Indian Institute of Information Technology Bhagalpur

Electronics and Communication Engineering (ECE)

B.Tech. Curricula and Syllabus

Semester-V

Curricula:

Course Code	Course name	L	T	P	C
EC301	**Digital Signal Processing**	**3**	**0**	**0**	**3**
EC302	Control Systems	3	1	0	4
EC303	Introduction to VLSI Design	3	0	0	3
EC304	**IoT and Embedded System**	**3**	**0**	**0**	**3**
CS303	**Artificial Intelligence**	**3**	**0**	**2**	**4**
EC311	**Digital Signal Processing LAB**	**0**	**0**	**3**	**2**
EC312	**IOT and Embedded System LAB**	**0**	**0**	**3**	**2**
EC313	VLSI Design LAB	0	0	3	2
SAI-S-II	**Academia Internship**	**0**	**0**	**0**	**1**

Syllabus:

<table>
<tr><th>Course Code</th><th>Course name</th><th>L</th><th>T</th><th>P</th><th>C</th><th>Year</th><th>Semester</th></tr>
<tr><td>EC301</td><td>Digital Signal Processing</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3rd</td><td>5th</td></tr>
<tr><td colspan="8">Course objective: The main objectives of the course are: to identify the signals and systems, apply the principles of discrete-time signal analysis to perform various signal operations, apply the principles of z-transforms to finite difference equations, apply the principles of Fourier transform analysis to describe the frequency characteristics of discrete-time signals and systems, apply the principles of signal analysis to filtering and use computer programming tools to process and visualize signals.</td></tr>
<tr><th>Topic</th><th colspan="6">Contents</th><th>No. of Lectures</th></tr>
<tr><td>Module-I</td><td colspan="6">Review of discrete time signals, systems and transforms: Discrete time signals, systems and their classification; Analysis of discrete time LTI systems: impulse response, difference equation, frequency response, transfer function, DTFT, DTFS and Z-transform.</td><td>08</td></tr>
<tr><td>Module-II</td><td colspan="6">Ideal filter characteristics, low-pass, high-pass, band-pass and band-stop filters, Paley-Wiener criterion, digital resonators, notch filters, comb filters, Butterworth filter, chebyshev filter, inverse systems, minimum phase, maximum phase and mixed phase systems.</td><td>08</td></tr>
<tr><td>Module-III</td><td colspan="6">Signal flow graph representation, basic structures for FIR and IIR systems (direct, parallel, cascade and polyphase forms), transposition theorem, ladder and lattice structures; Design of FIR filters using windows, frequency sampling, Remez algorithm and least mean square error methods; Design of IIR filters using impulse invariance, bilinear transformation and frequency transformations.</td><td>09</td></tr>
</table>

Module-IV	Computational problem, DFT relations, DFT properties, fast Fourier transform (FFT) algorithms (radix-2, decimation-in-time, decimation-in-frequency), Goertzel algorithm, linear convolution using DFT.	**08**
Module-V	Finite word-length effects in digital filters: Fixed and floating point representation of numbers, quantization noise in signal representations, finite word-length effects in coefficient representation, round-off noise, SQNR computation and limit cycle; Introduction to multi-rate signal processing: Decimation, interpolation, poly-phase decomposition.	**09**
	Total	**42**
Text	1. S. K. Mitra, Digital Signal Processing: *A Computer-Based Approach*, Tata McGraw Hill, 2nd edition, 2001. 2. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, PHI, 4th edition, 2007.	
Reference	1. A. V. Oppenheim and R. W. Shafer, *Discrete-Time Signal Processing*; PHI, 2nd edition, 2004.	

Course Code	Course name	L	T	P	C	Year	Semester
EC302	Control Systems	3	1	0	4	3rd	5th

Course objective: To provide the basic skills required to understand, develop, and design various engineering applications involving electromagnetic fields. To lay the foundations of electromagnetism and its practice in modern communications such as wireless, guided wave principles such as fiber optics and electronic electromagnetic structures.

