EC – 1881(A) Neural Network and Fuzzy Logic

Course Title	Course Code	Credits - 3		
		L	T	P
Neural Network and Fuzzy Logic	EC 1881(A)	3	-	-

COURSE OBJECTIVE

The objective of course is to familiarize students with the concepts and application of Neural Network (NN). NN is an information processing system that is inspired by the way such as biological nervous systems e.g. brain. Neural network is trained to perform complex functions in various fields, including pattern recognition, identification, classification, speech and vision.

PRE-REQUISITES

Matlab Programming

COURSE CONTENTS

UNIT I: Introduction and NN Structure Biological neurons and artificial neurons, Model of an NN, Activation functions used in NNs, Typical classes of network architectures. Mathematical Foundations and Learning mechanisms: Re-visiting vector and matrix algebra, State-space concepts, Concepts of optimization, Error-correction learning, Memory-based learning, Hebbian learning, Competitive learning.

UNIT II: Single layer perceptrons: Structure and learning of perceptrons, Pattern classifier - introduction and Bayes' Classifiers, Perceptron as a pattern classifier, Perceptron convergence, Limitations of a perceptrons. Feed forward NN: Structures of Multi-layer feed forward networks, Back propagation algorithm, Back propagation - training and convergence, Functional approximation with back propagation, Practical and design issues of back propagation learning.

UNIT III: Radial Basis Function Networks: Pattern reparability and interpolation, Regularization Theory, Regularization and RBF networks, RBF network design and training, Approximation properties of RBF. Support Vector machines: Linear reparability and optimal hyper plane, Determination of optimal hyper plane. Optimal hyper plane for non separable patterns, Design of an SVM, Examples of SVM.

UNIT IV: Competitive Learning and Self organizing NN: General clustering procedures, Learning Vector Quantization (LVQ), Competitive learning algorithms and architectures. Self-organizing feature maps, Properties of feature maps.

UNIT V: Fuzzy Logic :Basic concepts of fuzzy logic, Fuzzy vs. Crisp set, Linguistic variables, Membership functions, Operations of fuzzy sets, Fuzzy IFTHEN rules, Variable inference techniques, De-Fuzzi fication, Basic fuzzy inference algorithm, Fuzzy system design

COURSE OUTCOMES:

On successful completion of this course student should be able to:

CO1: Describe and explain the basics of NN and various learning mechanisms and code for perceptron's and feed forward NN.
CO2: understand and analyze the performance of the Radial Basis Function Network and Support Vector Machine.
CO3: make use of concepts of ANN and fuzzy logic for designing and improving the performance of ANN

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TEXT BOOKS & REFERENCES:

- S.N. Sivanandan, S. Sumathi, S. N. Deepa,"Introduction to Neural Networks using MATLAB 6.0"
- Simon Haykin, "Neural Networks: A comprehensive foundation", Second Edition, Pearson Education Asia.
- Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.
- Robert J. Schalkoff, "Artificial Neural Networks", McGraw-Hill International Editions, 1997
- Fuzzy logic with engineering application by ROSS J.T (Tata Mc)
- Neural Networks & Fuzzy Logic by Bart Kosko

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EC – 1881(B) Artificial Intelligence

Course Title	Course Code	Credits - 3		
		L	T	P
Artificial Intelligence	EC1881 (B)	3	-	-

COURSE OBJECTIVE

This course is a study of the basic problem solving methods, state space search, different search methods. Knowledge representation, resolution and Question – Answering, conceptual dependency, frames and scripts. AI languages like PROLOG and LISP. Expert systems Design and ANN's

PRE-REQUISITES

- Engineering Mathematics
- Signals & Systems
- Digital Signal Processing

COURSE CONTENTS

Unit I: Basic Problem solving methods: Production systems-state space search, control strategies, Heuristic search, forward and backward reasoning, Hill climbing techniques, Breadth first search, Depth first search, Best search, staged search.

Unit II: Knowledge Representation: Predicate logic, Resolution question Answering, Nonmonotonic Reasoning, statistical and probabilistic reasoning, Semantic Nets, Conceptual Dependency, frames and scripts.

Unit III: Introduction to Expert Systems: Structure of an Expert system interaction with an expert, Design of an Expert system.

Unit IV: Introduction to ML; Problems, data, and tools; Visualization; Overfitting and complexity; training, validation, test data, Classification problems; decision boundaries; nearest neighbor methods, Probability and classification, Bayes optimal decisions, Naive Bayes and Bayes' Rule and Naive Bayes Model, Logistic regression.

Unit V: Linear classifiers, (SVM) Support vector machines and large-margin classifiers, Ensemble methods: Bagging, random forests, Unsupervised learning: clustering, k-means, support vector regression,Time series; Markov models; autoregressive models

COURSE OUTCOMES:

On successful completion of this course student should be able to:

CO1: Describe the general problem solving.
CO2: Analyze, contrast and compare different search strategies.
CO3: Make use of different Question Answering strategies, CD, Frames and Scripts, concepts of AI Languages, Expert system Design to implement ANN's

TEXT BOOKS& REFERENCES:

- "Adaptive Filter Theory", S. Haykin, Pearson Education 2003.
- "Adaptive Signal Processing" B. Widrow, and S. D. Sterns, Pearson Education 2005.
- "Statistical and Adaptive Signal Processing" Manolakis, Ingle, and Kogon, McGraw Hill International Edition.

