Integrated Master of Technology in Electronics

Specialization: Embedded Systems

Programme Outcomes:

An Embedded System is a programmed controlling and operating system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Following are the programme outcomes

1. To practically apply gained theoretical knowledge in order to design, analyze and implement embedded systems
2. To acquire knowledge of and be able to use tools for the development and debugging of programs implemented on microcontrollers and DSPs.
3. To apply formal method, testing, verification, validation and simulation techniques and tools in order to engineer reliable and safe embedded systems
4. To acquire knowledge of sensor properties and apply these in the design of Electronic systems which integrate measurement and actuation in different industrial production contexts.
5. Exposure to the emerging field of Internet of Things

Scheme and Syllabus

Note: The Scheme/Syllabus of the programme/courses as detailed below, can be modified/updated keeping pace with technological advancement, feedback from industry etc, from time to time in accordance with University Ordinance No. 14.

Batch: 2022-27

Sixth Semester

Code	Title	Credits (L T P)
CORE COURSES		
EL16101	Embedded Microcontrollers	4 (3-1-0)
EL16201	Embedded Microcontroller Lab	2 (0-0-2)
EL16102	Wireless and Mobile Communication	4 (3-1-0)
ABILITY ENHANCEMENT COURSE		
EL16104	AI and Machine Learning	4 (3-1-0)
EL16204	AI and Machine Learning Laboratory	2 (0-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC		
EL16102	Database Management System	4 (3-1-0)
EL16202	DBMS Laboratory	2 (0-0-2)
Comprehensive Viva-Voce		
EL16301	Comprehensive Viva-Voce	4
VALUE ADDED (ADD-ON COURSE): It is an additional course. Its credits shall not be counted in calculating SGPA/ CGPA.		
	Students can opt for MOOC Courses as per their interest	
TOTAL CREDITS		**26**

EL16101	Embedded Microcontrollers	4 (3-1-0)

This course is structured to combine lectures, insightful demonstrations, case studies and tutorials for the students to gain an in-depth understanding of fundamental concepts on embedded systems. Upon completion of this subject, the students should be able to:

1. Understand the hardware and software components as well as their development cycles,
2. Understand the deployment of embedded processors and supporting devices in real-world applications
3. Interpret application specifications and make practical recommendations on resource selection for embedded systems.
4. Understand key concepts of embedded systems like IO, timers, interrupts, interaction with peripheral devices

Computer Architectures: RISC/CISC and Harvard. Princeton Architectures Introduction: The 8051. Microcontroller, Criteria for choosing a microcontroller, 8051 Family members & block diagram. The 8051 Assembly Language Programming: 8051 internal registers, Structure of Assembly Language, Program Counter & ROM Space, Data types & Directives, PSW, Register Banks & Stack. JMP, LOOP & CALL Instructions: Looping, Conditional & unconditional jump, LCALL, ACALL, PUSH, POP instructions & Subroutines. Time Delay Generation & Calculation. I/O Port Programming: Pin description, I/O Ports, Bit addressability & Read-modify-write feature.

Addressing Modes: Addressing modes, Indexed addressing & Look up tables, SFR registers and their addresses. Arithmetic & Logical Instructions: Addition, subtraction, BCD numbers and DA A instruction, multiplication and division, signed number and overflow problem in arithmetic operations. Logic & Compare Instructions, Rotate & Swap Instructions, BCD & ASCII conversion programs. Single Bit Instructions: Single bit instructions, Registers & bit addressability, Bit addressable RAM, Reading input pins Vs. Port Latch. 8051Timer /Counter Programming: Timer Registers, TMOD Register, Timer mode 1, mode 2, mode 3 programming. Counter Programming.

8051 Serial Communication: Basics of serial communication, Asynchronous serial communication & data framing, RS 232 standards, MAX 232. Baud rate selection & T1 register, SBUF, SCON Registers, and Serial port Programming to transmit & receive data serially.

8051 Interrupts Programming: 8051 interrupts, IVT for 8051, IE register, TCON register and Timer Interrupts, External H/W Interrupts Programming. Serial Port Interrupts Programming, Interrupt Priority upon reset and IP register.

Real World Interfacing: LED, Switches, LCD, ADC, DAC, Sensors, Stepper Motor, Keyboard, and Memory.

References

1. 8051 Microcontroller and Embedded Systems : M.A. Mazidi & J. G. Mazidi. Pearson Education

2. Microcontrollers: Architecture, Programming & System Design: Rajkamal Pearson Education

3. 8051 Microcontrollers Arch., Programming & Applications: K. J. Ayala Penram International

EL16102	Wireless and Mobile Communication	4 (3-1-0)

Course Learning Objectives

To get an understanding of mobile radio communication principles, types and to study the recent trends adopted in cellular and wireless systems and standards.

Unit-I: Introduction to wireless communications: history and evolution, current wireless communication systems, requirements of wireless services, and technical challenges of wireless communications. Generations of wireless communication.

Unit-II: Propagation and System Planning: Radio wave propagation in the mobile environment: Free space propagation, propagation mechanisms, large scale and small scale fading, path loss models.

