Department of EECE

Scheme of Studies & Syllabus

Bachelor of Technology

(Electronics and Communication Engineering)

July 2020

School of Engineering and Technology

THE NORTHCAP UNIVERSITY, GURGAON

(Established under Haryana Govt. Notification No. Leg. 33/2010-HARYANA ACT No.25 of 2010)

Bachelor of Technology in Electronics and Communication Engineering

Bachelor of Technology in Electronics and Communication Engineering- (2020-21)

Sem	Semester Course Code, Course Name (L-T-P) Credits							GP	CS	Hrs. Per week			Contact Hrs	Credits
										L	T	P		
1	MAL151 Engg Maths-I (3-0-2)4	CSL106 FOCP-I (2-0-4)4	CHL150 Engg Chemistry (2-0-2)3	CLL101 Effective Communication-I (2-1-0)2.5	MEP110 Engineering Graphics & Drawing (1-0-4)3	ECL110 Basic of Electrical & Electronics Engineering (2-0-2)3		ECR107 GP 1 Credits	ECS 100 CS1 #1 (35-Hrs)	12	1	14	405	19.5+1 =20.5
2	MAL152 Engg Maths-II (3-0-2)4	CSL108 FOCP-II (2-0-4)4	PHY150 Engineering Physics (3-0-2)4	CLL102 Effective Communication-II (2-1-0)2.5	MEL150 Basic of Mechanical & Civil Engg. (2-0-2)3	CSL110 Problem Solving and Design Thinking (2-0-2)3		ECR108 GP 1 Credits	ECS 100 CS1 #2 (35-Hrs) 1 Credit	14	1	12	405	20.5+2 =22.5
Summer	ECT101 In House Summer Internship including 7 days community service													1+1=2
3	ECL251 Analog Electronics & Integrated circuits (3-0-2)4	ECL253 Fields, waves and Antennas (3-0-2)4	ECL255 DE & CA (3-0-2)4	CSL225 Programming for data science (2-0-4)4	SML300 Entrepreneurship (3-0-0)3	SML*** Liberal arts (3-0-0)3		ECR207 GP 1 Credits	ECS 200 CS2 #1 (35-Hrs)	17		10	405	22+1= 23
4	ECL256 Embedded System Design (3-0-2)4	ECL252 Micro Controllers & Sensors (3-0-2)4	ECL254 Analog and Digital Communications (3-0-2)4	ECL258 Signal processing (3-0-2)4	Program Elective-1 (2-0-4)4			ECR208 GP 1 Credits	ECS 200 CS2 #2 (35-Hrs) 1 Credit	14		12	390	20+2= 22
Summer	ECT201 Industrial Training/Swachha Bharat internship including 7 days community service													02
5	CSL236 Introduction to AI & ML / CSL242 AI for Games (3-0-2)4	ECL 270 Control systems and power electronics (3-0-2)4	Program Elective-2 (2-0-4)4	Program Elective-3 (2-0-4)4	Open Elective – 1* (MOOC) (3-0-0)3	CLL120 HVPE (2-0-0-)2	ECV201 Skill Development 1 Credit	ECR307 GP 1 Credits	ECS 300 CS3 #1 (35-Hrs)	15		12	405	22+1= 23
6	ECL302 Data comm and networks (3-0-2) 4	Program Elective-4 (2-0-4)4	Program Elective-5 (2-0-4)4	Program Elective-6 (2-0-4)4	Open Elective-2 (3-0-0)3	CLP300 Campus to Corporate (1-0-0)1	ECC301 Seminar 1 Credit	CSR308 GP 1 Credits	ECS 300 CS3 #2 (35-Hrs) 1 Credit	13		14	405	21+2= 23
Summer	ECT301 Industrial Training including 7 days community service													03
7	Program Elective-7 (2-0-4)4	Program Elective-8 (2-0-4)4	ECD401 Project # 1 4 Credits	Open Elective – 3* (MOOC) (3-0-0)3	CHL100 EVS (3-0-0)3	Foreign Language (3-0-0)3			ECS 400 CS4 #1 (70-Hrs)	13		8	315	21
8	Open Elective – 4* (MOOC) (3-0-0)3	Open Elective – 5* (MOOC) (3-0-0)3	ECD402 Project # 2 /Internship 6 Credits	SEG 400 Self-Study Course GATE Audit					ECS 400 CS4 #2 (70-Hrs) 2 Credits	6			90	12+2= 14
	Total									104	2	82		**164+6 +6= 176**

Program Electives for each track

Tracks	IOT	Embedded System & VLSI Design
Program Elective-1	CSL253 Web frameworks	ECL261 Linux & Scripting
Program Elective-2	ECL451 Image Processing and Computer Vision I	ECL262 Digital CMOS VLSI Design & Layout
Program Elective-3	CSL234 Data Engineering	ECL361 Data Structures & OOPs
Program Elective-4	ECL316 Wireless & Mobile Communication	ECL264 RTL Design & Synthesis
Program Elective-5	CSL361 Security in IoT	ECL365 Analog CMOS VLSI Design & Layouts
Program Elective-6	CSL362 Big Data	ECL362 Real Time Operating Systems
Program Elective-7	CSL364 Cloud & Fog Computing	ECL364 Verification Methodologies & Bus Architectures
Program Elective-8	ECL352 Design for IoT	ECL366 VLSI CAD & Algorithms

Short Syllabus and Course Outcomes

B.Tech ECE with Specialization in Internet of Things

"If you think that the internet has changed your life, think again. The Internet of Things is about to change it all over again!" as said Mr. Brendan O'Brien, Chief Architect & Co-founder of Aria Systems, clearly sums up the story about the future and rightly explains why all this hype around the Internet of Things. The IoT is when everyday products such as refrigerators, watches, speakers and more connect to the internet and to one another.