Topic	Contents	No. of Lectures
Module-I	Basic Concepts of Control Systems: Open loop and closed loop systems, Derivation of Transfer functions, Signal flow Graphs, Mason's Gain Formula; Feedback characteristics of Control Systems; Time response of first order and Second order systems, Steady State Errors and Static Error Constants of systems.	**09**
Module-II	Routh-Hurwitz stability criterion, Application of the Routh stability criterion to linear feedback system, Relative stability by shifting the origin in s-plane; Root locus concepts, Root contours, Systems with transportation lag. Effect of adding open loop poles and zeros on Root locus; Frequency domain specifications, correlation between Time and Frequency Response with respect to second order system, Polar plots, Bode plot, Determination of Gain Margin and Phase Margin from Bode plot	**08**
Module-III	Stability in frequency domain: Principle of argument, Nyquist stability criterion, Application of Nyquist stability criterion for linear feedback system. Constant M-circles, Constant N-Circles, Nichol's chart; Controllers: Concept of Proportional, Derivative and Integral Control actions, P, PD, PI, PID controllers. Zeigler-Nichols method of tuning PID controllers	**08**
Module-IV	Mapping between the S-Plane and the Z-Plane, Primary strips and Complementary Strips, Constant frequency loci, Constant damping ratio loci, Stability Analysis of closed loop systems in the Z-Plane. Jury stability test, Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion.	**08**

Module-V	Transient and steady State Response Analysis, Design based on the frequency response method, Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PI, PD, and PID controllers.	**09**
	Total	**42**
Text	1. I. G. Nagarath, M. Gopal, *Control Systems*, Tata McGraw Hill Education, 4th edition, 2012. 2. M. Gopal, Digital Control and State Variables Methods, Tata McGraw Hill Education, 2nd edition, 2003.	
Reference	1. B. C. Kuo, *Automatic Control Systems*, Tata McGraw-Hill, 10th edition, 2017. 2. K. Ogata, *Modern Control Engineering*, Pearson Education India, 5th edition, 2015.	

Course Code	Course name	L	T	P	C	Year	Semester
EC303	Introduction to VLSI Design	3	0	0	3	3rd	5th
Course objective: This is an advanced course which introduces the issues, processes and the technology used to design a digital integrated circuit (IC). This course also introduces the MOSFET and CMOS technology used in the fabrication of ICs.							
Topic	**Contents**						**No. of Lectures**
Module-I	Issues and Challenges, design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles; CMOS p-well and n-well processes, layout design rules, Latch-up immune designs						**08**
Module-II	MOS Device Model with Sub-micron Effects, VTC Parameters, CMOS Propagation Delay, Parasitic Capacitance Estimation, Layout of an Inverter, Switching, Short-Circuit and Leakage Components of Energy and Power;						**09**
Module-III	Interconnects: Resistance, Capacitance Estimation, delays, Buffer Chains, Low Swing Drivers, Power Distribution, and Performance Optimization of Digital Circuits by Logical Effort Sizing;						**08**
Module-IV	Static CMOS Construction, Ratioed Logic, Pass Transistor, Transmission Gate Logic, DCVSL, Dynamic Logic Design and noise considerations in dynamic design, Power Dissipation in CMOS, Domino and NORA designs.						**09**
Module-V	Classification, Parameters, Static Latches and Register, Race Condition, Dynamic Latches and Registers, Two Phase vs. Single Phase clock designs,						**08**
						Total	**42**
Text	1. J. M. Rabaey, A. Chandrakasan and B. Nikolic, *Digital Integrated Circuits- A Design Perspective*, PHI, 2nd edition, 2009.						
Reference	1. N. Weste and D. Harris, *CMOS VLSI Design: A Circuits and Systems Perspective*, Pearson Education India, 3rd edition, 2012.						

