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Scheme & Syllabus Based on AICTE Flexible Curricula **(B. Tech)**
Electronics & Communication Engineering Department

	Metro System & Engineering	**L: T: P (0 hrs.)**	**Credits:**

Prerequisite: Electronics Circuit, Signals & System, engineering materials, Civil Engg.

Course Objective: The objective of this course is that students can learn fundamental concepts of electronic circuits together with concepts of Civil and Mechanical engineering for designing of metro systems.

MODULE I **(8 hrs.)**

Difference between metro and rail system, Signal protocols in railways, Types of Signals in electronics system, LED, Power supply, Microcontroller and Microprocessor, Timers, General introduction to IC, IC555, IC741, CD4000 series etc. and their datasheets.

MODULE II **(8 hrs.)**

Automatic door system in metro, GPS, Servo motor, Motor driver circuit, Electronic fare collection system in metro, RFID, Passenger information system , Modes of addressing, LCD, IVRS, Mic, Speakers, Wacky Tacky, Radio wave Propagation, AM,
FM modulation.

MODULE III **(8 hrs.)**

Overview of metro systems , Different mechanism, Mechanical vibration and human comfort, Basics of vehicle dynamics and structure, types of braking system, suspension system and its types, Rolling stock, Lifts and Escalators.

MODULE IV **(8 hrs.)**

Different engineering materials, stress strain analysis, Basics of refrigeration system and cycles, Ventilation of mainline rail tunnels, Tunnel Ventilation systems; Air conditioning for stations and buildings.

MODULE V **(8 hrs.)**

General: Overview of Metro Systems, Need for Metros, routing studies, Basic Planning and Financials.

Civil Engineering:- Overview and construction methods for: Elevated and underground Stations, Viaduct spans and bridges, Underground tunnels, tunnel ventilation systems, air - conditioning for stations and buildings, Initial Surveys & Investigations, Basics of Construction Planning & Management, Construction Quality & Safety Systems.

Assessment: Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

Course Outcome:

1. To apply knowledge of various types of signals and their significance in telecommunication.
2. Demonstrate and classify various types of integrated circuits and their pin configuration and compare the performance of various modulation schemes.
3. Understand different mechanism and vehicle dynamics of metro systems.
4. Explain tunnel ventilation systems; air -conditioning for stations and buildings.
5. To understand basics of construction planning & management, construction quality & safety systems.

Text/ Reference Books:

1. Rey Bhurchandi, "Advanced Microprocessor Architecture", 2nd edition, TMH, 2001.
2. B.P. Lathi, "Modern Digital and Analog Communication System", TMH.
3. M. Morris Mano, "Digital Logic and Computer Design", 1st edition, Pearson India Education, 2012.
4. Ramakant A Gaikward, "OP- Amp and linear Integrated circuits", Third edition 2006, Pearson.
5. Fundamentals of Vehicle Dynamics by Thomas D. Gillespie, published by SAE International with a Product Code of R-114, ISBN of 978-1-56091-199-9.
6. Civil Engineering For Underground Rail Transport, J.T. Edwards (Chairman, Halcrow Fox and Associates; formerly Senior Partner, Freeman Fox and Partners).
7. Handbook of Research on Emerging Innovations in Rail Transportation Engineering, B. Umesh Rai (Chennai Metro Rail Limited, India).

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PCC-EC601	Embedded Systems & Robotics	3L: 0T: 2P (04 hrs.)	Credits: 04

Prerequisite: Fundamentals of microprocessors, microcontrollers, programming and interfacing.

Course Objective: The objective of this course is that students can learn fundamental concepts of Robotics and advanced microcontrollers like PIC, AVR and ARM.

MODULE I **(7 hrs.)**
Introduction & Fundamentals of Robotics: Introduction and classification of robots. Robotics Sensors: Position Sensors, robot calibration by optical encoder, proximity sensors, Ultrasonic & IR sensors, Force and Torque sensors, Touch and Slip sensors, Temperature and Humidity sensors, Light and Sound sensors, Pressure and Gas sensors, Acceleration sensors. Sensor Communication Protocols: I2C, SPI, CAN, USART.

