STATE INSTITUTE OF ENGINEERING & TECHNOLOGY, NILOKHERI
KURUKSHETRA UNIVERSITY, KURUKSHETRA

('A+' Grade, NAAC Accredited)

SCHEME OF EXAMINATIONS FOR

MASTER OF TECHNOLOGY in Robotics & Artificial Intelligence

Department of Computer Engineering

(W. E. F. SESSION: 2021-22)

SEMESTER-I

S. No.	Course Code	Subject	Teaching Schedule			Hours/ Week	Examination Schedule & Percentage Distribution			Duration of Exam (Hrs.)	Credit
			L	T	P		Major Test	Minor Test	Total		
1	MTRA-101	Introduction to Artificial Intelligence	3	0	0	3	60	40	100	3	**3**
2	MTRA-102	Introduction to Robotics	3	0	0	3	60	40	100	3	**3**
3	*	Program Elective -I	3	0	0	3	60	40	100	3	**3**
4	**	Program Elective -II	3	0	0	3	60	40	100	3	**3**
5	MTRA-115	Artificial Intelligence Lab	0	0	4	4	60	40	100	3	**2**
6	$	Program Elective Lab	0	0	4	4	60	40	100	3	**2**
7	MTRM-116	Research Methodology and IPR	2	0	0	2	60	40	100	3	**2**
8	***	Audit Course-I	2	0	0	2	--	100	100	3	**0**
Total						**24**	**420**	**280**	**700**	**-**	**18**

***Program Elective -I**		****Program Elective -II**	
Course No.	**Subject**	**Course No.**	**Subject**
MTRA-103	Embedded Systems	MTRA-106	Automation in Robotics
MTRA-104	Fundamental of Internet of Things (IoT)	MTRA-107	Advanced Data Structure and Programming
MTRA-105	Number Theory and Cryptography	MTRA-108	Speech and Language Processing

$ Program Elective Lab			
MTRA-109	Embedded Systems Lab	MTRA-112	Automation in Robotics Lab
MTRA-110	Fundamental of Internet of Things (IoT) Lab	MTRA-113	Advanced Data Structure and programming Lab
MTRA-111	Number Theory and Cryptography Lab	MTRA-114	Speech and Language Processing Lab

***** Audit Course-I**	
Course No.	**Subject**
MTAD-101	English for Research Paper Writing
MTAD-103	Disaster Management
MTAD-105	Sanskrit for Technical Knowledge
MTAD-107	Value Education

Note: 1.The course of program elective will be offered at 1/3rd or 6 numbers of students (whichever is smaller) strength ofthe class. 2. ***Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

MTRA-101	INTRODUCTION TO ARTIFICIAL INTELLIGENCE						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	Familiar with basic principles of AI, capable of using heuristic searches, aware of knowledge based systems, Able to use fuzzy logic and neural networks, Learn various applications domains AI						
Course Outcomes (CO)							
CO1	Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents capable of problem formulation.						
CO2	Evaluation of different uninformed search algorithms on well formulate problems alongwith stating valid conclusions that the evaluation supports						
CO3	Design and Analysis of informed search algorithms on well formulated problems. Formulate and solve given problem using Propositional and First order logic.						
CO4	Apply planning and neural network learning for solving AI problems. Apply reasoning for non-monotonic AI problems.						

UNIT-1

Introduction, A.I. Representation, Non-AI &AI Techniques, Representation of Knowledge, KnowledgeBase Systems, State Space Search, Production Systems, ProblemCharacteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation Formulation of real world problems, Breadth First Search, Depth First Search, Depth LimitedSearch, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information, Sensor-less problems, Contingency problems.

UNIT-2

Generate& test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint satisfaction, Game playing: Minimax Search, Alpha-Beta Cutoffs, Waiting for Quiescence

UNIT-3

Knowledge based agents, Wumpus world. Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining.First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forwardand Backward Chaining. Basics of PROLOG: Representation, Structure, Backtracking. Expert System: Case study of Expert System in PROLOG

UNIT-4

Blocks world, STRIPS, Implementation using goal stack, Introduction to Neural networks:- basic, comparison of human brain and machine, biological neuron, general neuron model, activation functions, Perceptron learning rule, applications and advantages of neural networks. Brief introduction to single layer and multiplayer networks. Non Monotonic Reasoning, Logics for Non Monotonic Reasoning, Justification based Truth Maintenance Systems, Semantic Nets, Statistical Reasoning, Fuzzy logic: fuzzy set definition and types, membership function, designing a fuzzy set for a given application. Probability and Bayes' theorem, Bayesian Networks.