Unit-III: Evolution of cellular systems, PSTN, principles and concepts of cellular systems, ISDN. Multiple access techniques: FDMA, TDMA, CDMA. Introduction to 4G and diversity, Overview of MIMO system, transmit diversity and spatial multiplexing.

Unit IV: Introduction to IEEE 802.11 Project Wireless LAN, Bluetooth, wireless MAN, short range wireless networks, and integration of different types of wireless networks.

References:

1. Goldsmith , "Wireless Communications", Cambridge University Press, 2005.
2. Molisch, "Wireless Communications", Wiley-IEEE, 2nd Edition, 2010
3. T. S. Rappaport, "Wireless Communications: Principles and Practice", Prentice Hall, 2nd Edition,2002

EL16104	AI and Machine Learning	4 (3-1-0)

Course Learning Objectives

- The course is designed to provide complete knowledge of Machine Learning. Students will be able to develop logics which will help them to create programs, for models.
- Also by learning, able to deal with data related real time problems.

Introduction to Python: What is Python and history of Python? Unique features of Python. Python-2 and Python-3 differences. Install Python and Environment Setup. First Python Program. Python Identifiers, Keywords and Indentation. Comments and document interlude in Python. Command line arguments. Getting User Input. Python Data Types. What are variables?
Python Core objects and Functions. Number and Maths. List, Ranges & Tuples in Python, Introduction Lists in Python More about Lists, Understanding Iterators, Generators, Comprehensions and Lambda Expressions o Introduction o Generators and Yield o Next and Ranges

Understanding and using Ranges: More About Ranges, Ordered Sets with tuples. Python Dictionaries and Sets, Introduction to the section, Python Dictionaries, More on Dictionaries
Sets, Python Sets Examples

Learning Problems Perspectives and Issues: Concept Learning Version Spaces and Candidate. Various python based libraries used in development of machine learning like numpy, pandas, matplotlib, scikit learning, Mathematics and statistics to fine tune ML models: Mean, median, Gaussian distribution, probability distribution, partial differentiation, linear algebra, polynomials, mean square error, cost function, gradient descent algorithm, activation unit, sigmoid function.

ML Models: Linear regression, Polynomial regression, K-means clustering, logistic regression, Decision Tree. Scratch model development by python, fine tuning parameters like learning rate, change in number of iterations, regularization factor. Diagnostic mechanism to deal with errors such as cost function vs. degree of polynomials, regularization factor vs. degree of polynomials, number of samples vs. degree of polynomials.

NEURAL NETWORKS AND GENETIC ALGORITHMS: Neural Network Representation Problems, Perceptions Multilayer Networks and Back Propagation Algorithms – Advanced Topics. Reduction in loss and fine-tuning of weights at each layer.

Referred Books

1. Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems: Geron Aurelien
2. Machine Learning for Absolute Beginners: Oliver Theobald

Course outcomes

On completion of this course the students will be,

1. Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems.
2. Demonstrate an understanding of how to find out insights from the data by applying machine learning

EL16102	Database Management System	4 (3-1-0)

Unit 1: Introduction: Advantages of DBMS approach, Various views of data, data independence, schema & sub-schema, primary concept of data models, database languages, transaction management, database administrator & users, data dictionary, database architectures.

E-R model: Basic concepts, design issues, mapping constraint, keys, E-R diagram, weak & strong entitysets, specialization & generalization, aggregation, inheritance, design of E-R schema, Reduction of ER Schema to tables. Domains, relation, kind of relation, Relational databases, Various types of keys.

Unit 2: Relational Algebra and SQL: Relational algebra with extended operations, modification of database, Idea of relational calculus, basic structure of SQL, Set operation, Aggregate functions, Null values, Nested Sub queries, derived relations, views, Modification of database, join relation, Domain, relation & keys, DDL in SQL.Programming concepts of PL/SQL

Unit 3: Relational Database Design & Normalization: Basic definitions, Trivial & non-trivial dependencies, Introduction to Normalization, Normal forms, Decomposition, Functional dependencies, non loss decomposition, FD diagram, First, second & third normal forms, Dependency preservation, BCNF, multivalue dependencies and fourth normal form, join dependencies and fifth normal form, Database Integrity. Transaction, Concurrency & Recovery: Basic concept, ACID properties, transaction state, Implementation of atomicity & durability, Concurrent execution, Basic idea of serializability, Basic idea of concurrency control, basic idea of deadlock, Failure Classification, storage structure-types, stable storage implementation, data access, recovery & Atomicity: log based recovery, deferred database modification, immediate database modification, checkpoints.

Unit 4: Storage Structure & File Organization: Overview of physical storage media, magnetic disk: performance & optimization, RAID, File organization, Organization of records in files, basic concept of Indexing, ordered indices: B+ tree & B tree index files, Query processing, Query optimization.

Suggested Books:

1. Database System concepts – Henry F. Korth , Tata McGraw Hill
2. SQL, PL/SQL The programming language of Oracle- Ivan Bayross
3. An introduction to Database System - C.J Date
4. Complete Reference – Oracle 10g