Department of Electrical, Electronics and Communication Engineering

The department of Electrical, Electronics and Communication Engineering offers the following programmes during the academic year 2021-22.

Master of Technology (M.Tech)

- Electronics and Communication Engineering with specialization in Communication Engineering
- Electronics and Communication Engineering with specialization in VLSI Design

Bachelor of Technology (B.Tech)

- Electronics and Communication Engineering
- Electronics and Communication Engineering with specialization in Internet of Things (IoT)
- Electronics and Communication Engineering with specialization in Embedded Systems and VLSI design

M.Tech. in Electronics and Communication Engineering (part-time) program has been designed especially for working professionals. The whole scheme is uniformly spread over 3 years covering 6 semesters. The program is very comprehensive and in-line with the latest trends in the industry and academia. The program has total credits of 57. The curriculum is designed in such a way that there are specialization options in communication engineering or VLSI design. Students can opt for any one of these specializations by taking the seminar, minor project and dissertation in those specializations. There is a lot of emphasis on research and project work based on the specialization chosen by the student starting from 3rd semester.

The curriculum of B.Tech. Electronics and Communication Engineering program helps an overall development of the student in various aspects desired for a successful career in engineering while being aware of his societal responsibilities and limitations. It develops basic competence required to pursue advanced study and research in Electronics and Communication Engineering and related disciplines. While framing the curriculum, not only the technological development in Electronics and Communication Engineering but also the technological development in Internet of Things, Information technology, biotechnology, mechatronics, computers, Internet of things, Embedded Systems and VLSI design have been taken into account. The B.Tech programme curriculum is designed in such a way that there are two specalization options each having a total credits of 170.

Department of EECE

BachelorofTechnologyinElectronics & CommunicationEngineering

With Specialization inEmbedded System & VLSI

Basic Science Courses

		L-T-P	C
MAL151	Engineering Math -I	3-0-2	4
MAL152	Engineering Math -II	3-0-2	4
PHY150	Engineering Physics	3-0-2	4
CHL150	Engineering Chemistry	2-0-2	3

Engineering Science Courses

		L-T-P	C
CSL106	FOCP I	2-0-4	4
CSL108	FOCP II	2-0-4	4
MEP110	Engineering Graphics & Drawing	1-0-4	3
MEL150	Basics of Mechanical and Civil Engineering	2-0-2	3
ECL 110	Basics of Electrical & Electronics Engineering	2-0-2	3
CSL110	Problem Solving and design thinking	2-0-2	3

Program Core L-T-PC

ECL251	Analog Electronics and Integrated Circuits	3-0-2	4
ECL253	Fields, waves and Antennas	3-0-2	4
ECL255	Digital Electronics and Computer Architecture	3-0-2	4
CSL255	Programming for Data Science	2-0-4	4
ECL256	Embedded System Design	3-0-2	4
ECL252	Microcontrollers & Sensors	3-0-2	4
ECL254	Analog and Digital Communication	3-0-2	4
ECL258	Signal Processing	3-0-2	4
CSL237	Introduction to AI, ML and DL	3-0-2	4
ECL270	Control Systems and Power Electronic	3-0-2	4
ECL302	Data Communication and Networks	3-0-2	4
	Self Study Course GATE	Audit	

General Proficiency

		C
ECR107	General Proficiency-I	1
ECR108	General Proficiency -II	1
ECR207	General Proficiency -III	1
ECR208	General Proficiency -IV	1
ECR307	General Proficiency -V	1
ECR308	General Proficiency -VI	1

***Upto 20% of courses can be done through MOOC courses subject to department approval**

Program/Specialization Electives L-T-PC

ECL261	Linux & Scripting	2-0-4	4
ECL262	Digital CMOS VLSI Design & Layout	2-0-4	4
ECL361	Data Structures & OOPs	2-0-4	4
ECL264	RTL Design & Synthesis	2-0-4	4
ECL365	Analog CMOS VLSI Design & Layout	2-0-4	4
ECL362	Real Time operating Systems	2-0-4	4
ECL364	Verification Methodologies & Bus Architecture	2-0-4	4
ECL366	VLSI CAD & Algorithms	2-0-4	4

Humanities and Management Courses L-T-P C

CLL101	Effective Communications I	2-1-0	2.5
CLL102	Effective Communications II	2-1-0	2.5
BSL101	Entrepreneurship	3-0-0	3

University-Wide Compulsory Courses L-T-PC

CHL100	Environmental Studies	3-0-0	3
CLL120	Human Values and Professional Ethics	2-0-0	2
CLP300	Campus to Corporate	1-0-0	1