Books and References:

1. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hill.
2. Stuart Russell & Peter Norvig : "Artificial Intelligence : A Modern Approach",Pearson Education, 2nd Edition.
3. Ivan Bratko : "Prolog Programming For Artificial Intelligence" , 2nd Edition AddisonWesley, 1440.
4. Eugene, Charniak, Drew Mcdermott: "Introduction to Artificial Intelligence.", AddisonWesley
5. Patterson: ―Introduction to AI and Expert Systems‖, PHI
6. Nilsson : ―Principles of Artificial Intelligence‖, Morgan Kaufmann.
7. Carl Townsend, ―Introduction to turbo Prolog‖, Paperback, 1483
8. Jacek M. Zurada, Introduction to artificial neural systems, Jaico Publication

Note for paper setter: Eight question will be set in all. Two questions from each unit. The candidate will be required to attempt four question in all and selecting one question from each unit.

MTRA-102	INTRODUCTION TO ROBOTICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The objective of this course is to impart comprehensive knowledge of the Robot and its differents parts needed for design and implementation. The course also aims at developing necessary skills required for efficient infrastructure for Robotics.						
Course Outcomes (CO)							
CO1	Understand the basic components of robots and differentiate types of robots and robot grippers.						
CO2	Model forward and inverse kinematics of robot manipulators and also Analyze forces in links and joints of a robot.						
CO3	Programme a robot to perform tasks in industrial applications.						
CO4	Design intelligent robots using sensors.						

UNIT-1

Robotics-Introduction-classification with respect to geometrical configuration (Anatomy), Controlled system & chain type: Serial manipulator & Parallel Manipulator. Components of Industrial robotics-precession of movement-resolution, accuracy & repeatability-Dynamic characteristics- speed of motion, load carrying capacity & speed of response-Sensors-Internal sensors: Position sensors,& Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, & Force or Torque sensors.

UNIT-2

Grippers – Mechanical Gripper-Grasping force--mechanisms for actuation, Magnetic gripper vaccume cup gripper-considerations in gripper selection & design . Industrial robots specifications. Selection based on the Application

UNIT-3

Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix, D-H transformation matrix, D-H method of assignment of frames. Direct and Inverse Kinematics for industrial robots. Differential Kinematics for planar serial robots

UNIT-4

Robot Applications: Material transfer and machine loading/unloading, processing operations assembly and inspection. Concepts of safety in robotics, social factors in use of robots, economics of robots.

Text Books

1. Groover M P, Industrial Robotics, Mc Graw Hill Ltd.
2. John J. Craig, Introduction to Robotics, Pearson Education Asia
3. Jazar, Theory of Applied Robotics, Springer.
4. Ghosal, Robotics, Oxford india.

Note for paper setter: Eight question will be set in all. Two questions from each unit. The candidate will be required to attempt four question in all and selecting one question from each unit.

MTRA-103	Embedded Systems						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To introduce the complete design of a modern embedded system with functional requirements for hardware and software components including processor, networking components, and sensors, along with applications, subsystem interfaces, networking, and middleware and to show how to understand and program such systems using a concrete platform built around.						
Course Outcomes (CO)							
CO1	Understand key concepts of embedded systems like History, definition and Classification, and characteristics of Embedded Systems						
CO2	Complete system design concepts of embedded systems for Processor and Memory Organization and peripheral devices.						
CO3	Understand the basics of Microcontrollers and assembly Language programming process.						
CO4	Become aware of interrupts and deployment of embedded processors and supporting devices in real-world applications						

Unit 1

Introduction to embedded systems: Background and History of Embedded Systems, definition and Classification, Programming languages for embedded systems: desirable characteristics of programming languages for embedded systems, low-level versus high-level languages, main language implementation issues: control, typing. Major programming languages for embedded systems. Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits.

Unit 2

Processor and Memory Organization: Structural units in processor, Processor selection for an embedded system, Memory devices, Memory selection, Allocation for memory to program segments and blocks and memory map of a system, DMA, Interfacing processor. I/O Devices -Device I/O Types and Examples? Synchronous -iso-synchronous and Asynchronous Communications from Serial Devices -Examples of Internal Serial-Communication Devices -UART and HDLC -Parallel Port Devices -Sophisticated interfacing features in Devices/Ports-Timer and Counting Device.