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EC – 1881(C) Telecom System Design

Course Title	Course Code	Credits - 3		
		L	T	P
Telecom System Design	EC 1881 (C)	3	-	-

COURSE OBJECTIVE	The objective of the course To familiarize the student with the design, analysis and operation t of modern Telecommunication networks and to provide the student with a working knowledge of the types of communications network systems and their strengths and limitations in solving various network problems.
PRE-REQUISITES	• Advance Communication Systems
COURSE CONTENTS	**Unit I: Introduction**: Types of Information, Tele-communication Systems, A Basic Telecommunications System, Common Types of Tele-communications Systems, Networks, Connection-oriented Transport Service (COTS) and Connectionless, Network Service (CLNS), Circuit-, Packet- and Cell-switched Networks, Considerations for Network Planners, Technical Standards for Telecommunications Systems. **Introduction to Queuing Theory:** The M/M/I Queue with Queue limit, Birth and Death Models, The M/M/C Queue: Comparison with Single-channel Queues, Markovian Queues, The M/G/c Loss System-Insensitivity, Balancing Equitation's & Generating Functions, M/G/1 Queue, Poisson Arrivals See Time Averages (PASTA). **Unit-II:** The Principles of Switching, Circuit-switched Exchanges, Call Blocking within the Switch Matrix, Full and Limited Availability, Fan-in-Fan-out Switch Architecture, Switch Hardware Types, Strowger Switching, Crossbar Switching, Reed Relay Switching, Digital Switching, Packet and Cell Switches **Unit-III**: Network Routing, Interconnection and Interworking, The Need for a Network Routing Plan, Network Routing Objectives and Constraints, The Administration of Routing Tables, Routing Protocols Used in Modern Networks, Network Topology State and the 'Hello State Machine', Signaling Impact upon Routing and Call Set-up Delays, Plausibility Check During Number Analysis, Network Interconnection: Network Interconnection Services, Interconnect, Equal Access, Number Portability, Shared Use of Access Network Ducts and Cables, Pitfalls of Interconnection, The Point of Interconnection and Collocation, The Interconnection Contract, Interworking **Unit-IV**: Tele traffic Theory, Telecommunications Traffic, Traffic Intensity (Circuit-switched Networks), Practical Traffic Intensity (Erlang) Measurement, The Busy Hour, The Formula for Traffic Intensity, The Traffic-carrying Capacity of a Single Circuit, Dimensioning Circuit-switched Networks, Example Route Dimensioning, Call Waiting Systems, Dimensioning Data Networks, Pollaczek-Khinchine Delay Formula, Practical Dimensioning of Networks.

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	Unit-V: Quality of Service (QOS) and Network Performance (NP), Framework for Performance Management, Quality: A Marketing View, Quality of Service (QOS) and Network Performance (NP), Quality of Service Parameters, Generic Network Performance Parameters, Performance Monitoring Functions of Modern Networks, Network Performance Planning and Measurement, A Few Practical
COURSE OUTCOMES:	**After successful completion of this course a student will able to:** **CO1:** Demonstrate broad knowledge of fundamental principles and technical standards of telecommunication network, the architecture and operations of a Switching systems **CO2:** Analyze networking systems and their interconnections, Trafficking theory and use it to analyze and design communication systems **CO3:** Analyze network performance parameters and use them to design improved networking systems
TEXT BOOKS& REFERENCES:	• M.P. Clark, Networks and Telecommunications, Design and Operation, John Wiley & Sons. • S Raghavan, G Anandalingam, Telecommunication planning, Springer

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EC – 1882(A) Internet of Things

Course Title	Course Code	Credits - 3		
		L	T	P
Internet of Things	EC 1882(A)	3	-	-

COURSE OBJECTIVE

Assess the genesis and impact of IoT applications, architectures in real world.
Illustrate diverse methods of deploying smart objects and connect them to network.
Compare different Application protocols for IoT.
Infer the role of Data Analytics and Security in IoT.
Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

PRE-REQUISITES

- Digital Circuit Systems.
- Microprocessor
- Embedded Systems Design

COURSE CONTENTS

UNIT 1: What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

UNIT 2: Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

UNIT 3: IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

UNIT 4: Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment

UNIT 5: IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. Temperature Monitoring System Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.

COURSE OUTCOMES:

On successful completion of this course student should be able to:

CO1: grasp an understating of what is IOT and its applications, and working of devices and systems functioning as part of an Network
CO2: analyze the performance of various sensors, actuators, smart networks, and optimize the performance transport layers and applications
CO3: Apply the knowledge, analyze and design various IOT networks for developing and monitoring smart infrastructures.