Other Mandatory Courses L-T-P C

	Open Elective – 1	3-0-0	3
	Open Elective – 2	3-0-0	3
	Open Elective – 3	3-0-0	3
	Open Elective – 4	3-0-0	3
	Open Elective – 5	3-0-0	3
	Foreign Language Elective	3-0-0	3
	Liberal Arts Course	3-0-0	3

Project & Internship(P) L-T-P C

ECD401	Project – I		4
ECD402	Project – II/ Internship		6
ECV201	Skill Development	1-0-2	2
ECC301	Seminar		1
ECT101	In House Summer Internship		1
ECT201	Practical Training		2
ECT301	Industrial Internship		3

***Open electives can be chosen from University list of Open Elective courses**

Department of EECE

BachelorofTechnologyinElectronics & CommunicationEngineering with Specialization inInternet of Things

Basic Science Courses

		L-T-P	C
MAL151	Engineering Maths -I	3-0-2	4
MAL152	Engineering Maths -II	3-0-2	4
PHY150	Engineering Physics	3-0-2	4
CHL150	Engineering Chemistry	2-0-2	3

Engineering Science Courses

		L-T-P	C
CSL106	FOCP I	2-0-4	4
CSL108	FOCP II	2-0-4	4
MEP110	Engineering Graphics & Drawing	1-0-4	3
MEL150	Basics of Mechanical and Civil Engineering	2-0-2	3
ECL 110	Basics of Electrical & Electronics Engineering	2-0-2	3
CSL110	Problem Solving and design thinking	2-0-2	3

Program Core L-T-PC

ECL251	Analog Electronics and Integrated Circuits	3-0-2	4
ECL253	Fields, waves and Antennas	3-0-2	4
ECL255	Digital Electronics and Computer Architecture	3-0-2	4
CSL255	Programming for Data Science	2-0-4	4
ECL256	Embedded System Design	3-0-2	4
ECL252	Microcontrollers & Sensors	3-0-2	4
ECL254	Analog and Digital Communication	3-0-2	4
ECL258	Signal Processing	3-0-2	4
CSL237	Introduction to AI, ML and DL	3-0-2	4
ECL270	Control Systems and Power Electronic	3-0-2	4
ECL302	Data Communication and Networks	3-0-2	4
	Self Study Course GATE	Audit	

General Proficiency

		C
ECR107	General Proficiency-I	1
ECR108	General Proficiency -II	1
ECR207	General Proficiency -III	1
ECR208	General Proficiency -IV	1
ECR307	General Proficiency -V	1
ECR308	General Proficiency -VI	1

***Upto 20% of courses can be done through MOOC courses subject to department approval**

Program/Specialization Electives L-T-PC

CSL253	Web frameworks	2-0-4	4
ECL451	Image Processing and Computer Vision	2-0-4	4
CSL234	Data Engineering	2-0-4	4
ECL316	Wireless and Mobile Communication	2-0-4	4
CSL361	Security in IOT	2-0-4	4
CSL362	Big Data	2-0-4	4
CSL364	Cloud and Fog Computing	2-0-4	4
ECL352	Design for IOT	2-0-4	4

Humanities and Management Courses L-T-P C

CLL101	Effective Communications I	2-1-0	2.5
CLL102	Effective Communications II	2-1-0	2.5
BSL101	Entrepreneurship	3-0-0	3

University-Wide Compulsory Courses L-T-PC

CHL100	Environmental Studies	3-0-0	3
CLL120	Human Values and Professional Ethics	2-0-0	2
CLP300	Campus to Corporate	1-0-0	1

Other Mandatory Courses L-T-P C

	Open Elective – 1	3-0-0	3
	Open Elective – 2	3-0-0	3
	Open Elective – 3	3-0-0	3
	Open Elective – 4	3-0-0	3
	Open Elective – 5	3-0-0	3
	Foreign Language Elective	3-0-0	3
	Liberal Arts Course	3-0-0	3

Project & Internship(P) L-T-P C

ECD401	Project – I		4
ECD402	Project – II/ Internship		6
ECV201	Skill Development	1-0-2	2
ECC301	Seminar		1
ECT101	In House Summer Internship		1
ECT201	Practical Training		2
ECT301	Industrial Internship		3

***Open electives can be chosen from University list of Open Elective courses**

Bachelor of Technology in Electronics and Communication Engineering- (2021-22)