Unit 3

Microcontroller: Introduction to Microcontrollers, Evolution, Microprocessors vs. Microcontrollers, MCS-51 Family Overview, Important Features, Architecture.8051 Pin Functions, Architecture, Addressing Modes, Instruction Set, Instruction Types. **Programming:** Assembly Programming. Timer Registers, Timer Modes, Overflow Flags, Clocking Sources, Timer Counter Interrupts, Baud Rate Generation. Serial Port Register, Modes of Operation, Initialization, Accessing, Multiprocessor Communications, Serial Port Baud Rate.

Unit 4

Interrupts: Interrupt Organization, Processing Interrupts, Serial Port Interrupts, External Interrupts, Interrupt Service Routines. Microcontroller Specification, Microcontroller Design, Testing, Timing Subroutines, Look-up Tables, Serial Data Transmission. **Applications:** Interfacing Keyboards, Interfacing Displays, Interfacing A/D and D/A Converters, Pulse Measurement, Loudspeaker Interface, Memory Interface.

Books and References:

1. John Catsoulis, “Designing Embedded Hardware”, O’reilly
2. An Embedded Software Primer”, David E. Simon, Pearson Education
3. Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley & Sons, Inc
4. Karim Yaghmour, “Building Embedded Linux Systems”, O’reilly
5. Michael Barr, “Programming Embedded Systems”, O’reilly
6. Alan C. Shaw, “Real-time systems & software”, John Wiley & sons, Inc.
7. Wayne Wolf, “Computers as Components”, Harcourt India Pvt. Ltd.

Note for paper setter: Eight question will be set in all. Two questions from each unit. The candidate will be required to attempt four question in all and selecting one question from each unit.

MTRA-104	Fundamental of Internet of Things (IoT)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	This course focuses on the latest microcontrollers with application development, product design and prototyping. This also focuses on interoperability in IoT along with various IoT Platforms for application development.						
Course Outcomes (CO)							
CO1	Understand the various network protocols used in IoT						
CO2	Understand the role of Big Data, Cloud Computing and Data Analytics in a typical IoT system.						
CO3	Design a simple IoT system made up of sensors, wireless network connection, data analytics and display/actuators, and write the necessary control software.						
CO4	Build and test a complete IoT system.						

UNIT-1

Introduction to IoT, Sensing, Actuation, Basics of Networking, Communication Protocols 6 Sensor Networks, Machine to Machine Communications. Understanding of the IoT ecosystem, various layers in building an IoT application and interdependencies.

UNIT-2

Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Python programming 5 Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi. Build use cases using Raspberry Pi.

UNIT-3

Introduction to SDN, SDN for IoT, Data Aggregation, Handling and Analytics 4 Cloud Computing, Sensors, Fog Computing 4 Understanding of the various protocols being used in IoT like MQTT, AMQP, REST API.

UNIT-4

Understanding of the IoT platforms like PTC Thingworx and IoT frameworks like MS Azure, Understanding of the usage of these platforms to build applications like Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Case Study: Agriculture, Healthcare, Activity Monitoring.

Books and References:

1. David Etter, “IoT (Internet of Things) Programming: A Simple and Fast Way of Learning IoT,” Kindle Edition.
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, and David Boyle, “From Machine to Machine to the Internet of Things: Introduction to a New Age of Intelligence,” Elsevier Science Publishing Co. Inc, 2014.
3. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases,” 1st Edition, Auerbach Publications, 2017.
4. Yasuura, H., Kyung C.M., Liu Y., and Lin Y.L., “Smart Sensors at the IoT Frontier,” 1 st Edition, Springer International Publishing, 2018.

Note for paper setter: Eight question will be set in all. Two questions from each unit. The candidate will be required to attempt four question in all and selecting one question from each unit.

MTRA-105	Number Theory and Cryptography						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
4	**0**	**0**	**4**	**60**	**40**	**100**	**3Hrs.**
Program Objective (PO)	To introduce the concepts and methodology used in the Number Theory and Cryptography.						
Course Outcomes (CO)							
CO1	To introduce the mathematical fundamentals involve in cryptography.						
CO2	To describe the process of primality testing and factorization						
CO2	To understand the strength and weakness of cryptosystems						
CO3	To introduce the elliptic curve cryptography.						