B-Tech ECE with Internet of Things specialization offers students with theory and practice to enable them to understand and implement IoT-based applications. The curriculum lays the foundation of IOT fundamentals covering all major three distinct stages: 1. Sensors which collect data (including identification and addressing the sensor/device) 2. An application which collects and analyzes this data for further consolidation 3. Decision making and the transmission of data to the decision-making server. Analytical engines and Big data may be used for the decision making process.

Market Trends of Internet of Things (IoT):

- The Internet of Things (IoT) has a potential economic impact of **$2.7 to $6.2T until 2025. (McKinsey)**
- The cellular IoT connections is forecasted to grow at **25% compound annual growth rate (CAGR) till 2025. (Ericssion)**
- Industrial Internet of Things (IIoT) is expected to top **$60 trillion during the next 15 years**. **(Forbes)**
- The total revenue generated from IoT industry would be **USD 300 billion and the connected devices would be 27 billion by the year end 2020 globally**. **(Gartner)**

Unique Selling Points of the Specialization:

- Industry-oriented curriculum which enables the students prepare for technical careers in developing IoT applications with emphasis on various sensors, IoT Protocols, cloud infrastructure, performance and security in IoT, Hardware interfacing, kind of distributed system needed to support them.
- IoT design considerations, constraints and interfacing between the physical world and device
- Integration of Artificial Intelligence, Big Data and IoT concepts to handle more tasks and make autonomous decisions
- Provides a sound understanding of IoT Cluster network, responsive web design, system to communicate with external hardware and sensors.
- Industry aligned curriculum, designed by Industry Experts
- Well-trained and qualified faculty
- Project Guidance & Mentoring by Industry Experts

- Blended Learning 24 * 7
- Well Equipped Labs for hands on learning
- Holistic Pedagogy-Emphasis on development of additional skills with strong emphasis on:
  - Communication & soft skill modules
  - Compulsory Foreign Language course
  - Large number of open electives with interdisciplinary learning
  - Flexibility in curriculum to choose electives
  - Exposure through Fine Arts and Liberal Study courses for creative thinking

Career Options:

IoT Data analytics

IoT Hardware engineer

Embedded Programs Engineer

IoT Architect

IoT Developer

Network Engineer

B.Tech ECE with Specialization in Embedded Systems & VLSI Design

"Through 2020, integration work will account for 50% of the time and cost of building a digital platform" as said Massimo Pezzini, research Vice President and Gartner fellow, clearly signifies that there is undergoing a digital transformation with attention on the sleek new looks, improved efficiency and higher speeds.

B-Tech ECE with Embedded systems & VLSI Design specialization offers students with theory and practice to enable them for designing and developing IC-based systems (Application Specific Integrated Circuits). The curriculum lays the foundation of VLSI Design fundamentals along with various computer aided design (CAD) tools and methodologies. It also provides the students a broad base and understanding about the semiconductor industry, enabling them lucrative opportunities in future endeavours

Market Trends of Embedded System & VLSI Design:

- The global semiconductor market will be $655.6B in 2025 compared to $342.7B in 2015 with CAGR of 6.7%. **(White paper IBS)**
- The forecast for revenue by global semiconductor industry will be $415.4B by the end of 2020**. (Gartner)**
- **'Make in India'** campaign to promote domestic manufacturing, on the way to setup two fabrication facilities in Gujarat and Utter Pradesh, that gives great thrust to VLSI industry.
- The Indian semiconductor and embedded design industry is expected to earn revenues of $114.2B in 2025 compared to $27.6B in 2015, with a CAGR of 15.3% **(India Semiconductor Association (ISA))**

Unique Selling Points of the Specialization:

- Industry-oriented curriculum which enables the students prepare for technical careers to design, develop and prototype VLSI systems (both Front end & Back end designs) , apply verification methods, design-for-test techniques to IC designs for testable designs and high yield, low power design techniques, mixed mode design methodologies and use hardware description languages to design cores and standalone logic.
- Provides a sound understanding of Embedded system and VLSI methodology to implement various models for gates and synthesize their physical layouts as well as how to validate complex hardware.
- Focus on the development of hands-on skills in designing semiconductor devices and circuits, architecting systems using embedded components such as CPU, memory and peripherals.
- Integration of Artificial Intelligence and Embedded systems concepts to facilitate for smarter decision making.
- Offers strong knowledge in the Embedded system design covering thrust areas, such as, Advanced Embedded Microcontrollers, Real Time Embedded Systems, Advanced Embedded System Design and System On Chip.
- Industry aligned curriculum, designed by Industry Experts
- Well-trained and qualified faculty
- Project Guidance & Mentoring by Industry Experts
- Blended Learning 24 * 7
- Well Equipped Labs for hands on learning
- Holistic Pedagogy-Emphasis on development of additional skills with strong emphasis on:
  - Communication & soft skill modules
  - Compulsory Foreign Language course
  - Large number of open electives with interdisciplinary learning
  - Flexibility in curriculum to choose electives
  - Exposure through Fine Arts and Liberal Study courses for creative thinking