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 101 CS-I (35-Hrs) S/NS Course	12	1	14	27	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 102 CS-II (35-Hrs) 2 Credit	14	1	12	27	20.5+3 =23.5
Summer	ECT101 In House Summer Internship including 7 days community service													1
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		ECL361 Data Structures (3-0-2)4		ECR207 GP 1 Credits	ECS 201 CS-III (35-Hrs) S/NS Course	14		12	26	23+1= 24
4	ECL256 Embedded System Design (3-0-2)4	SML*** Liberal arts (3-0-0)3	ECL254 Analog and Digital Communications (3-0-2)4	ECL258 Signal processing (3-0-2)4	Program Elective-1 (2-0-4)4	Open Elective – 1* (MOOC) (3-0-0)3		ECR208 GP 1 Credits	ECS 202 CS-IV (35-Hrs) 2 Credit	17		12	27	23+3= 26
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	ECL252 Micro Controllers & Sensors (3-0-2)4	Open Elective-2 (3-0-0)3	CLL120 HVPE (2-0-0-)2	ECV201 Skill Development 1 Credit	ECR307 GP 1 Credits	ECS 301 CS-V (35-Hrs) S/NS Course	15		12	26	22+1= 23
6	ECL302 Data comm and networks (3-0-2) 4	Program Elective-3 (2-0-4)4	ECL362 Real Time Operating Systems(3-0-2)4	Program Elective-4 (2-0-4)4	Open Elective – 3* (MOOC) (3-0-0)3	CLP300 Campus to Corporate (1-0-0)1	ECC301 Seminar 1 Credit	CSR308 GP 1 Credits	ECS 302 CS-VI (35-Hrs) 2 Credit	14		12	26	21+3= 24
Summer	ECT301 Industrial Training including 7 days community service													03
7	SML300 Entrepreneurship (3-0-0)3	Program Elective-5 (2-0-4)4	ECD401 Project # 1 4 Credits	Open Elective – 4* (MOOC) (3-0-0)3	CHL100 EVS (3-0-0)3	Foreign Language (3-0-0)3			ECS 401 CS-VII (70-Hrs) S/NS	14		4	18	17
8	Program Elective-6 (2-0-4)4	Open Elective – 5* (MOOC) (3-0-0)3	ECD402 Project # 2 /Internship 6 Credits	SEG 400 Self-Study Course GATE Audit					ECS 402 CS-VIII (70-Hrs) 2 Credits	12			12	12+2= 14
	Total									106	2	78		**178**

Program Electives for each track

Tracks	IOT	Embedded System & VLSI Design
Program Elective-1	CSL238 Intro to cloud computing	ECL261 Linux & Scripting
Program Elective-2	CSL253 WebFrame Works	ECL262 CMOS VLSI Design & Layout
Program Elective-3	ECL316 Wireless & Mobile Communication	ECL264 RTL Design & Synthesis
Program Elective-4	ECL352 Design for IOT 1	ECL366 VLSI Physical Design
Program Elective-5	ECL451 Image Processing and Computer Vision I	ECL364 Verification Methodologies & Bus Architectures
Program Elective-6	ECL353 Design for IoT	ECL461 Embedded Systems and VLSI Industry: Employment & Higher Studies Trends

Course Descriptions:

Bachelor of Technology in Electronics and Communications Engineering

Department of Electrical, Electronics and Communications Engineering

DEPARTMENT CORE SUBJECTS

ECL110 Basics of Electrical and Electronics Engineering

3 credits (2-0-2)

D.C. Circuits, Mesh analysis, Nodal analysis, D.C. Network theorems, star-delta transformation, A.C. Circuits, RMS and average value of voltage and current, form factor, peak factor, series RLC circuit, complex power, transformer, diode, rectifier, clipper, clamper, LED, photodiode, zener diode, BJT, common base, common emitter, common collector configuration.

ECL 251 Analog Electronics & Integrated circuits

4 Credits (3-0-2)

This course will discuss the basic concepts of Analog Electronics and Integrated Circuits that can help the students to have a clear understanding of the working of analog circuits and integrated system.This course enables students to understand the concepts of BJT, FET, JFET, MOSFET, Biasing of transistors, transistor hybrid model, transistor amplifiers, introduction to differential amplifiers, Operational amplifiers and their characteristics, different feedback topologies, applications of Op-amps.

ECL253 Fields, Waves and Antennas

4 credits L-T-P(3-0-2)

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 different media, EMI, EM hazards and compatibility, Working principle of an antenna, radiation mechanism, antenna parameters,Friis transmission Equation, Analysis of Hertziandipole,Different types of antennas along with radiation pattern, radiation resistance and gain, Antenna arrays, Microstrip patch antenna, space wave propagation through Troposphere and ionosphere, MIMO systems, Smart antenna.