Unit I

Elementary Number Theory: Divisibility, Division Algorithm, Euclidean Algorithm; Congruences, Complete Residue systems, Reduced Residue systems; Fermat's little theorem, Euler's Generalization, Wilson's Theorem; Chinese Remainder Theorem, Generalized Chinese Remainder Theorem-Euler Phi-function, multiplicative property; Finite Fields, Primitive Roots; Quadratic Residues, Legendre Symbol, Jacobi Symbol; Gauss's lemma, Quadratic Reciprocity Law.

Unit II

Primality Testing and Factorization: Primality Tests; Pseudo primes, Carmichael Numbers; Fermat's pseudoprimes, Euler pseudo primes; Factorization by Pollard's Rho method; Simple Continued Fraction, simple infinite continued fractions; Approximation to irrational numbers using continued fractions; Continued Fraction method for factorization.

Unit III

Public Key Cryptosystems: Traditional Cryptosystem, limitations; Public Key Cryptography; Diffie Hellmann key exchange; Discrete Logarithm problem; One-way functions, Trapdoor functions; RSA cryptosystem; Digital signature schemes; Digital signature standards; RSA signature schemes; Knapsack problem; El Gamal Public Key Cryptosystem; Attacks on RSA cryptosystem: Common modulus attack; Homomorphism attack, timing attack; Forging of digital signatures; Strong primes, Safe primes, Gordon's algorithm for generating strong primes.

Unit IV

Elliptic Curve Cryptography: Cubic Curves, Singular points, Discriminant; Introduction to Elliptic Curves, Geometry of elliptic curves over reals; Weier strass normal form, point at infinity; Addition of two points; Bezout's theorem, associativity; Group structure, Points of finite order; Elliptic Curves over finite fields, Discrete Log problem for Elliptic curves; Elliptic Curve Cryptography; Factorization using Elliptic Curve; Lenstra's algorithm; ElGamal Public Key Cryptosystem for elliptic curves.

Reference Books:

1. A Course in Number Theory and Cryptography, Neal Koblitz, (Springer 2006).
2. An Introduction to Mathematical Cryptography, Jill Pipher, Jeffrey Hoffstein, Joseph H.Silverman (Springer, 2008).
3. An Introduction to theory of numbers, Niven, Zuckerman and Montgomery, (Wiley 2006).
4. Elliptic curves: Number theory and cryptography, Lawrence C. Washington, (Chapman & Hall/CRC 2003).
5. An Introduction to Cryptography, R.A. Mollin (Chapman & Hall, 2001).
6. Rational Points on Elliptic Curves, Silverman and Tate (Springer 2005).
7. Guide to elliptic curve cryptography Hankerson, Menezes, Vanstone (Springer, 2004).
8. Elementary Number Theory, Jones and Jones (Springer, 1998).

Note for paper setter: Eight question will be set in all. Two questions from each unit. The candidate will be required to attempt four question in all and selecting one question from each unit.

MTRA-106	Automation in Robotics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	**To introduce the concepts of Robotic system, its components and instrumentation and control related to robotics**.						
Course Outcomes (CO)							
CO1	Acquire basic Knowledge on Robots						
CO2	Ability to process end effectors and robotic controls.						
CO3	Analyze Robot Transformations and Sensors						
CO4	Able to understand Robot cell design and applications						

Unit 1

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems

Unit 2

End Effectors And Robot Controls Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robotControl system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDTMotion Interpolations-Adaptive control.

Unit 3

Robot Transformations and Sensors Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

Unit 4

Robot Cell Design And Applications Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software Introductions-Robot applicationsMaterial handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot.

Reference Books

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.
3. Carl D. Crane and Joseph Duffy, Kinematic Analysis of Robot manipulators, Cambridge University press, 2008.
4. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987.
5. Craig. J. J. “Introduction to Robotics mechanics and control”, Addison- Wesley, 1999.
6. Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985.

Note for paper setter: Eight question will be set in all. Two questions from each unit. The candidate will be required to attempt four question in all and selecting one question from each unit.