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TEXT BOOKS & REFERENCES:

- Dr. Rajkamal "INTERNET OF THINGS Architecture and design principles" by Mc Graw Hill Education Private Limited.
- David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743)
- Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017
- Adrian Mcewen, Hakin Cassimally, "Designing The Internet of Things" Wiley.
- Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications.
- Charalampos Doukas, Building The Internet of Things with the Arduino: V.10, 2012.
- Hakima Chaouchi (Ed.), The Internet Of Things: Connecting Objects, Wiley, 2010.
- A Bahaga, V. Madisetti," Internet of Things-Hands on approach", VPT publisher.

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EC – 1882(B) Robotics

Course Title	Course Code	Credits - 3		
		L	T	P
Robotics	EC 1882(B)	3	-	-

COURSE OBJECTIVE	1. To acquire the knowledge on advanced algebraic tools for the description of motion. 2. To develop the ability to analyze and design the motion for articulated systems. 3. To develop an ability to use software tools for analysis and design of robotic systems
PRE-REQUISITES	• Digital Circuit Systems. • Basic Electronics. • Microprocessor • Embedded Systems Design
COURSE CONTENTS	Robots: Introduction, anatomy, Robot specifications, Robot characteristics, Areas of application, classification of robots. Robotic arm, Sensors, Encoders, Tachometers, Robotic drive systems and actuators, Specification, principle of operation and areas of application of: DC motor, Stepper motor, Servo motor and brushless DC motor, Microprocessor control of electric motors, speed control using PWM and direction control using H- Bridge, Robotic vision systems, Image processing techniques, kinematics, inverse kinematics, Velocity kinematics, Application of velocity kinematics for all serial manipulators, Digital and Programmable Logic (PLC) controllers. Robot Programming, Industrial applications of Robots, Mobile robots, Micro robots, Recent developments in Robotics.
COURSE OUTCOMES:	**On successful completion of this course student should be able to:** **CO1:** Be able to use matrix algebra and Linear algebra for computing the kinematics of robots. **CO2:** Be able to calculate the forward kinematics and inverse kinematics of serial and parallel robots. **CO3:** Be able to calculate the Jacobian for serial and parallel robot. **CO4:** Be able to do the path planning for a robotic system. CO5: Be proficient in the use of Maple or Matlab for the simulation of robots.

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TEXT BOOKS & REFERENCES

- Mikell and Groover, Industrial Robotics – Technology, Programming and Applications, McGraw Hill, 2/e, 2012
- Saeed B. Niku Introduction to Robotics. Analysis and control, applications- Wiley student edition, 2010 3. Spong and Vidyasagar, Robot Dynamics and Control, John Wiley & Sons, 1990.

References:

- Ashitava Ghosal, Robotics, Fundamental concepts and analysis, OXFORD University Press, 2006
- Fu, K.S,Gonzalez,R.C,Lee, C.S.G.,Robotics, Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.
- John. J.Craig, Introduction to Robotics: Mechanics and Control, PHI, 2005.
- Klafter, R.D., Chmielewski, T.A, Negin, M, Robotic Engineering An Integrated Approach, PHI, 2007
- Robert J. Schilling, Fundamentals of Robotics: Analysis & Control, Pearson Education, 2000
- S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi, 1994.

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EC – 1882(C) Wireless Sensor Network

Course Title	Course Code	Credits - 3		
		L	T	P
Wireless Sensor Network	EC 1882(C)	3	-	-

COURSE OBJECTIVE	The course is aimed both at students who wish to do research in the sensor networks area, as well as at students from related disciplines, such as signal processing, wireless communications, databases, algorithms, etc., who wish to understand what new challenges sensor networks pose for their own discipline
PRE-REQUISITES	• Digital Circuit Systems. • Basic Electronics. • Instrumentation and Meaurement
COURSE CONTENTS	Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks Mobile Adhoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and Zig Bee, Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols. Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, Internet to WSN Communication. Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to Tiny OS and nesC.
COURSE OUTCOMES:	**On successful completion of this course student should be able to:** **CO1:** This course provides an introduction to fundamentals of wireless sensors, software platforms required for WSN, MAC protocols for different communication standards used in WSN, **CO2:** Analyze characteristics of wireless sensors, software platforms, communication systems used in WSN, **CO3:** Design data gathering, data fusion applications.
TEXT BOOKS& REFERENCES:	• Waltenegus Dargie , Christian Poellabauer, Fundamentals Of Wireless Sensor Networks Theory And Practice By John Wiley & Sons Publications **Reference Books** • Sabrie Soloman, SENSORS HANDBOOK by Mc Graw Hill publication. • Feng Zhao, Leonidas Guibas, Wireless Sensor Networks, Elsevier Publications. • Kazem Sohrby, Daniel Minoli, Wireless Sensor Networks: Technology, Protocols and Applications, Wiley-Inderscience • Philip Levis, And David Gay Tinyos Programming by Cambridge University Press.

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