ECL255 Digital Electronics and Computer Architecture

4 Credits (3-0-2)

"This course will discuss the basic concepts of digital circuits and computer architecture and organization that can help the students to have a clear understanding of the working of digital circuits and computer system.This course enables students to design combinational circuits like adders, subtractors, multiplexer, demultiplexer, decoder, encoder and sequential circuits like latches, flipflops, registers and counters.

The course explains the structure and behaviour of the various functional modules of a computer and how they interact to provide the processing needs of a user. It progress to elaborate how the hardware components are connected together to form a computer system. By the end of this course the students will have a comprehensive understanding of the various aspects of computer architecture and organization."

ECL254 Analog and Digital Communication

4 Credits (3-0-2)

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 cclassification 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.

ECL258 Signal Processing

4 Credits (3-0-2)

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 cclassification 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.

ECL302 Data Communication Networks

4 Credits (3-0-2)

Introduction, Network Hardware, Transmission modes, Topologies, Performance Parameters of a network, Topologies, Local area networks (LAN),Metropolitan area Networks (MAN) and Wide area Networks (WAN), Protocols & Reference Models: OSI, TCP/IP, Physical Layer, wired and wireless technologies, Interfaces, Data Link Layer, Channel access methods, Network Layer, Switching techniques, Routing algorithms, IP addressing, IPv6.

ECL256 Embedded System Design

4 Credits (3-0-2)

Importance of Embedded Systems, Applications, Indian and Global Market.Microprocessors vsMiicrocontrollers.RISC and CISC Architectures. Low-levl and high level embedded programming concepts. Register and Memory architecture. Addressing Modes, Arithmetic and Logical Operations, Delay Subroutines, Timers, Serial Communications, Interrupt handling, Interfacing with LED, LCD, ADC, DAC, DC and PWM Motor Control, and Sensor. Application Prototyping.

ECL252 Microcontrollers and Sensors

(3-0-2) 4

This course provides an in-depth and hands-on introduction to interfacing real-world sensors and actuators to embedded computing systems. The course covers basic microcontroller concepts and students learn to program and control the microcontroller systems for real-time operation and user interaction, such as digital input/outputs, interrupt service routines and serial communications. The course will conclude with a student-designed final project demonstration and presentation.

ECL267 Control Systems

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 2^{nd} 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.

ECR107,108,207,208,307,308,407

General Proficiency

1 Credit each (0-1-0)

General proficiency evaluation is conducted in the 8th semester where a student will be evaluated for his achievements and participation in extra-curricular activities throughout four years and also for his academic excellence. The evaluation is based on academic performance, co-curricular activities in sports, cultural fest etc., social outreach, general awareness, soft skill development and outstanding achievements.

ECD401 Major Project (A)

4 Credits (0-0-8)

Development of a technical project, research and simulation or hardware implementation of new or recent technological trend under the guidance of faculty. Complete literature survey, feasibility testing, circuit design, component arrangement etc

ECD402 Major Project (B)/Internship

6 Credits (0-0-12)

Completion of Project with good hardware which has Financial Viability ,Originality-innovativeness, Customer end applicability, Usefulness to society-addressing a larger section, Sustainability or simulation results with good research paper and report of complete project with appropriate results and conclusions undertaken as ECD405.

A full 14 week internship can be done in lieu of major project part B which has to be approved prior to start and evaluated after completion.

ECC307 Seminar

1 Credit (1-0-0)

Independent study on any latest trend in communication technology or any recent research field. Students are evaluated on individual basis on the parameters like content of the topic, delivery, presentation techniques and viva-voce.

ECT106 In house training for Minor Projects

1 Credit

Aim of practical Training for the B.Tech students of EECE at the end of first year is to have knowledge about the basic electronic components, assembling and testing of small electronic projects before they start their major projects on their own or go for some Practical training. This training will be held after the final examinations of second Semester. Students are expected to do a minor project under the guidance of NCU faculty. They will be using the departmental project lab and other facilities of the NCU University during this training.

ECT208 Industrial Training

2 Credits

Better interaction between Technical institutions and industry is of the essential today. At the end of semester 4, Students are sent to industries of interest areas for 4-6 weeks to have hands on experience and exposure to industrial environment. This is continuously monitored by internal faculty supplemented by a compulsory visit of faculty to company for feedback. At the end of the training the students are evaluated.