MTRA-107	ADVANCED DATA STRUCTURE AND PROGRAMMING						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The goal of this course is to provide an introduction to different data types, Python and JavaScript programming. The course will discuss topics necessary for the participant to be able to create and execute programs in Python and JavaScript which are essential ingredients of Artificial Intelligence. The lectures and presentations are designed to provide knowledge and experiences to students that serve as a foundation for continued learning of presented areas. The focus of the course is to provide students with an introduction to programming, I/O, and visualization using Python and JavaScript programming languages.						
Course Outcomes (CO)							
CO1	Have knowledge of arranging data in different ways						
CO2	Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python						
CO3	Express different Decision Making statements and Functions						
CO4	Understand and summarize different File handling operations in Python Design and develop Client Server network applications using JavaScript 6. JavaScript to program the behavior of web.						

UNIT-1

Data Structures Arrays and Strings, Algorithm Development, Complexity analysis, Recursion, Linear Data Structures, Stacks, Queues, Circular Queues, Links Lists, Operation – Creations, insertion, Deletion, Circular Lists, Doubly Linked List.

UNIT-2

Trees: Definition, Basic Terminology, Binary Tree, External and Internal Nodes, Static and Dynamic Implementation of a Binary Tree, Primitive Operations on Binary Trees, Binary Tree Traversals: Pre-Order, In-Order and Post-Order Traversals. Representation of Infix, Post-Fix and Prefix Expressions using Trees. Introduction to Binary Search Trees: B+ trees, AVL Trees, Threaded Binary trees, Balanced Multi-way search trees, Implementation of Heap Sort Algorithm. **Graphs**: Basic Terminology, Definition of Undirected and Directed Graphs, Memory Representation of Graphs, Minimum-Spanning Trees, Warshal Algorithm, Graph Traversals Algorithms: Breadth First and Depth First.

UNIT-3

Python Programming Introduction, gitHub, Functions, Booleans and Modules, Sequences, Iteration and String Formatting, Dictionaries, Sets, and Files, Exceptions, Testing, Comprehensions, Advanced Argument Passing, Lambda -- functions as objects, Object Oriented Programming, More OO -- Properties, Special methods, Iterators, Iterables, and Generators, Decorators, Context Managers, Regular Expressions, and Wrap Up.

UNIT-4

JavaScript Basics, Functional programming, Object oriented programming, Client-side applications, Server-side applications, Design patterns and Idioms, Popular frameworks.

Reference Books:

1. Theory and Problems of Data Structures by Jr. Symour Lipschetz, Schaum's outline, TMH.
2. Data Structures and Algorithms by PAI, TMH.
3. Fundamentals of Data structures by Ellis Horowitz and Sartaj Sahni, Pub, 1983, AW.
4. Data Structures and Algorithms by A.V. Aho, J.E. Hopcroft and T.D. Ullman, Original edition, Addison-Wesley, 1999
5. Data Structures and Program Design in C by Robert Kruse, PHI,
6. Shukla, Data Structures using C++, Wiley India
7. Introduction to Computers Science -An Algorithms Approach, Jean Paul Tremblay, Richard B. Bunt, 2002, T.M.H.
8. Data Structure and the Standard Template library – Willam J. Collins, 2003, T.M.H.

Note for paper setter: Eight question will be set in all. Two questions from each unit. The candidate will be required to attempt four question in all and selecting one question from each unit.

MTRA-108	Speech and Language Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**60**	**40**	**100**	**3Hrs.**
Program Objective (PO)	This subject covers the overview and description of automatic speech recognition system.						
Course Outcomes (CO)							
CO1	To learn the concepts in mechanics of speech						
CO2	To understand the spectral analysis of the speech signal and noise reduction methodology.						
CO3	To implement and use of the statistical approaches for the design and development of AutomaticSpeech Recognition (ASR).						
CO4	Understand the formal language theory of language processing and complexity measures.						

Unit I

Mechanics of Speech: Speech Production Mechanism, Nature of Speech Signal, Discrete Time Modeling of Speech Production, Representation of Speech Signals, Classification of Speech Sounds, Phones, Phonemes, Phonetics, IPA and Phonetic Alphabets, Articulatory Features, Auditory Perceptions, Anatomical Pathways from Ear to the Perception of Sound Peripheral Auditory System.

Unit II

Spectral Analysis of Speech Signal: Time Domain Parameter of Speech Signal, Methods of Extracting The Parameters:Energy Filter bank Analysis, Short Time Fourier analysis, Formant Extraction, Pitch Extraction; Noise Reduction Techniques, Spectral Estimation, Feature Analysis: MFCC, PLP, RASTA, PLP-RASTA; TRAP.