Course Code	Course name	L	T	P	C	Year	Semester
EC304	IoT & Embedded Systems	3	0	0	3	3rd	5th

Course objective: This main objective of this course facilitates to design, describe, validate and optimise embedded electronic systems in different industrial application areas. More particularly, the architecture of advanced processors, their instruction sets, interfacings to develop different kinds of systems.

1. To provide in depth knowledge about embedded processor, its hardware and software.
2. To explain programming concepts and embedded programming in C and assembly language
3. To explain real-time operating systems, inter-task communication and an embedded software development tool.

Topic	Contents	No. of Lectures
Module-I	An introduction to Embedded system design & modelling with unified mark-up language; 8-bit and 16- bit, von Neumann and Harvard architectures, CISC and RISC architectures; Advanced RISC Machines, Open source core (LEOX), Introduction to microcontrollers, ARM versions, ARM instruction set: assembly language, Thumb instruction set, memory organization, data operations and flow control; Input/output mechanisms, isolated and memory mapped IO; interrupts and real time operations, ARM interrupts vectors, priorities and latency; co-processors; cache memory and memory management.	**09**
Module-II	Embedded Platforms: bus protocols, system bus configuration, USB and SPI buses, DMA, ARM bus; memory devices: memory device configuration, ROM, RAM, DRAM; I/O devices: timers, counters, ADC & DAC, keyboards, displays and touch screens. Processes: multiple tasks and multiple processes; process abstraction; context switching: cooperative multitasking, pre-emptive multitasking, process and object-oriented design	**09**
Module-III	Operating Systems: operating systems and RTOS; scheduling polices; inter-process communication; Networks: distributed embedded architectures: networks abstractions, hardware and software architectures; networks for embedded systems: I2C bus, CAN bus.	**09**
Module-IV	An Introduction to Internet-of-Things, Sensing, Actuation, Basics of Networking; Communication Protocols, Sensor Networks, Machine-to-Machine Communications, Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination	**07**
Module-V	Developing IoTs: Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python; Domain specific applications of IoT: Home automation, Industry applications, Surveillance applications, Other IoT applications.	**08**
	Total	**42**
Text	1. A. N. Sloss, D. Symes, and C. Wright, *ARM system developer's guide: Designing and optimizing system software*; Elsevier, 1st edition. 2008. 2. Pethuru Raj and Anupama C. Raman, *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*,CRC Press, 2017.	
Reference	1. Arshdeep Bahga and Vijay Madisetti, *Internet of Things: A Hands-on Approach*, Universities Press, 2017. 2. W. Wolf, *Computers as components: Principles of embedded computing system design*; Elsevier, 3rd edition, 2013.	

Course Code	Course name	L	T	P	C	Year	Semester
CS303	Artificial Intelligence	3	0	2	4	3rd	5th

Course Objective: The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches. Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning.

Topic	Contents	No. of Lectures
Module 1	Fundamental issues in intelligent systems: History of artificial intelligence; philosophical questions; fundamental definitions; philosophical questions; modeling the world; the role of heuristics.	**2**
Module 2	Search and constraint satisfaction: Problem spaces; brute-force search; best-first search; two-player games; constraint satisfaction.	**10**
Module 3	Knowledge representation and reasoning: Review of propositional and predicate logic; resolution and theorem proving; non-monotonic inference; probabilistic reasoning; Bayes theorem.	**8**
Module 4	AI planning systems: Definition and examples of planning systems; planning as search; operator-based planning; propositional planning.	**8**
Module 5	Sequential decision making: Achieving behaviour by specifying rewards, Markov Decision Problems.	**7**
	Total	**35**

Text Books	**1.** Stuart Russell and Peter Norvig: Artifical Intelligence: A Modern Approach, Pearson; Third edition (2013). **2.** Elaine Rich, Kevin Knight and Shivashankar B Nair, Artificial Intelligence, Tata McGraw Hill, 3rd Edition 2009.
Reference Books	1. N. J. Nilsson, "Principles of Artificial Intelligence", Narosa Publishing House, 1980. 2. Clocksin & Mellish, Programming in PROLOG, Narosa Publ. House.