ECT308 Industrial Training

3 Credits

Exposure to the industrial atmosphere and subsequent placement of young graduating engineers in industries across the country is of the essential today. At the end of semester 6, students are sent to industries of interest areas for 6-8 weeks to have hands on experience and exposure to industrial environment. The students are

exposed to the professional environment and learn the technical and behavioral skills. They are continuously monitored by internal faculty supplemented by a visit to the company by the same faculty during their training. At the end of training they are evaluated.

ECV201 Skill Development Course I

(0-0-2) 1 Credit

Introduction to MATLAB, plotting of functions and data, built-in functions, dealing with matrices and arrays, 2-D and 3-D plotting with graphics, integration and differential equations, basic MAT LAB commands, M-files, introduction to Simulink and building basic models with examples, SimPower System, introduction to Control system toolbox, signal processing toolbox and communication toolbox.

This course will make the students proficient in skills required in industry such as programming in software like Android (Mobile Apps) or System Verilog driven verification.

Introduction to Android Environment & it's Setup, Android Architecture, building applications using Android environment, Managing Activity Lifecycle, Development of Multi-device Application and Dynamic User Interfaces, Saving Data, Interaction with other Apps and Content Sharing.

CLP 310 Campus to Corporate

1 Credit (0-0-2)

Difference between CV/ Resume / Bio data; Importance of a professional resume; Writing objectives; Cover letter; Resume writing layout; Verbal skills; Reasoning; Perceptual speed & accuracy; Handle analytical questions ; Understanding group discussion; Kinds of group discussion; Techniques to handle group discussion; Case study group discussion; Mock Group discussions; Importance of grooming; Powerful dressing for men and women; Body language postures and gestures; Understanding interview process; Types of interview; Handling case study interview; Do's and Don'ts in an interview; Interview cracking techniques; Frequently asked questions in the interview; Myers–Briggs Type Indicator (MBTI); Practice and rehearsals with feedback.

SEG400 GATE

0 Credits –Audit Course

Preparation and test of National GATE examination. The scores of GATE test will be mapped to the marks scheme of NCU and an internal qualifying test will be used for credit calculation.

CSL252 Programming 1

4 Credits (2-0-4)

Python is one of the premier, flexible and powerful open-source language that is easy to learn, easy to use and has powerful libraries for data manipulation and analysis. For over a decade, Python has been used in scientific computing and highly quantitative domains such as finance, oil and gas, physics, and signal processing. This course is designed to provide an introduction to the Python programming language with focus on Lists, tuples, dictionary, procedures and functions, iteration, recursion, arrays and vectors, strings, algorithms, exceptions, object-oriented programming, GUIs (graphical user interfaces) and data manipulation libraries. Emphasis is placed on common algorithms and programming principles utilizing the standard library distributed with Python. The course teaches programming through interactive content like quizzes, videos, and hands-on projects utilizing learn-by-doing approach.

Upon completion, Students should be able to design, code, test, and debug Python language programs with GUI and Data Analysis.

4 Credits (3-0-2)

CSL237Introduction to AI, ML and DL

Intoduction to artificial intelligence, History of AI, Proposing and evaluating AI application, Problem spaces and search, Knowledge and rationality, Heuristic search strategies, Search and optimization (gradient descent) Adversarial search, Planning and scheduling, Logic and inference, Ontologies, Bayesian reasoning, Temporal reasoning, Case study: Medical diagnosis, Simple Linear Regression, Multiple Regression, Polynomial Regression, Support Vector Regression SVR, Decision Tree Regression, Random Forest Regression, Logistic Regression, K Nearest Neighbors, Support Vector Machine, Kernel SVM, Naïve Bayes, Decision Trees Classification, Random Forest Classification, Basic Terminologies: Over fitting, Under fitting, Bias and Variance model, Bootstrapping, Cross-Validation and Resampling Methods, Performance Measures: Confusion matrix, ROC. Comparing two classification Algorithms: McNemar's Test, paired t-test.

APPENDIX- I

Bachelor of Technology in Electronics and Communication Engineering with Specialization Track in IOT (2019-20)

Highlights of B.Tech in ECE with specialization track in Internet of Things

Internet of Things is among the newest innovations in the field of information technology. It is the network of physical devices, home appliances, vehicles and other items embedded with electronics, software, actuators, sensors connected through network which enable these objects to connect and exchange data. It is set to create a huge wave in the common man's life and change the way we receive information.

Internet of Things specialization is designed to deliver the key aspect of technologies that collectively lead to this new concept. It allows students to explore the enabling technologies such as microcontrollers, instrumentation, sensors and wireless networks. Leading business organizations have started focusing on the opportunities thrown up by Internet of Things like smart cities; therefore, companies are in search of professionals who have strong foundational knowledge in the concepts of Internet of Things. Students with B.Tech. (ECE) with specialization in Internet of Things will get to know the benefits of a connected world and smart cities.

