontrollers, Raj kamal, Pearson Education.
8. http://nptel.ac.in/courses.php
9. http://jntuk-coeerd.in/

PE/CSEAIML/1-T (d): Robotics								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: To introduce the functional elements of Robotics, impart knowledge on the direct and inverse kinematics, introduce the manipulator differential motion and control, educate on various path planning techniques.

Course Outcomes	By the end of this course, the student will be able to
CO1	Ability to understand basic concept of robotics.
CO2	Analyze Instrumentation systems and their various applications.
CO3	Know about the differential motion add statics in robotics
CO4	Know about the various path planning techniques.
CO5	Know about the dynamics and control in robotics industries

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (d)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

Course Content
PE/CSEAIML/1-T (d): Robotics

Unit I	Basic Concepts: Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.
Unit II	Direct and Inverse Kinematics: Mathematical representation of Robots - Position and orientation – Homogeneous transformation-Various joints- Representation using the Denavit Hattenberg parameters - Degrees of freedom-Direct kinematics- Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution.

Unit III	Manipulator Differential Motion and Statics: Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse - Wrist and arm singularity - Static analysis - Force and moment Balance.
Unit IV	Path Planning: Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

Recommended Books

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2017.
2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. Mikell P Groover, Mitchell Weiss, Roger N Nagel, Nicholas Odrey, Ashish Dutta "Industrial Robotics (SIE): Technology, Programming and Applications, McGraw Hill Education India, 2012
4. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
5. K. K.Appu Kuttan, Robotics, I K International, 2007.
6. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
7. R.D.Klafter, T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
8. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers,Chennai, 1998.
9. S.Ghoshal, " Embedded Systems & Robotics" – Projects using the 8051 Microcontroller", Cengage Learning, 2009.

PE/CSEAIML/1-T (e): Quantum Computing								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course to understand the basic concept of quantum computing it's relation to mathematics and physics, quantum circuits, quantum information and cryptography, quantum algorithms.

Course Outcomes	By the end of this course, the student will be able to
CO1	define quantum computation:mechanics, circuit, multiple,teleportation, cryptography and programming languages
CO2	understand and describe quantum computation: mechanics, circuit,multiple, teleportation, quantum algorithms cryptography and programming languages.interpret: error correction and computation of fault-tolerant.
CO3	determine the relationship of quantum with: mathematics, physics. Illustrate the relationship between quantum and classical complexityclasses.
CO4	analyze: quantum programming languages, quantum computations,error correction, fault-tolerant computation.
CO5	compare: quantum algorithms, classical and quantum information theory,classical gates and quantum gates. evaluate: classical computation on quantum computers.

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (e)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	-	-	-	-	1	3
CO2	2	1	1	3	1	-	-	-	-	-	2	3
CO3	3	1	1	3	3	-	-	-	-	-	3	3
CO4	3	3	1	3	1	-	-	-	-	-	3	3
CO5	3	1	1	3	3	-	-	-	-	-	3	3
Average	2.4	1.8	1	2.6	1.8	-	-	-	-	-	2.4	3

Course Content PE/CSEAIML/1-T (e): Quantum Computing	
Unit I	Introduction to Quantum Computation: Concept and need of quantum computing, Quantum bits and quantum operations, Postulates of quantum mechanics, Bloch sphere representation of a qubit, multiple qubits, classical gates versus quantum gates.
Unit II	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. Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum circuits.
Unit III	Quantum Information and Cryptography: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem, Quantum programming languages, Probabilistic and Quantum computations.
Unit IV	Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search. Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation.

Recommended Books

1. An Introduction to Quantum Computing Algorithms, Pittenger A. O., 2000.
2. Quantum computing explained, David McMahon, John Wiley & Sons, Inc. Publication 2008
3. Quantum computation and quantum information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press 2010
4. Introduction to Quantum Mechanics, 2e, David J. Griffiths, Prentice Hall New Jersey 1995
5. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008
6. Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, Benenti G., Casati G. and Strini G., World Scientific, 2004.

PE/CSEAIML/1-T (f): Cyber Security								
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks			Exam Duration	Assessment Methods
				External	Internal			
Professional Elective	04	04	Lecture	70	30		3 Hours	TEE/MTE/ Assignment/ Attendance
					20	5 5		

Instructions to paper setter for Final-Term Examination: The Final-Term examination shall cover the whole content of the course. The total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective-type questions from the complete syllabus. In addition to the compulsory first question, there shall be four units in the question paper each consisting of two questions. The student will attempt one question from each unit in addition to the compulsory question. All questions will carry equal marks.

Course Objectives: The course has been designed to give students an extensive overview of cyber security issues, tools and techniques that are critical in solving problems in cyber security domains.

Course Outcomes	By the end of this course, the student will be able to
CO1	definethevariouschallengesandconstraintsincyber security.
CO2	discussITACT(Cyberlaw) to thegivencase/problemandanalyseit.
CO3	understand the need for Computer Cyber forensics.
CO4	analysethedesignofIntellectualPropertyLaw.
CO5	demonstratethenetworkdefencetoolstoprovidesecurityofinformation.