Career Options:

RTL Design Engineer

Verification Engineer

Synthesis Engineer

Software Testing

DFT Engineer

Product & Validation Engineer

FPGA Engineer

Physical Design Engineer

Layout Design Engineer

Analog Design Engineer

SoC Design Engineer

EDA Development

Firmware Developer Engineer-WLAN/CAN/RTOS/FPGA

Microcontroller/Device Driver Engineer

System Architecture Engineer

Android Middleware Validation Engineer

Software & Automotive Engineers

Hardware Design Engineer

System Testing Engineer

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: Basics of Electrical and Electronics Engineering (BEEE)	**Course Code**	**L-T-P**	**Credits**
	Code: ECL 110	**3-0-2**	4
3.Type of Course (Check one):	Programme Core ☑	Programme Elective ☐	Open Elective ☐
4.Frequency of offering (check one):	Odd ☐	Even ☐	Either semester ☐ Every semester ☑

5.Brief Syllabus: Elements in an Electrical circuit: R, L, C, Diode, Voltage and current sources, open-circuit and short-circuit, (independent and dependent/controlled sources with examples). D.C. Circuits: KCL, KVL, Mesh analysis, Nodal analysis, D.C. Network theorems: Thevenin's, Norton's, maximum power transfer, star-delta transformation, single phase a.c. Circuits: RMS and average value of voltage and current, form factor, peak factor, series RL, RC, RLC circuit, phasor diagram, complex power, diode, rectifier, clipper, clamper, LED, photodiode, Zener diode, BJT: common base, common emitter, common collector configuration, small signal model, Introduction to Internet of Things and its applications, Embedded and VLSI Design, Cybersecurity and Block chain, Data Science and Artificial Intelligence, Gaming technology, Augmented reality and Virtual reality

6.Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Classify the various circuit elements and quantities. Analyze the current, voltage, power, etc in a dc circuit using different network theorems.
CO 2	Analyze the behavior of a.c. circuit with different circuit elements
CO 3	Design a clipper, clamper and rectifier circuit based upon the input and output waveforms. Know about various types of diodes. Examine the transistor, find out its configuration and plot its characteristics
CO 4	Know about latest trends in Industry like IoT, AI, Cybersecurity, Embedded and VLSI design, Virtual Reality, Data Science etc and their applications

COURSE TEMPLATE

1.Department:	Department of Electrical, Electronics and Communication Engineering		
2. Course Name: : Analog Electronics & Integrated Circuit Applications	**Course Code**	**L –T- P**	**Credits**
	Code: ECL251	**2- 0- 2**	**3**
3.Type of Course (Check one):	Programme Core ☑	Programme Elective ☐	Open Elective ☐
4. Frequency of offering (check one): Odd ☑	Even ☐	Either semester ☐	Every semester ☐

5.Brief Syllabus:

BJT, FET, MOSFET, biasing of transistors, hybrid model for 2-port network, transistor hybrid model, analysis of a transistor amplifier, cascaded system, RC coupled amplifier and its frequency response, cascade amplifier, characteristics of negative and positive feedback, different feedback topologies, Integrated circuits and their types, interpretation of data sheets, characteristics and performance parameters, differential amplifiers, operational amplifiers, feedback configurations, series and shunt feedback, voltage-series feedback amplifiers, oscillators, filters and comparator with Op-Amp as building blocks

6.Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Understand the operating conditions, characteristics of various transistors and design the various transistor models
CO 2	Designing the different analog electronic circuits with BJT.
CO 3	Analyse the performance parameters of op-amp and differential amplifier.
CO 4	Design various analog circuits with op amps like oscillators, integrator, differentiator, amplifiers and to compare experimental results in the laboratory with theoretical analysis.

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: Fields, Waves and Antennas	**Course Code**	**L - T- P**	**Credits**
	Code: ECL 253	**3 - 0 - 2**	**4**
3.Type of Course (Check one):	Programme Core ✓ Programme Elective ☐ Open Elective ☐		
4.Frequency of offering (check one): Odd ☐ Even ☐ Either semester ✓ Every semester ☐			

5. Brief Syllabus: Basic Vector Algebra, Coordinate Systems, Del Operator, Divergence and Curl theorems Electric field, Flux, Potential, Gauss's law and applications, Bio-Savart's Law, Ampere's law and applications, magnetic flux density, Faraday's law and displacement current, Maxwell's equations in final form, EM waves in free space, EMI, EM hazards and compatibility, Working principle of an antenna, radiation mechanism, antenna parameters, Friis transmission Equation, Hertzian dipole, Different types of antennas along with radiation pattern, radiation resistance and gain, Antenna arrays, Microstrip antenna, MIMO systems, Smart antenna.

6. Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to the student once it is completed

CO 1	Effectively apply the three dimensional coordinate systems (Cartesian, Cylindrical, Polar) and vector calculus in EM problems.
CO 2	Understanding the basics of Electromagnetics, and conceptualize the laws which govern Electric field, Magnetic field and their mutual interactions.
CO 3	Understanding of Maxwell's Equations & propagation of EM waves
CO 4	Study the fundamental concepts of antenna theory.
CO 5	Uderstanding & design the various types of antennas and reflectors such as monopole, yagi-uda, dipole, log periodic, microstrip antennas and parabolic reflectors.
CO 6	Study basics of antenna arrays and applications to modern antenna systems like MIMO , Smart Antennas , EMI / EMC concepts and safety techniques

COURSE TEMPLATE

1. Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: Digital Electronics and Computer Architecture	**Course Code**	**L-T-P**	**Credits**
	ECL255	3-0-2	4
3.Type of Course (Check one):	Programme Core ☑	Programme Elective ☐	Open Elective ☐
4.Frequency of offering (check one): Odd ☑	Even ☐	Either semester ☐	Every semester ☐

5.Brief Syllabus:

Digital signal, Logic gates, Number system, Boolean Algebra and Switching functions, Minimization Techniques, Combinational circuits, Logic Modules and their functions, Sequential circuits and their applications, Digital Logic families, Building blocks of a computer, Addressing techniques and registers, Memories, Advances in Technology, Current applications of digital electronics, Simulation Software (ORCAD, Labview), Case studies and analysis of Real time Situations

6.Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.

CO 1	Apply number systems and logic Gates concepts
CO 2	Minimization of logical expression and Designing digital circuits employing logic gates
CO 3	Designing any combinational circuit using gates and logic elements like multiplexer, decoder etc.
CO 4	Designing sequential circuits like latches, flip flops, registers and counters.
CO 5	Understanding of the various architectural components of a digital computer and Classify various addressing techniques and register operations in real time applications
CO 6	Categorize different types of memory in real time applications

COURSE TEMPLATE

1.Department:	**Department of Electrical, Electronics and Communication Engineering**		
2.Course Name: Embedded System Design	**Course Code**	**L –T- P**	**Credits**
	Code: ECL256	**3- 0- 2**	**4**
3.Type of Course (Check one):	Programme Core ✓ Programme Elective ☐ Open Elective ☐		
4.Frequency of offering (check one): Odd ☐ Even ✓ Either semester ☐ Every ☐ semester			
5.Brief Syllabus: Importance of Embedded Systems, Applications, Indian and Global Market. Microprocessors vs Microcontrollers. RISC and CISC Architectures. Low-level and high-level embedded programming concepts. 8051 microcontroller: Register and Memory architecture. Addressing Modes, Arithmetic and Logical Operations, Delay Subroutines, Timers, Serial Communications, Interrupt handling, Interfacing with LED, LCD, ADC, DAC, DC Motor Control, and Sensor. PIC controller and ARM cortex M3 processor: Architecture, pipelining, instruction sets, addressing modes			
6.Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Compare different architectures of processor/controller technologies and understand architecture of 8051 microcontroller		
CO 2	Write assembly/C language programs in 8051 for various arithmetic, logical and timer operations		
CO 3	Write assembly/C language programs in 8051 for serial communications and interrupts		
CO 4	Interface various peripherals, sensors etc. with 8051/PIC microcontroller		
CO 5	Understand the architecture of PIC microcontroller and ARM Processors and program them for embedded applications		

1. 1.Department:	**Department of Electrical, Electronics and Communication Engineering**		
2. Course Name: Micro controllers & Sensors	**Course Code**	**L- P**	**Credits**
	Code: ECL252	2-5	4.5
3.Type of Course (Check one):	Programme Core ☑	Programme Elective ☐	Open Elective ☐
4.Frequency of offering (check one): Odd ☐	Even ☑	Either Sem. ☐	Every Sem. ☐

5.Brief Syllabus: Introduction to microcontrollers, difference between microprocessors and microcontrollers, classification of microcontrollers, their applications, Overview of Atmega328P microcontroller & NodeMCU, Interfacing digital & analog sensors, display modules and actuators with Arduino Uno, posting data on cloud, creating a webserver, posting data on web page, interfacing modules like GPS, GSM and Bluetooth with nodemcu, Raspberry Pi basics and programming in python, interfacing HaT, Camera module, display modules and sensors with Raspberry Pi.

6.Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Understand the basics and fundamentals of Microcontrollers and Microprocessors
CO 2	Knowledge about development boards, basic sensors and actuators
CO 3	Learn interfacing different peripherals with Arduino board
CO 4	Understand basics of NodeMCU and uploading various sensors data on webpage or cloud
CO 5	Understand basics of Raspberry Pi coding and interfacing different modules

COURSE TEMPLATE

1.Department:	**Department of Electrical, Electronics and Communication Engineering**		
2.Course Name: Analog and Digital Communication	**Course Code**	**L –T- P**	**Credits**
	Code: ECL254	**2- 0- 2**	**3**
3.Type of Course (Check one):	Programme Core ✓	Programme Elective ☐	Open Elective ☐
4.Frequency of offering (check one):	Odd ☐	Even ☐	Either semester ☐	Every semester ✓

5.Brief Syllabus: This course is to study both analog and digital communication that forms an integral part of communication systems in many diverse areas of electronic communication. It includes introduction to analog and digital communication: Bandwidth and information capacity, transmission modes, Signal analysis, Noise considerations. Modulation and demodulation concepts (AM, FM, PM). Recievers, Digital communication: Sampling theorem, coding and decoding, Pulse modulation, Digital modulation techniques.