Learning Outcomes of this Track:

- Interpret unique ways of communication between the human world and physical devices.
- Apply practical knowledge on IoT sensors, microcontrollers, networks, cloud computing and machine learning to develop IoT systems.
- Develop latest web application and programming skills including python and applications in machine learning and AI.
- Employ both electronics and computer science engineering technologies with focus on both hardware and software.
- Analyze and interpret the future trends associated with IoT devices and its various components.
- Design real life projects like home automation, smart parking etc. where information can be extracted from devices and used for enhancement of the techniques used in the business.
- Use several tools and techniques that tackle real-world problems and generate suitable solutions.

Career Options:

IoT Data analytics

IoT Hardware engineer

Embedded Programs Engineer

IoT Architect

IoT Developer

Network Engineer

ECL352 Design for IoT

4 Credits (2-0-4)

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

ECL451 Image Processing and Computer Vision

4 Credits (2-0-4)

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

CSL253 Web Frameworks

4 Credits (2-0-4)

With the fast paced nature of technology, developers can no longer become experts in aspects of development, but now must learn the entire process of development from design to actual deployment. As a Full Stack Web Developer, you are the go-to expert that companies rely on to build, support and maintain their web applications. This course is the first step towards the series of courses crafted to set the students up for success in this critical role. Students will hone their understanding of how the web works, develop complex relational databases used to store applications data, secure and configure their own Linux-based servers, and build complete web applications using HTML, CSS, JavaScript, JQuery and SQL. By the end of this course, a student's portfolio will clearly demonstrate key skills mastery to their future employers.

CSL361 Security in IOT

4 Credits (2-0-4)

This course provides the steps needed to design and implement an IoT Security Program. It will begin by providing an understanding of the unique threats associated with the IoT and the differences when compared with traditional Information Technology (IT) systems. It will provide a guide for employing an IoT security lifecycle within an organization that includes robust security engineering processes, the ability to integrate IoT devices into existing security infrastructure (e.g., identity and access management, security monitoring systems), and detailed information regarding how to perform an IoT Privacy Impact Assessment (PIA) and Safety Impact Assessment. The course will also discuss how to create a secure IoT device and how to securely integrate IoT devices to the Cloud.

CSL364 Cloud& Fog Computing

4 Credits (2-0-4)

Parallel and Distributed System Models, Cloud & Fog enabling technologies, Cloud Platform Architecture, Service Oriented Architecture, Cloud Programming and Software environments, Performance Scalability and Consistency on Cloud & fog, Cloud & Fog Security

ECL316 Wireless mobile communication

4 credits (2-0-4)

Mobile Radio Systems around the world, examples of Wireless Communication Systems, Co-channel interference Analysis- Hand over Analysis, Call flows, 3G and 4G technologies, WIMAX, LTE, VoLTE, Multiple Access Techniques, Large scale path loss, propagation mechanisms, Small scale fading, parameters of multipath channels, Mobile radio propagation

CSL 362Introduction to Big data

4 credits (2-0-4)

Characteristics of big data, Big Data and its importance, Challenges of big data, Big data applications, Hadoop Architecture, HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read NameNode, Secondary NameNode and DataNode, Hadoop Technologies – Cassandra, Understanding Inputs and Outputs of MapReduce, Elastic MapReduce on Cloud, HadoopMapReduce paradigm Map and Reduce tasks, Cluster Setup , Getting Started with Spark, Setting up Python with Spark, RDD, Functional Programming, Local Virtual Box Set-up, Amazon Web Service (AWS) EC2 PySpark Set-up, Databricks Setup (Optional), AWS EMR Cluster Setup, Running Spark on a Cluster, SparkSQL, Spark DataFrame Basics, Spark Graph X, Collaborative Filtering for Recommender Systems, Natural Language Processing in Spark, Real-time analytics with Spark Streaming

CSL 252Programming II

4 credits (2-0-4)

The Advanced Python course is a logical continuation of the Intermediate Python course in the previous semester. Advanced Python begins with a quick review of some of the more prominent intermediate Python programming concepts, and then quickly transitions into an in-depth, hands-on examination of more commonly and less commonly used advanced Python features. Along the way, Students will learn the ins-and-outs of writing multithread programs with Python, creating network aware applications using both Sockets and URLs, and applying Test-Driven Development concepts with unit test and nose test. Where the Intermediate Python course scratches the surface on multi-threaded programming, the Advanced Python course dives in deeply, exploring the nooks and crannies associated with creating high-throughput multi-thread solutions. Similarly, the Advanced Python course explores the more advanced OO programming used in modern software development, like Metaclasses. Upon completion of this course, Students will become an expert at creating high-throughput, multithreaded, network oriented programs written in Python.