CO-PO Mapping Matrix for Course PE/CSEAIML/1-T (f)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	-	-	-	-	-
CO2	2	1	1	3	1	-	3	-	-	-	-	-
CO3	3	1	1	3	3	-	3	-	-	-	-	-
CO4	2	1	1	3	1	-	3	-	-	-	-	-
CO5	2	1	3	1	3	-	3	-	-	-	-	-
Average	2	1.4	1.4	2.2	1.8	-	3	-	-	-	-	-

Course Content
PE/CSEAIML/1-T (f): Cyber Security

Unit I	IntroductiontoCyberSecurity:OverviewofCyberSecurity,InternetGovernance:Challenges Constraints, Threats, Cyber and Warfare, Cyber Crime, Cyber terrorism,CyberEspionage,needforaComprehensiveCyberSecurityPolicy,NeedforaNodalAuthority,InternationalconventiononCyberspace.
Unit II	IntroductiontoCybercrimeandLaws:OriginsofCybercrime,ClassificationsofCybercrimes, information Cybercriminals, Criminals Plan

	Cybercafe,Botnets,AttackVector,TheIndianITACT2000andamendments. Cybercrime:Introduction,Proxy for Attacks, ServerandAnonymizers,Password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, DOSandDDOSattack,SQLinjection.
Unit III	PhishingandIdentityTheft:IntroductiontoPhishing,MethodsofPhishing,PhishingTechniques, Phishing Toolkits and Spy Phishing. Identity Theft: PII, Types of Identity TheftTechniques of ID Digital Forensics Science, andDigitalEvidence,DigitalForensicsLifeCycle. Need for Computer Cyber forensics IntroductiontoIntellectual PropertyLaw– TheEvolutionaryPast-TheIPRToolKit-Para - LegalTasksinIntellectualPropertyLawEthicalobligationsinParaLegalTasksinIntellectualPropertyLaw–types intellectualpropertyrights.
Unit IV	NetworkDefencetools:FirewallsandPacketFilters:FirewallBasics,Packet Filter vs Firewall, PacketCharacteristic to Filter, Stateless Vs. Stateful Firewalls, Network AddressTranslation (NAT) and Port Forwarding, Virtual Private Networks, SnortDetectionSystem, Introductiontoblockchaintechnologyanditsapplications.

Recommended Books

1. Mike Shema, Anti-Hacker ToolKit (Indian Edition), McGraw Hill.
2. Nina Godbole and Sunit Belpure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley.
3. Marjie T. Britz, Computer Forensics and Cyber Crime: An Introduction, Pearson Education.
4. Chwan-Hwa(John)Wu, J. David Irwin, Introduction to Compute Networks and Cyber security, CRC Press
5. Bill Nelson, Amelia Phillips, Christopher Steuart, Guide to Computer Forensics and Investigations, Cengage Learning.
6. Debirag E. Bouchoux, Intellectual Property, Cengage Learning.

PE/CSEAIML/3-P: Soft Lab – Professional Elective III							
Course Type	Course Credit	Contact Hours/ Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Program Core	02	04	Practical	25	25	3 Hours	TEE/MTE/ Assignment/ Attendance

Instructions to paper setter for Final-Term Examination: The Final-Term examination will be conducted by a panel of internal and external examiners. Examinees will be evaluated based on practical file, performance in practical exam and a viva voce exam.

Course Objectives: The objective of this course is to make the students familiar with the topics.

CO-PO Mapping Matrix for Course PE/CSEAIML/3-P

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	-	3	2	1	-	2	-
CO2	2	1	1	3	1	-	3	2	1	-	2	-
CO3	3	1	1	3	3	-	3	2	1	-	2	-
CO4	2	1	1	3	1	-	3	2	1	-	2	-
CO5	2	1	3	1	3	-	3	2	1	-	2	-
CO6	3	3	1	1	3	-	3	2	1	-	2	-
Average	2	1.4	1.4	2.2	1.8	-	3	2	1	-	2	-

EEC/CSEAIML/5: Project 2							
Course Type	Course Credit	Contact Hours/Week	Delivery Mode	Maximum Marks		Exam Duration	Assessment Methods
				External	Internal		
Employment Enhancement Courses	08	08	Presentation	150	50	3 Hours	Report Writing / Viva-Voce

Instructions: Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc
An internal evaluation is done by internal examiner/(s) appointed by the Chairperson.
Significance and originality of the problem addressed, and the solution provided: 10
Knowledge of the problem domain and tool used (VIVA-VOCE):15
Report Writing: 15
Judgement of the skill learnt, and system developed: 10

Course Objectives: Students will do an Industrial Training of 4 to 6 weeks after VIIIth semester. They are expected to learn novel skills and develop some software application during the training period.