6.Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Identify varios communication modes, transmission media & communication systems, difference between signal and noise and dealing with noise in a system
CO 2	Categorize various modulation techniques used and select one most suitable for use in a typical wireless application and mobile standards and technologies in present, past and future sets and factors involved in doing so.
CO 3	Plan and design a communication transmitter and receiver system with given set of parameters of Signal and Noise conditions.
CO 4	Understand the concept of ISI,BER, information and its different parameters and its importance in digital communication
CO 5	Distinguish between different digital modulation schemes and the advantage and disadvantages of each.

COURSE TEMPLATE

1.Department:	**Department of Electrical, Electronics and Communication Engineering**		
2.Course Name: Signal Processing	**Course Code**	**L –T- P**	**Credits**
	Code: ECL258	**3- 0- 2**	**3**
3.Type of Course (Check one):	Programme Core ✓	Programme Elective ☐	Open Elective ☐
4.Frequency of offering (check one): Odd ☐	Even ✓	Either semester ☐	Every semester ☐

5.Brief Syllabus: This course is to study both analog and digital signal processing that forms an integral part of engineering systems in many diverse areas, including communications, speech processing and image processing. It includes classification and properties of continuous time and discrete time signals and systems, properties of LTI systems, Fourier transform and its properties, Laplace Transform and its properties, bilateral and unilateral Z-transform and its properties, ROC, solution of difference equation, inverse Z-transform, Analysis of systems in time and frequency domain, convolution Digital filter realizations, canonical forms, Digital Filter Design (IIR Filter and FIR Filter), DFT and FFT computation, circular convolution, Finite register lengths effects.

6.Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Understand about various types of signals and systems, classify them, analyze them, and perform various operations on them
CO 2	Understand use of transforms in analysis of signals and system in continuous and discrete time domain in daily life applications
CO 3	Understands definitions and basic properties of forward and inverse discrete Fourier transform and their computation by fast algorithms..
CO 4	Understands signal flow graph and block diagram representations of difference equations that realize digital filters
CO 5	Learns basic digital filter design methods and apply them to solve the real time problems

COURSE TEMPLATE

<table>
<tr><td>1.Department:</td><td colspan="4">Department of Electrical, Electronics and Communication Engineering</td></tr>
<tr><td colspan="2" rowspan="2">2.Course Name: Control Systems</td><td>Course Code</td><td>L-T-P</td><td>Credits</td></tr>
<tr><td>Code: ECL 266</td><td>2-0-1</td><td>2.5</td></tr>
<tr><td>3Type of Course (Check one):</td><td colspan="4">Programme Core ☐ Programme Elective ☑ Open Elective ☐</td></tr>
<tr><td colspan="5">4.Frequency of offering (check one):Odd ☑ Even ☐ Either semester ☐ Every semester ☐</td></tr>
<tr><td colspan="5">5.Brief Syllabus: Types of control systems with appropriate examples, Transfer function concept, reduction techniques: block diagram, signal flow graphs, Mason’s gain formula, time response of 1st order and 2nd order systems time domain specifications (general and of an under damped 2nd order system), steady state error and error constants, concept of stability, Routh stability criterion, PID controller, Time Domain and Frequency Domain Plots, concept of lag-lead compensation.</td></tr>
<tr><td colspan="5">6.Course Outcomes (COs)
Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed</td></tr>
<tr><td>CO 1</td><td colspan="4">Obtain overall transfer function of the control system using various techniques.</td></tr>
<tr><td>CO 2</td><td colspan="4">Design any system based on various time domain specifications.</td></tr>
<tr><td>CO 3</td><td colspan="4">Learn various controllers for steady state and transient state of a system</td></tr>
<tr><td>CO 4</td><td colspan="4">Obtain stability of any system using various techniques based on time domain and frequency domain analysis</td></tr>
</table>

1.Department:	Department of Electrical, Electronics and Communication Engineering		
2.Course Name: LINUX and SCRIPTING	**Course Code**	**L –T- P**	**Credits**
	Code: ECL261	**2- 0- 4**	**4**
3.Type of Course (Check one):	Programme Core ☐ Programme Elective ☑ pen Elective ☐		
4.Frequency of offering (check one): Odd ☐ Even ☐ Either semester ☑ Every semester ☐			
5.Brief Syllabus: Introduction to Unix and Linux, Command and Utility Syntax, Linux file and directories, Creating files, Creating directories, Disk utilization information, File and directory permission and privileges, Job and process management, Scheduling Jobs, Text editors- vi, vim editors, Editing files, Running C/C++ on Linux compiler, Shell scripting, Shell environment, Shell script programming concepts, Sequential flow, Decision and branch structures, Advanced shell programming, Perl scripting, Environment, Syntax overview, Object oriented concepts and support, Process management, Functions			
6.Total lecture, Tutorial and Practical Hours for this course: 90 Hours (Taking 15 teaching weeks per semester)			
Course Outcomes (COs)			
CO 1	Understanding the basic set of commands and utilities in Linux/UNIX systems.		
CO 2	To learn to develop software for Linux/UNIX systems. To learn the important Linux/UNIX library functions and system calls. To understand the inner workings of UNIX-like operating systems for other tools and technologies.		
CO 3	Understand various editors and execute C programs on Linux compiler.		
CO 4	Understand Shell environment and write shell scripts for sequential flow and decision and branch Structures.		
CO 5	To learn how to produce robust scripts in Perl using software engineering techniques such as review and extensive program testing.		
CO 6	Develop substantial Shell and Perl scripts, when appropriately reusing previously created scripts.		