APPENDIX- II

Bachelor of Technology in Electronics and Communication Engineering with Specialization Track in ES-VLSI (2019-20)

Highlights of B.Tech (ECE) with specialization Track in Embedded Systems & VLSI Design

Embedded and VLSI Industry are the future of Indian and Global Electronics and Computer industry. This world of electronics and computer engineers has tremendous growth opportunities in various sectors as, Domestic Electronics, Medical Science, Automobile, Aircraft, Mobile, Computing, IoT, Entertainment, Banking, Robotics, and many more. The demand for the Embedded and VLSI design engineers is quite high in India to develop Systems, Software, Hardware-Software Co-design Models, SoC, ASIC, Standard Cells, and Verification**.** This course aims to prepare students to be industry ready for Embedded Systems and Semiconductors Industry segment for the PAN India and Global market. Also, since India is running short in skilled workforce in Embedded Systems and VLSI Design, this course of BTech in ECE with Specialization in Embedded Systems and VLSI Design shall create skilled and productive engineers for these industries in order to fulfill the skills shortage gaps.

Learning Outcomes of this Track:

1. Develop the concepts of automation during the design cycle phase by compiling on Linux OS and using Scripting Languages.
2. Analyze and implement the fundamental concepts of designing of Digital and Analog circuits and systems using CMOS devices and standard cells.
3. Apply the CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, simulation, verification, testing, and low power techniques in the VLSI system and sub-system design.
4. Plan, create and implement the hardware, software, Co-design design test models at the complex embedded systems in our day to day life.
5. Evaluate, describe, validate and optimize embedded electronic systems in different areas of industrial application such as automobile, aircraft, house-hold, communications, robotics, etc.
6. Use the embedded and VLSI tools and technologies to meet the real world challenges and propose suitable solution for them.

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

ECL261 Linux and Scripting

4 credits (2-0-4)

Introduction To Unix and Linux, Installing and Updating Applications. Linux files and directories, showing, editing file contents and file permissions. Job and Process Management, background process and scheduling. Text Editor, vi/vim, emacs, Running C/C++ on Linux. Basics of Shell Scripting, Basics of Perl Scripting, Regular Expressions.Latest trends in scripting.

ECL262 Digital CMOS VLSI Design and Layout

4 credits (2-0-4)

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

ECL264 RTL Design and Synthesis

4 credits (2-0-4)

ASIC Design Flow, Language Constructs and Conventions in Verilog HDL, Combinational Logic Design, Sequential Logic Design, Architecture of FPGA, Behavioral Modeling, Modeling Techniques, State Machine, Moore and Mealay State Model, User Defined Primitives, Programming Language Interface, Logic Synthesis, Introduction to FPGA, Current Trends.

ECL361 Data Structures and OOPs (C++)

4 credits (2-0-4)

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. OOPs with C++.

ECL364 Verification Methodologies and Bus Architectures

4 credits (2-0-4)

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, SystemVerilogAssertation, Four-Port ATM Routers, Randomization, Constraints Details, Pre and Post Randomization, Threads and Interprocess Communication, Events, Semaphore, Mailbox, Testbench Building, Advanced OOPs and Guidelines. Bus Architectures, Testbench, Code Coverage and Functional Coverage Verification.

ECL365 Analog CMOS VLSI Design and Layouts

4 credits (2-0-4)

Introductionto MOS Device Physics, Small Signal & Large Signal Models of MOS &

BJT transistor. SingleStage Amplifiers:, Diff erential Amplifiers, Passive and Active Loa ded DifferentialAmplifiers:Common Emitter, Common base, Common Collector, Comm on Drain, Common Gate & Common Sourc

e Amplifiers, Current Mirror Circuits, Freq uency Response of Amplifiers, CMOS Oper ational Amplifiers, Stability and Frequency Compensation, Design of two stage MOS Op erational Amplifier, two stage MOS operati onal Amplifier with cascodes, MOS telesco pic
cascode operational amplifiers, MOS Folded-cascode operational amplifiers.

ECL366 VLSI CAD and Algorithms

4 credits (2-0-4)

Partitioning, problem formulation, classification of partitioning algorithms, group migration algorithms, simulated annealing and evolution, performance driven partitioning, floor planning and pin assignment, problem formulation, classification of floor planning algorithms, classification of pin assignment algorithms, placement, problem formulation, classification of placement algorithms, simulation based placement, partitioning based placement, performance driven placement, routing, global routing, problem formulation, classification of global routing algorithms, detailed routing, problem formulation, classification of detailed routing algorithms.