Unit III

Statistical Framework of ASR: Probability, Bayes Theorem, Covariance and Correlation, Gaussian Mixture Model, ASR Framework: Feature Extraction, Acoustic Model, Pronunciation Model, Language Model, Decoder; Unit Selection, Limitation of Basic HMM and Applications, Advanced HMM, Refinement of HMM, Hybrid HMM/ANN.

Unit IV

Language Processing: Formal Language Theory: Chomsky Hierarchy, Chart Parsing for Context Free Grammars, Stochastic Language Models: Probabilistic Context-Free Grammar, N-gram Language Models, Complexity measure of Language Models: N-Gram Smoothing, Deleted Interpolation Smoothing, Backoff Smoothing, Class n-grams, Performance of N-gram Smoothing, Adaptive Language Models: Cache Language Models, Topic-Adaptive Models, Maximum EntropyModels.

References:

1. Speech and language processing, Daniel Jurafsky and James H. Martin, University of Colorado, Boulder.
2. Fundamentals of Speech Recognition, Lawrence Rabiner, Biing Hwang Juang and B.Yegnarayana, Pearson Edition
3. Speech Recognition – Theory and C++ Implementation, Claudio Becchetti, KlucioPrinaRicotti, Fondazione Ugo Bordoni, Rome, Italy.
4. Spoken Language Processing – A Guide to Theory, algorithm and system development, X.Huang, A. Acero, H. W. Hon.

Note for paper setter: Eight question will be set in all. Two questions from each unit. The candidate will be required to attempt four question in all and selecting one question from each unit.

MTRA-115	ARTIFICIAL INTELLIGENCE LAB						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	Familiar with basic principles of AI, capable of using heuristic searches, aware of knowledge based systems, able to use fuzzy logic and neural networks, Learn various applications domains AI						
Course Outcomes (CO)							
CO1	1. Understand the basics of the theory and practice of Artificial Intelligence as a discipline andabout intelligent agents capable of problem formulation.						
CO2	2. Evaluation of different uninformed search algorithms on well formulate problems alongwith stating valid conclusions that the evaluation supports.						
CO3	3. Design and Analysis of informed search algorithms on well formulated problems. Formulate and solve given problem using Propositional and First order logic.						
CO4	4. Apply planning and neural network learning for solving AI problems Apply reasoning for non-monotonic AI problems.						

LIST OF PRACTICALS

1. Implement Non-AI and AI Techniques
2. Implement any one Technique from the following
   - Best First Search & A* algorithm
   - AO* algorithm
   - Hill Climbing
3. Implement Perceptron learning algorithm
4. Implement a real life application in Prolog.
5. Expert System in Prolog-new application
6. Implement any two Player game using min-max search algorithm.
7. Design a fuzzy set for shape matching of handwritten character

MTRA-109	Embedded Systems Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	**This laboratory will develop the programming skills in the embedded systems field. Emphasisis given to interface handling; device driver and application development. Programming of mobile devices is included.**						
Course Outcomes (CO)							
CO1	To Familiarize with programming methods and tools for embedded systems.						
CO2	To Write efficient programs in C to develop embedded systems.						
CO3	To Program Device Drivers for embedded systems.						
CO4	To Program mobile devices.						

List of practical

1. Design an embedded system for traffic light controller using 8051 microcontroller.
2. Program for an embedded system in C using GNU development tools.
3. Program to demonstrate a simple interrupt handler and setting up a timer.
4. Program to create two tasks which trigger blinking of two LEDs at different timings.
5. Program to send messages to mailbox by one task and read from mailbox by another task.
6. Write an assembly program to configure and control General Purpose Input/Output (GPIO) port pins.
7. Program to imlement Buzzer interface on IDE environment.
8. To interface and convert Digital to Analog data using DAC in ARM processor.
9. To develop, code, configure and test a device driver.
10. To implement concurrency and resource management in mobile devices.

MTRA-110	Fundamentals of IoT Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.						
Course Outcomes (CO)							
CO1	Explain the concept and Application of Internet of Things.						
CO2	Illustrate key technologies, Protocols and Standards in Internet of Things.						
CO3	Design a simple IoT system comprising Sensors, Edge Devices and Wireless Network Connections involving Prototyping, Programming and Data Analysis.						