COURSE TEMPLATE

1.Department:	**Department of Electrical, Electronics and Communication Engineering**		
2.Course Name: Image Processing and Computer Vision	**Course Code**	**L –T- P**	**Credits**
	Code: ECL451	2-0-2	**3**
3.Type of Course (Check one):	Programme Core ☑	Programme Elective ☐	Open Elective ☐
4.Frequency of offering (check one):	Odd ☐	Even ☐	Either semester ☑ Every semester ☐

5.Brief Syllabus: This course will cover methods in image processing and computer vision, with an emphasis on the state-of-the-art techniques currently used in academia and industry. Topics will include image filtering, edge detection, corner detection, segmentation, object\image\face classification, object detection, morphological operators, object tracking, camera calibration, image registration, and activity classification

6.Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Acquire the fundamental concepts of a digital image processing system. Design and implement with computer-based algorithms for spatial domain digital image processing operations
CO 2	Analyze images in frequency domain through various transforms
CO 3	Distinguish between and apply various image compression and segmentation techniques
CO 4	Understand and implement common algorithms of computer vision
CO 5	Understand and implement the machine learning techniques

COURSE TEMPLATE

1.Department:	Department of Electrical, Electronics and Communication Engineering		
2.Course Name: Digital CMOS VLSI Design & Layouts	**Course Code**	**L –T- P**	**Credits**
	Code: ECL262	**2-0-4**	**4**
3.Type of Course (Check one):	Programme Core ☐ ✓ Programme Elective ☐ Open Elective ☐		
4.Frequency of offering (check one): Odd ☐ Even ☐ √ Either semester ☐ Every semester ☐			
5.Brief Syllabus: MOS transistor, Enhancement and Depletion MOS transistors, Threshold Voltage, Fabrication and Modeling, MOSFET Scaling, CMOS Inverter, transfer characteristics, Power, Delay and Energy parameters, Combinational MOS Logic Design, Sequential MOS Logic Design, Static and Dynamic Latches and Registers, Low-Power Design Techniques, Design of Arithmetic Building Blocks, Memory Cells Design			
6.Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO1	Demonstrate fundamental understanding on MOS device, its technology and operation.		
CO2	Understand the basic components of any design through detailed analysis on CMOS Inverter.		
CO3	Evaluate the performance of Static and Dynamic CMOS logic in designing combinational circuits.		
CO4	Evaluate the performance of Static and Dynamic CMOS logic in designing sequential circuits.		
CO5	Design and implement Low-Power CMOS Logic Circuits.		
CO6	Implement and verify the working of arithmetic building blocks and memory cells through project work.		

COURSE TEMPLATE

1.Department:	**Department of Electrical, Electronics and Communication Engineering**		
2.Course Name: **Data Structures & Algorithm in C++**	**Course Code**	**L-T-P**	**Credits**
	ECL582	**3 0 2**	4
3.Type of Course (Check one):	Programme Core ☑	Programme Elective ☐	Open Elective ☐

4.Frequency of offering (check one): Odd ☑ Even ☐ Either semester ☐ Every semester

5.Brief Syllabus:

Mathematics for Algorithmic Algorithm Analysis, Asymptotic Notations. Computational Complexity of an algorithm. Divide and Conquer Algorithms: Master theorem, Recurrence relation. Sorting Bubble Sort, Insertion Sort, Selection Sort, Heap Sort, Merge Sort, Quick Sort. Shortest Path Algorithm, Greedy Algorithms. Knapsack Problem, NP Hard and NP complete Problems, Cooks Theorem, Back Tracking General Method, the 8 Queen Problem, Subset Problem, Graph Coloring Problem, Hamiltonian Cycle.

6.Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO 1	Apply the learning of the basic array and linked list operations.
CO 2	Able to understand the basics of C++.
CO 3	Understand and apply the sorting and searching algorithm.
CO 4	Apply the learning of the notations.
CO 5	Understanding the Elementary Data Structures and Analyze the NP Problem.