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Courses offered to Other Departments

ECL110 Basics of Electrical & Electronics Engineering

Basic electrical quantities, Ohm's Law, Kirchhoff's Laws, D.C. and A.C Circuits, R,L and C components, behaviors of these components in A.C. circuits, Principle, construction & working of transformer, Network Theorems, Introduction to Voltmeter, Ammeter, Watt meter, Energy meter, Oscilloscope, Function Generator, PN Junction diode, Rectifiers and filter circuits, Clippers, Clampers. Zener diodes, Photodiodes, Light emitting diodes (LED's).Construction and characteristics of Bipolar Junction Transistor, MOSFET (both depletion and enhancement type), CMOSFET's.

ECL200 Digital Electronics

Digital signal, Logic gates, Number system, Error detection and correction codes, Boolean Algebra and Switching functions, Minimization Techniques, Combinational circuits, Logic Modules and their functions, Sequential circuits and their applications, Digital Logic families, A/D and D/A converters, Advances in Technology, Current applications of digital electronics, Simulation Softwares (ORCAD, Labview), Case studies and analysis of Real time Situations

ECL310 Microprocessor and Microcontroller

Basic elements and functions of contemporary Microprocessors: Memory, CPU, Address Data Bus, And Control signals .Pipelining. Architecture and operations of microprocessors and microcontroller (8051)Instructionsets of 8051Timers, interrupts,Serial communication. Timing sequence of different instruction. Interfacing of sensors and transducers with 8051.Hardware/software tradeoffs involved in the design of microprocessor and microcontrollers based systems.

ECL430 Genetic Algorithm

Introduction to Evolutionary Computation, Search Operators, Mutation for real-valued representations,, Selection Schemes, Search Operators and Representations, Evolutionary Combinatorial Optimization, Niching and Speciation, Constraint Handling, Genetic Programming & software simulation, current applications of GA, Case studies and analysis of Real time Situations

ECL 440: Optimization Techniques

Review of Historical development of engineering application of optimization, single-variable optimization and multivariable optimization, optimality criteria, various methods of constrained optimization, Kuhn Tucker condition, transformation methods, penalty function, application of linear programming, simplex method, revised simplex method, duality in linear programming, applications of optimization techniques and Softwarecomputation of various optimization problems through Mat lab.

ECL410 Artificial Neural Networks

Artificial Neuron, Characteristics, Architectures, Activation functions, Signal flow graph, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Learning Laws, Feedforward Network, Feedback Networks, Back Propagation Model, Counter Propagation Network, Adaptive Resonance Theory network, CMAC Network, Hopfield, Brain-in-state model, Boltzmann Machine Applications.

ECL421 IoT Based Application Development

IBM Internet of Things Foundation on Bluemix provides a framework for easily connecting devices to the Bluemix Cloud environment and manages them. These devices will generate large amounts of data. IBM provides a visual development environment named Node-RED where various devices can be wired together visually, combined with other services on Bluemix, and also with many publicly available APIs to create interesting applications. Internet of Things developers working in the Bluemix environment can leverage a large number of services in areas such as data management and analytics provided by IBM and third parties in their applications. IBM IoT Foundation provides developers a means to rapidly connect their sensors and devices to the cloud, create IoT applications, and deploy.

ECL413 Machine Learning

Artificial Intelligence, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Models, Activation function, Self-organizing Maps, k-means clustering, dimensionality reduction, Statistical Learning, Support Vector Machines, Kernal regression, logistic regression, Decision Trees, Bayesian Learning. Applications.

ECL324: Wireless Sensor Networks

WSN architecture and protocol Stack, mote platforms, WSN applications, Factors influencing WSN design, physical and MAC layer technologies, channel effects, challenges for routing and transport protocols, cross layered solutions, time synchronization, Network time protocol, Localization, ranging techniques, wireless sensor and actor networks.

ECL 323 Biomedical Electronics

Biomedical instrumentation system,cell structure, Bioelectrical signals, Bio-electrodes, Respiration sensors, ECG machine, EEG machine, EMG machine, Heart rate measurement. Pulse rate measurement, Respiration rate measurement, Blood pressure measurement, Cardiac output measurement, phonocardiography, Vector-cardiography.Defibrillators, pacemakers, Computed Tomography, Magnetic Resonance Imaging, Nuclear Medicine, Telemedicine.