List of practical

EXPERIMENT

1 Start Raspberry Pi and try various Linix commands in command terminal window:ls, cd, touch, mv, rm, man, mkdir, rmdir, tar, gzip, cat, more, less, ps, sudo, cron,chown, chgrp, ping etc.

2 Run some python programs on Pi like:
Read your name and print Hello message with name Read two numbers and print their sum, difference,product and division. Word and character count of a given string Area of a given shape (rectangle, triangle and ircle) reading shape and appropriate values fromtandard input
Print a name 'n' times, where name and n areread from standard input, using for and while loops.
Handle Divided by Zero Exception.
Print current time for 10 times with an interval of 10seconds.
Read a file line by line and print the word count ofeach line.

3 Light an LED through Python program

4 Get input from two switches and switch oncorresponding LEDs

5 Flash an LED at a given on time andoff time cycle, where the two times are taken froma file.

6 Flash an LED based on cron output (acts asan alarm)

7 Switch on a relay at a given time using cron, where the relay's contact terminals are connected to a load.

8 Get the status of a bulb at a remote place(on the LAN) through web.

MTRA-111	Number Theory and Cryptography Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	To be able to implement and analyze algorithms for different encryption techniques. Applications to cryptography are explored including symmetric and public-key cryptosystems. To be able to implement different methods of attacks on data.						
Course Outcomes (CO)							
CO1	To understand mathematics behind cryptography.						
CO2	Students will be able to implement algorithms of cryptography, including encryption/decryption andhash functions.						
CO3	Students will be able to implement various network security practice applications.						
CO4	Identify various attacks and formulate defense mechanism.						

List of Practical

1. Write a program to implement encryption using binary/byte addition.
2. Write a program to implement encryption using binary Exclusive-OR (XOR).
3. Write a program to implement Triple DES with CBC mode and Weak DES keys.
4. Write a program to implement RSA Encryption and Factorization Attacks.
5. Write a program to implement Attack on RSA encryption with short RSA modulus.
6. Write a program to implement hash generation and sensitivity of hash functions to plaintext modifications.
7. Write a program to implement Digital Signature Visualization.
8. Write a program to implement RSA Signature.
9. Write a program to implement Attack on Digital Signature/Hash Collision.
10. Write a program to implement Firewalls and IDS.

MTRA-112	Automation in Robotics Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	This laboratory is intended to provide hands-on experience on industrial robotics, manufacturing automation, mobile robotics, and dynamics and control of field robots.						
Course Outcomes (CO)							
CO1	Explain the fundamentals of robotics and its components						
CO2	Illustrate the Kinematics and Dynamics of robotics						
CO3	Elucidate the need and implementation of related Instrumentation & control in robotics						
CO4	Illustrate the movement of robotic joints with computers/microcontrollers.						

List of Practical

1. Demonstration of Cartesian/ cylindrical/ spherical robot.
2. Demonstration of Articulated/ SCARA robot.
3. Virtual modeling for kinematic and dynamic verification any one robotic . structure using suitable software.
4. Design, modeling and analysis of two different types of grippers.
5. Study of sensor integration.
6. Two program for linear and non-linear path.
7. Study of robotic system design.
8. Setting robot for any one industrial application after industrial visit.

MTRA-113	ADVANCED DATA STRUCTURE AND PROGRAMMING Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	The goal of this course is to provide an introduction to different data types, Python and JavaScript programming. The course will discuss topics necessary for the participant to be able to create and execute programs in Python and JavaScript which are essential ingredients of Artificial Intelligence. The lectures and presentations are designed to provide knowledge and experiences to students that serve as a foundation for continued learning of presented areas. The focus of the course is to provide students with an introduction to programming, I/O, and visualization using Python and JavaScript programming languages						
Course Outcomes (CO)							
CO1	Have knowledge of arranging data in different ways						
CO2	Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python						
CO3	Express different Decision Making statements and Functions						
CO4	Understand and summarize different File handling operations in Python Design and develop Client Server network applications using JavaScript 6. JavaScript to program the behavior of web						

List of Practical

1. Write a program for Sorting and Searching.
2. Implement the Stack Application (Expression conversion etc.)
3. Implement the Queue Application (Job scheduling, resources allocation etc.)
4. Write a program to implement Linked list.
5. Write a program to implement BST operations(Create, Insert, Delete and Traversals)
6. Write a program to implement MST using Prim's and Kruskal's Algorithm.
7. Implement at least two program using Python programming.
8. Implement at least two program using Java script.