COURSE TEMPLATE

1.Department:	**Department of Electrical, Electronics and Communication Engineering**		
2.Course Name: Wireless Mobile Communication	**Course Code**	**L-T-P**	**Credits**
	Code: ECL316	**2 - 0- 2**	**3**
3.Type of Course (Check one):	Programme Core ☐ Programme Elective ☐ Open Elective ☑		
4.Frequency of offering (check one): Odd ☐ Even ☐ Either semester ☐ Every semester ☑			
5.Brief Syllabus: Mobile Radio Systems around the world, examples of Wireless Communication Systems,Co-channel interference Analysis- Hand over Analysis,GSM specifications, Architecture and details of all blocks, Network Identities, GSM communication Channels, Call flows, Multiple Access Techniques, Large scale path loss, propagation mechanisms, Small scale fading, parameters of multipath channels.			
6.Course Outcomes (COs) Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed			
CO 1	Categorize wireless and mobile standards and technologies in present, past and future sets and factors involved in doing so.		
CO 2	Plan and design a cellular network with given set of operator's frequencies and geographical allocations		
CO 3	Calculate the interference, capacities and relativeness of different systems against provided design parameters, standards and technologies. And able to understand the Ad Hoc networks and new trends in Mobile/wireless communication.		
CO 4	Examine impact of environmental mechanisms on wave propagation and select relevant parameters that can best fit the channel models.		
CO 5	Able to understand the characteristics of different multiple access techniques in mobile/wireless communication		

COURSE TEMPLATE

1.Department:	**Department of Electrical, Electronics and Communication Engineering**		
2.Course Name: RTL Design & Synthesis	**Course Code**	**L-T-P**	**Credits**
	ECL264	2-0-4	4
3.Type of Course (Check one):	Programme Core ☑	Programme Elective ☐	Open Elective ☐
4.Frequency of offering (check one):	Odd ☑	Even ☐	Either semester ☐ Every semester ☐

5.Brief Syllabus:

The VerilogHDL constructs are being used in sophisticated digital system designs. It starts from simple design concepts to the more complex. The Verilog constructs interprets a design at various design stages and design abstractions, including behavioural, dataflow, and structure description to meet the design specifications. It includes Design automation with Verilog, Design with Verilog, Combinational circuits in Verilog, Sequential circuits in Verilog, Language utilities, Test methodologies. The Logic Synthesis using Verilog HDL covers how to write accurate Verilog descriptions of digital systems (combinational and sequential) that can be synthesized into digital system netlists with desirable characteristics with a focus on common pitfalls in the development of synthesizable VerilogHDL and methods for avoiding them. The FPGA architecture, digital design flow using FPGAs, and other technologies associated with field programmable gate arrays helps to test a design at hardware functional level. The study will involve extensive lab projects to give students hands-on experience on designing digital systems on FPGA platforms.

6.Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed.

CO 1	To understand the need for Hardware Description Language for the design of Digital Systems.
CO 2	To know and apply the language constructs and semantics to write an efficient and functional Verilog code.
CO 3	To know and apply the language constructs and semantics to write an efficient and functional Verilog code.
CO 4	To write the Verilog description of Combinational and Sequential Logic Circuits, synthesize and test them for their functional correctness.
CO 5	To design digital logic using basic MOS and CMOS Switch logic elements to ensure a more detailed logical description using VerilogHDL.
CO 6	To learn FPGA Design and Implementation methodologies at Xilinx Hardware platforms and test hardware functionality of digital logic components and circuits.

COURSE TEMPLATE

1.Department:	**Department of Electrical, Electronics and Communication Engineering**		
2.Course Name: Analog CMOS VLSI Design & Layouts	**Course Code**	**L –T- P**	**Credits**
	Code: ECL365	**2-0-4**	**4**
3.Type of Course (Check one):	Programme Core ☐ ✓ Programme Elective ☐ Open Elective ☐		
4.Frequency of offering (check one): Odd ☐ √ Even ☐ Either semester ☐ Every semester ☐			

5.Brief Syllabus:

Introduction to MOS Device Physics, Small Signal & Large Signal Models of MOS & BJT transistor. Si ngle Stage Amplifiers, Differential Amplifiers, Passive and Active Load Differential Amplifiers: Common Emitt er, Common base, Common Collector, Common Drain, Common Gate & Common Source Amplifiers, Current Mirror Circuits, Frequency Response of Amplifiers, CMOS Operational Amplifiers, Stability and Frequency Compensation, Design of two stage MOS Operational Amplifier, two stage MOS operational Amplifier with cascodes, MOS telescopic-cascode operational amplifiers, MOS Folded-cascode operational amplifiers.

6.Course Outcomes (COs)

Possible usefulness of this course after its completion i.e. how this course will be practically useful to him once it is completed

CO1	Understanding the structure, operation, analysis of MOSFETs
CO2	Design and analysis of BJT and MOSFETs amplifiers
CO3	Design and analysis of current mirror circuits
CO4	Design and analysis of op amp and OTA circuits
CO5	Design of non-linear analog circuits

COURSE TEMPLATE

1.Department:	Department of Electrical, Electronics and Communication Engineering		
2.Course Name: Real Time Operating System	**Course Code**	**L –T- P**	**Credits**
	Code: ECL 361	**2- 0- 2**	**3**
3.Type of Course (Check one):	Programme Core ☑ Programme Elective ☐ Open Elective ☐		
4.Frequency of offering (check one): Odd ☐ Even ☐ Either semester ☐ Every semester ☑			

5.Brief Syllabus: Real-Time Systems are now being used almost everywhere. In the context, this course addresses some basic issues that are necessary to develop and understand real-time system. The specific issues addressed are scheduling real-time tasks, Resource-sharing issues among real-time tasks, scheduling real-time tasks in multiprocessor and distributed systems, commercial real-time operating systems, real-time communication, and real-time databases.

In several software applications, especially in embedded application, the operating system is required to support the application to meet the timing constraints. The operating system achieves this by deploying suitable scheduling algorithms. A major problem arises, when the real-time tasks share resources. Priority inversions can take place in this case, unless suitable techniques are deployed. Starting with a brief introduction to real-time operating systems, we first discuss the important real-time task/thread scheduling algorithms and resource sharing protocols. An effort towards standardization of real-time operating systems has come to be known as POSIX-RT. We review POSIX-RT requirements. Besides, we review several commercial and open source real-time operating systems.

6.Course Outcomes (COs)

CO 1	Able to summarize the issues in real time computing
CO 2	To explain and give examples of real time operating systems.
CO 3	Able to solve scheduling problems and can apply them in real time applications in industry.
CO 4	Design an RTOS and will be able to interpret the feasibility of a task set to accomplish or not.
CO 5	Analyze the situation of fault occurrence and will be able to apply solutions accordingly.

1.Department:	Department of Electrical, Electronics and Communication Engineering		
2.Course Name: Verification Methodologies & Bus Architectures	**Course Code**	**L –T- P**	**Credits**
	Code: ECL 364	**2- 0- 4**	**4**
3.Type of Course (Check one):	Programme Core ☐ Programme Elective ☑ Open Elective ☐		
4.Frequency of offering (check one): Odd ☐ Even ☐ Either semester ☑ Every semester ☐			

5.Brief Syllabus: Verification Guidelines: Verification Methodology, Data Types, Procedural Statements, Task and Functions, Routine Arguments, Local Data Storage, Basic OOP, Static and Global variables, Objects and Classes, Connecting the Testbench and Design, Stimulus Timing, SystemVerilog Assertation, Four-Port ATM Routers, Randomization, Constraints Details, Pre and Post Randomization, Threads and Interprocess Communication, Events, Semaphore, Mailbox, Testbench Building, Advanced OOPs and Guidelines.

6.Course Outcomes (COs)

CO 1	Model a scenario for Verification of a DUT in SystemVerilog.
CO 2	Analyze the usefulness of a driver, monitor, checker, testcases in a verification environment.
CO 3	Understand different kinds of datatypes and can distinguish difference between an HDL and HVL.
CO 4	Design testbench to verify the functionality of a design.
CO 5	Understand the concept of randomization and its importance in verification coverage in a bigger design.
CO6	Able to design a VIP for an IP as a project.

COURSE TEMPLATE

<table>
<tr><td>1.Department:</td><td colspan="4">Department of Electrical, Electronics and Communication Engineering</td></tr>
<tr><td rowspan="2">2.Course Name: Design for IOT (Project Based)</td><td>Course Code</td><td>L –T- P</td><td colspan="2">Credits</td></tr>
<tr><td>Code: ECL 352</td><td>1- 0- 6</td><td colspan="2">4</td></tr>
<tr><td>3.Type of Course (Check one):</td><td colspan="4">Programme Core ☑ Programme Elective ☐ Open Elective ☐</td></tr>
<tr><td colspan="5">4.Frequency of offering (check one): Odd ☐ Even ☐ Either semester ☐ Every semester ☑</td></tr>
<tr><td colspan="5">5.Brief Syllabus: Through this course, a high level view of IOTs, design of smart objects that provide collaboration and ubiquitous services will be explored. Design for longevity/energy efficiency will be highlighted. Step by step system design will be introduced. Small video chips that will allow students to prototype will be displayed. At the end of the course, the student is expected to make the right choice of hardware, software and protocols for the proposed application</td></tr>
<tr><td colspan="5">6.Course Outcomes (COs)</td></tr>
<tr><td>CO 1</td><td colspan="4">Introduction to IOT and power block of IOT</td></tr>
<tr><td>CO 2</td><td colspan="4">Study of IOT Protocols</td></tr>
<tr><td>CO 3</td><td colspan="4">Understand of IOT wireless interfaces</td></tr>
<tr><td>CO 4</td><td colspan="4">Familiarization with various IOT systems</td></tr>
</table>

1.Department:	Department of Electrical, Electronics and Communication Engineering		
2.Course Name: VLSI CAD & Algorithms	**Course Code**	**L –T- P**	**Credits**
	Code: ECL 366	**2- 0- 4**	**4**
3.Type of Course (Check one):	Programme Core ☐ Programme Elective ☑ Open Elective ☐		
4.Frequency of offering (check one): Odd ☐ Even ☐ Either semester ☑ Every semester ☐			
5.Brief Syllabus: VLSI design flow, Basic algorithms and data structures, Partitioning, Floorplanning and Placement & Routing algorithms, Simulation, Logic Synthesis & Verification, High level synthesis and Compaction, Physical design automation of FPGAs & MCMs			
6.Course Outcomes (COs)			
CO 1	Understand the VLSI Design flow – FE & BE		
CO 2	The importance of CAD tools and technologies in current scenario of chip design		
CO 3	Understand the algorithm for synthesis and physical design, as Partitioning – Floor planning – Placement & Routing Algorithms and their limitations.		
CO 4	Able to work on the Cadence SoC Encounter EDA Tools & Technologies to understand the project level aspects in a CAD flow.		
CO 5	Able to understand the role of optimization of various aspects of a chip, floorplan, partition, routing, congestion, timing, etc. and FPGA implementation		
CO6	Able to develop/write a simple algorithm as a project.		