MODULE II **(7 hrs.)**
Robotics Actuators: Relays and their types, Specifications and characteristics of Stepper motors, AC motors, DC motors and servo motors. Power driving circuit and Power management for actuators, Torque and speed relationship of motors, Motor speed controlling techniques.

MODULE III **(8 hrs.)**
Classification of Robots, Basics of matrices, Rotations & transformations, Introduction to D-H parameters and its physical significance, Orientation of gripper, Trajectory planning.

MODULE IV **(9 hrs.)**
8-bit PIC (1PICF877) Microcontroller Architecture, memory technologies, timing circuit, power- up& reset, parallel ports, ADC, interrupts, PWM, counters & timers, Instruction set, Memory mapping, Peripherals, Software development environment, programming tools.AVR (ATMEGA328) Features, Architecture, Instruction Set, Peripherals, Programming Interfaces, Programming in embedded C.

MODULE V **(9 hrs.)**
Interfacing of PIC and AVR: LED, LCD, 7 segment display, motor driver, ADC, DAC, memory, timers, delays, keyboard, GSM. Introduction to ARM microcontroller, Assemble the single shaft servo Motor Humanoid, Assemble the double shaft servo motor Humanoid. Assemble a line follower robot, Assemble an obstacle avoider robot.

List of Experiments:

1. Write a program in embedded C to read temperature from LM35 and display on LCD.
2. Write a program in embedded C to read data from keypad & display on LCD.
3. Write a program in embedded C to control speed of motor.
4. Write a program in embedded C to control servo motor.
5. Write a program in embedded C to control IR sensor.
6. Code a sequence in Robotic software to pick and place an object by Robotic hand.
7. Code a sequence in Robotic software to control hands of a humanoid Robot.
8. Code a sequence in Robotic software to control legs of a humanoid Robot.
9. Code a sequence in Robotic software to make a Robot walk.
10. Code a sequence in Robotic software to make a Robot dance.

Assessment: Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

Course Outcome:

Students should be able to:

1. Understand the fundamentals of Robotics and explain working of sensors and their types.
2. Define different types of Actuators used in Robotics and illustrate concepts about their working.
3. Classify types of Robots in different applications and define various concepts related to their movements.
4. Understand PIC & AVR microcontroller architectures and programming in Robotics and embedded systems.
5. Design automated embedded systems by interfacing different Modules with advance controllers. Illustrate overview of ARM microcontroller architectures.

Text/ Reference Books:

1. Muhammad Ali Mazidi, "The AVR microcontroller and embedded system using assembly and c", 3rd edition, Pearson, 2010.
2. Rajesh Singh, "Embedded System Based on Atmega Microcontroller: Simulation, Interfacing & Projects", Alpha Science, 2016.
3. Morton John, "PIC Microcontroller: Your Personal Introductory Course", 3rd edition, English, Paperback, 2005.
4. Phillip John McKerrow, "Introduction to Robotics", 1st edition, Paperback.
5. Dr. Kevin Klein, "Robotics: Discover the Robotic Innovations of the Future - An Introductory Guide to Robotics", 1st edition, Paperback, 2016.
6. Muhammad Ali Mazidi, "PIC Microcontroller and Embedded Systems: Using assembly and C for PIC 18", 1st edition, Pearson, 2008.

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PCC-EC405	Simulation Lab	0L: 0T: 2P (02 hrs)	Credits:01

Recommended Prerequisite: Engineering Mathematics, C Language

Course Objective: The objective of this laboratory is to provide the basic knowledge of MATLAB/MATLAB-Simulink/Scilab software which is used to simulate and implement the trigonometry formula, effect of variation in controller parameter on system response, solve system equations in state-variable form.

List of Experiments:

1. Familiarize with the MATLAB/MATLAB-Simulink/Scilab environment and running some basic commands.
2. To determine transpose, inverse values of given matrix.
3. To perform addition, subtraction, multiplies and divides of binary number of Digital System.
4. To plot Pole Zero Map of a discrete transfer function using MATLAB/MATLAB-Simulink/Scilab simulation.
5. To generate the amplitude modulated wave using MATLAB/MATLAB-Simulink/Scilab simulation.
6. To generate frequency modulated wave using MATLAB/MATLAB-Simulink/Scilab simulation.
7. To generate & analyze CRC code of given data.
8. To evaluate the stability of a system using state space model.
9. To perform operation in image processing for analyzing an image using MATLAB/Scilab.
10. To implement the trigonometry formula using MATLAB/MATLAB-Simulink/Scilab Simulink.

Assessment: Internal viva, Continuous evaluation of experiments, Journal write-up, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Aware of MATLAB/MATLAB-Simulink/Scilab software and perform basic programs.
2. Perform Real time application and know about basic key features of MATLAB/MATLAB-Simulink/Scilab software
3. Develop a program related to control system in MATLAB/MATLAB-Simulink/Scilab software.
4. Develop a program related to data communications in MATLAB/MATLAB-Simulink/Scilab software.
5. Generate and analyze the image using image processing tool box in MATLAB/MATLAB-Simulink/Scilab software.

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PEC-EC703(B)	**Fuzzy Logic and its Applications**	**3L: 0T: 0P (03 hrs.)**	**Credits: 03**

Recommended Prerequisite: Engineering Mathematics, Electronics

Course Objective: To master the various fundamental concepts of fuzzy logic and artificial neural networks. This will help you to get sufficient knowledge to analyze and design the various intelligent control systems.

MODULE I **(8 hrs.)**
Basics of Fuzzy sets: Fuzzy sets, operation on Fuzzy sets, and Extensions of Fuzzy set concepts, extension principle and its applications. Geometry of fuzzy sets, sets as points, counting with fuzzy sets.

MODULE II **(8 hrs.)**
Fuzzy Relations: Basics of fuzzy relations, operations on fuzzy relations, various types of Binary fuzzy relations, fuzzy relations equations.

MODULE III **(8 hrs.)**
Membership Functions: Features of the membership function, fuzzification, Membership Value assignments — in tuition, in science, Rank ordering, Neural Networks.

MODULE IV **(8 hrs.)**
Fuzzy — to — crisp: conversions: Defuzzification methods — Max-membership principle, Central method, weighted average method, mean-max membership, center of sums, center of Largest area, first (or last) of maxima.

MODULE V **(8 hrs.)**
Fuzzy Associative memories: Fuzzy systems as between — cube mappings, fuzzy and neural Function estimators, neural Vs Fuzzy representation of structured knowledge, FANS as Mappings, fuzzy Hebb FAMS, the bi-directional FAN theorem for correlation minimum Encoding, correlation — product exuding, superimposing FAM rules, recalled outputs and defizzifaction, FAM structure Architecture. Binary input — output FAMS, example of Invented pendulum — Fuzzy contains crane control.

Assessment: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

Course Outcomes:
Students earning credits will develop ability to:
1. Illustrate and Review Fundamentals of the concepts of regular and fuzzy sets.
2. Learn different types of fuzzy sets used in different applications.
3. Understanding the design of membership functions and fuzzification process.
4. Learning of fuzzy to crips and defuzzification process.
5. Design of different neural and fuzzy memories

Text/ Reference Books:

1. C.T. Lin and C. S. George Lee, "Neural Fuzzy Systems", PHI, 1996.
2. Bant A KOSKO, "Neural Networks and Fuzzy Systems", PHI, 1994.
3. Altrock, C.V., "Fuzzy Logic and Neuro Fuzzy Applications explained", PHI, 1995.

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PSEC-MEEC101(C)	SDR & Cognitive Radio	3L: 0T: 0P (03 hrs.)	Credits: 03

Recommended Prerequisite: Communication Networks, Mobile Communication.

Course Objective: To make the students understand the fundamental concepts Software Defined Radios (SDR) and Cognitive Radio. This Course provides Comprehensive coverage of hardware and software architecture of software defined radio .The Course deals with the design of the wireless networks based on the cognitive radios.

MODULE I **(8 hrs.)**
Introduction to Software Defined Radio: Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

MODULE II **(8 hrs.)**
SDR Architecture: Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

MODULE III **(8 hrs.)**
Introduction to Cognitive Radios: Marking radio self-aware, cognitive techniques– position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

MODULE IV **(8 hrs.)**
Cognitive Radio Architecture: Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

MODULE V **(8 hrs.)**
Next Generation Wireless Networks: The XG Network Architecture, Spectrum sensing, Spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross-layer design, channel modeling, RF front end design and applications.

Assessment: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.
Course Outcomes:
Students earning credits will develop ability to:
1. Describe the basics of the software defined radios.
2. Learn the hardware and software architecture of software defined radio.
3. Design the wireless networks based on the cognitive radios.
4. Gives an understanding of cognitive radio architecture.
5. Explain the concepts behind the wireless networks and next generation networks.

Text/ Reference Books:

1. Joseph Mitola III, "Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", JohnWiley & Sons Ltd. 2000.

2. Thomas W. Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", ARTECH HOUSE .2009.
3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.
4. Ian F. Akyildiz, Won–Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access /cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.
5. Simon Haykin, "Cognitive Radio: Brain–Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.
6. Hasari Celebi, Huseyin Arslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications, Jan 2008.
7. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.
8. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.
9. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010, www.nptel.ac.in.
10. Jeffrey H. Reed, "Software Radio: A Modern Approach to Radio Engineering" Pearson Education Low Price Edition.
11. Kwang Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd.

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PEC-EC802(C)	Artificial Neural Network	3L: 0T: 0P (03 hrs.)	Credits: 03

Recommended Prerequisite: Fundamental of Computing

Course Objective: The objective of this course is to provide basic understanding of the fundamentals and applications of artificial neural networks.

UNIT I **(8 hrs.)**
Introduction: Biological Neuron – Artificial Neural Model - Types of activation functions – Architecture: Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks.
Learning: Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron Convergence Theorem.

UNIT II **(8 hrs.)**
Supervised Learning: Perceptron learning and Non Separable sets, α-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, μ-LMS approximate to gradient descent, Application of LMS to Noise Cancelling, Multi-layered Network Architecture, Backpropagation Learning Algorithm, Practical consideration of BP algorithm.

UNIT III **(8 hrs.)**
Support Vector Machines and Radial Basis Function: Learning from Examples, Statistical Learning Theory, Support Vector Machines, SVM application to Image Classification, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.

UNIT IV **(8 hrs.)**
Attractor Neural Networks: Associative Learning Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.

UNIT **(8 hrs.)**
Self-organization Feature Map: Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self-organization Feature Maps, Application of SOM, Growing Neural Gas.

Assessment: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

Course Outcomes:
Students earning credits will develop ability to:
1. Understand and review the basic concepts of Artificial Neural Network (ANN) and its applications
2. Discuss and Analyze different types of learning and training algorithm for ANN.
3. Illustrate and Analyze Support Vector Machines and Radial Basis Function.
4. Discuss and analyze concept of Attractor Neural Networks.
5. Discuss and analyze the concept of Self-organization Feature Map.

Text Books/ Reference Books:

1. Lawrence Fussett, "fundamental of Neural network Prentice" PHI.
2. Bart Kosko, "Neural network and Fuzzy System" PHI.
3. J.M.Zurada, "Introduction to artificial neural systems,"Jaico Publication house, Delhi.
4. VallusuRao and HayagvnaRao, "C++ Neural network and fuzzy logic" BPB and Publication.