MTRA-114	Speech and Language Processing Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	**This Software Laboratory focuses on study of speech and the process of natural language in forms of token and tag some words to make meaningful. This also extracts information and measure the semantic similarity of sentences.**						
Course Outcomes (CO)							
CO1	To process the basic text in form of Tokenization and Stemming						
CO2	To study distributional properties in large samples of language data						
CO3	To implement and find semantics based on lexical semantics						
CO4	To extract information based on relation						

Case Study 1
Take a sample of sentences and process the text in form of tokenization and normalize this data using stemming

Case Study 2
Take a file of size less than 50MB and then select some word and convert these words to N-grams.

Case Study 3
A part-of-speech tagger, or POS-tagger, processes a sequence of words, and attaches a part of speech tag to each word. Take some adjective of English language and tag it.

Case Study 4
To Measure Semantic Similarity between sentences like sentence of "Harry is running fast" and "Harry is Sprinting"

Case Study 5
To associate each word with a word sense disambiguator to select the right meaning among all possible senses for each word.

Case Study 6
Build a system that will extract structured data, such as tables, from unstructured text and use them for training andevaluating models?

Case Study 7
Develop a Model Building in which a machine learning model is trained on a labeled dataset and Improve Performance of Text Classifier

MTRM-116	Research Methodology and IPR						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**60**	**40**	**100**	**3 Hrs.**
Program Objective (PO)	*To enable students to Research Methodology and IPR for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.*						
Course Outcomes (CO)							
CO1	Understand research problem formulation.						
CO2	Analyze research related information						
CO3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.						
CO4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.						

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2

Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper.Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 3

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 4

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'.
2. C.R. Kothari, "Research Methodology: Methods & Techniques, 2nd edition or above, New Age Publishers.
3. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
4. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
5. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
6. Mayall , "Industrial Design", McGraw Hill, 1992.
7. Niebel , "Product Design", McGraw Hill, 1974.
8. Asimov , "Introduction to Design", Prentice Hall, 1962.
9. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

Note for paper setter: Eight question will be set in all. Two questions from each unit. The candidate will be required to attempt four question in all and selecting one question from each unit.

MTAD-101	English For Research Paper Writing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	*Student will able to understand the basic rules of research paper writing.*						
Course Outcomes (CO)							
CO1	*Understand that how to improve your writing skills and level of readability*						
CO2	*Learn about what to write in each section*						
CO3	*Understand the skills needed when writing a Title*						
CO4	*Ensure the good quality of paper at very first-time submission*						

Unit 1

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences,Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit 3

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit 4

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper isas good as it could possibly be the first- time submission.

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York DordrechtHeidelberg London, 2011

MTAD-103	Disaster Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	Develop an understanding of disaster risk reduction and management						
Course Outcomes (CO)							
CO1	Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.						
CO2	Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.						
CO3	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.						
CO4	critically understand the strengths and weaknesses of disaster managementapproaches, planning and programming in different countries, particularly their home country or the countries they work in						

Unit 1

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit 2

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction ofEcosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 3

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone ToCyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application OfRemote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Unit 4

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India,New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep PublicationPvt. Ltd., New Delhi.

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MTAD-105	Sanskrit for Technical Knowledge						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students						
Course Outcomes (CO)							
CO1	To get a working knowledge in illustrious Sanskrit, the scientific language in the world						
CO2	Learning of Sanskrit to improve brain functioning						
CO3	Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power						
CO4	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature						

Unit –1

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit – 2

Order, Introduction of roots,Technical information about Sanskrit Literature

Unit –3

Technical concepts of Engineering: Electrical, Mechanical

Unit –4

Technical concepts of Engineering: Architecture, Mathematics

References

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi.
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

MTAD-107	Value Education						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**0**	**-**	**100**	**100**	**3 Hrs.**
Program Objective (PO)	Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character						
Course Outcomes (CO)							
CO1	Knowledge of self-development						
CO2	Learn the importance of Human values						
CO3	Developing the overall personality						
CO4	Know about the importance of character						

Unit 1

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.Moral and non-moral valuation. Standards and principles. Value judgements.

Unit 2

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration.Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature,Discipline

Unit 3

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

Unit 4

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi