B. Sc. (H) ELECTRONICS SCIENCE

COURSE OUTCOMES

CORE COURSES

Basic Circuit Theory and Network Analysis

At the end of this course, Students will be able to :

- Study basic circuit concepts in a systematic manner suitable for analysis and design,
- Understand transient analysis,
- Determine AC steady state response.
- Analyze the electric circuit using network theorems,
- Understand the two–port network parameters.

In lab course, Students will be able to

- Verify the network theorems and operation of typical electrical circuits,
- Choose the appropriate equipment for measuring electrical quantities and verify the same for different circuits,
- Prepare the technical report on the experiments carried.

Mathematics Foundation for Electronics

At the end of this course, Students will be able to

- Use mathematics as a tool for solving/modeling systems in electronics,
- Solve non-homogeneous linear differential equations of any order using a variety of methods, solve differential equations using power series and special functions,
- Understand methods to diagonalize square matrices and find eigenvalues and corresponding eigenvectors for a square matrix, and check for its diagonalizability,
- Familiarize with the concept of sequences, series and recognize convergent, divergent, bounded, Cauchy and monotone sequences.
- Perform operations with various forms of complex numbers to solve equations.

In lab course, students will be able to

- Perform operations with various forms of complex numbers to solve equations,
- Use mathematics as a tool for solving/modeling systems in electronics ,
- Prepare the technical report on the experiments carried.

Semiconductor Devices

- At the end of this course, Students will be able to

- Describe the behavior of semiconductor materials,
- Reproduce the I-V characteristics of diode/BJT/MOSFET devices ,
- Apply standard device models to explain/calculate critical internal parameters of semiconductor devices ,
- Explain the behavior and characteristics of power devices such as SCR/UJT etc

At the end of lab course, Students will be able to

- Examine the characteristics of basic semiconductor devices.
- Perform experiments for studying the behavior of semiconductor devices for circuit design applications.
- Calculate various device parameters‘ values from their IV characteristics.
- Interpret the experimental data for better understanding the device behavior.

Applied Physics

At the end of this course, Students will be able to

- Explain the limitation of classical physics and basic concepts of quantum physics,
- Describe the mechanical, thermal and magnetic properties of materials.
- Understand the various thermal effects life Seebeck and Peltier effect and their usefulness in solving the real life problems.

At the end of lab course, students will be able to

- Perfrom lab experiments for studying mechanical, thermal and magnetic parameters of materials
- Calculate and determine mechanical parameters such as young modulus, rigidity etc.
- Collect data and Present it in the form of lab report.

Electronics Circuits

At the end of this course, students will be able to

- Illustrate about rectifiers, transistor and FET amplifiers and its biasing. Also compare the performances of its low frequency models.
- Describe the frequency response of MOSFET and BJT amplifiers.
- Explain the concepts of feedback and construct feedback amplifiers and oscillators.
- Summarizes the performance parameters of amplifiers with and without feedback.

At the end of lab course, students will be able to

- Study various stages of a zener diode based regulated power supply.
- Understand various biasing concepts, BJT and FET based amplifiers.
- Understand the concept of various BJT based power amplifiers and Oscillators.

- Prepare the technical report on the experiments carried.

Digital Electronics and Verilog/VHDL

At the end of this course, students will be able to

- Understand and represent numbers in powers of base and converting one from the other, carry out arithmetic operations
- Understand basic logic gates, concepts of Boolean algebra and techniques to reduce/simplify Boolean expressions
- Analyze and design combinational as well as sequential circuits
- Explain the concepts related to PLD‘s
- Use VLSI design methodologies to understand and design simple digital systems & Understand the HDL design flow and capability of writing programs in VHDL/Verilog ,
- Familiar with Simulation and Synthesis Tools, Test Benches used in Digital system design.

At the end of lab course, students will be able to

- Apply VLSI design methodologies to understand and design simple digital systems.
- Familiarize with Simulation and Synthesis Tools, Test Benches used in Digital system design
- Write programs in VHDL/Verilog
- Prepare the technical report on the experiments carried.

C Programming and Data Structures

At the end of this course, students will be able to

- Develop algorithms for arithmetic and logical problems and write programs in C language,
- Implement conditional branching, iteration and recursion.
- Use concept of modular programming by writing functions and using them to form a complete program.
- Understand the concept of arrays, pointers and structures and use them to develop algorithms and programs for implementing stacks, queues, link list, searching and sorting.

At the end of lab course, students will be able to

- Develop algorithms and write programs in C language for arithmetic and logical operations.
- Write programs in C language to implement the concept of conditional branching, iteration, recursion, arrays and pointers.

- Write Programs in C language to implement data structures.
- Prepare the technical report on the experiments carried.

Operational Amplifiers and Applications

At the end of this course, students will be able to

- Understand basic building blocks of an op-amp and its parameters for various applications design.
- Elucidate and design the linear and non-linear applications of an op-amp.
- Understand the working of multivibrators using IC 555 timer and V-F inter-conversion using special application ICs 565 and 566.
- Study various fixed and variable IC regulators.

At the end of lab course, students will be able to

- Understand the non-ideal behaviour by parameter measurement of Op-amp.
- Design application oriented circuits using Op-amp ICs.
- Generate square wave using different modes of 555 timer IC.
- Prepare the technical report on the experiments carried.

Signals & Systems

At the end of this course, students will be able to

- Represent various types of continuous-time and discrete-time signals ,
- Understand concept of convolution, LTI systems and classify them based on their properties and determine the response of LTI system ,
- Determine the impulse response, step response and frequency response of LTI systems ,
- Analyze system properties based on impulse response and Fourier analysis.
- Analyze the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis ,
- Understand Laplace transform and its properties and apply the Laplace transform to obtain impulse and step response of simple circuits.

At the end of lab course, students will be able to

- Learn the practical implementation issues stemming from the lecture material.
- Learn the use of simulation tools and design skills.
- Learn to work in groups and to develop Scilab/MATLAB/other mathematical simulation software simulations of various signals and systems.
- Prepare the technical report on the experiments carried.

Electronic Instrumentation

At the end of this course, students will be able to

- Describe the working principle of different measuring instruments.
- Choose appropriate measuring instruments for measuring various parameters in their laboratory courses.
- Correlate the significance of different measuring instruments, recorders and oscilloscopes.

At the end of lab course, students will be able to

- Perform experiments on the measuring instruments.
- Perform measurements of various electrical/electronic parameters using appropriate instruments available in the laboratory.
- Prepare the technical report on the experiments carried.

Microprocessor and Microcontrollers

At the end of this course, students will be able to

- Understand the basic blocks of microcomputers i.e. CPU, Memory, I/O and architecture of microprocessor‘s and Microcontroller‘s ,
- Apply knowledge and demonstrate proficiency of designing hardware interfaces for memory and I/O as well as write assembly language programs for target microprocessor and microcontroller.
- Derive specifications of a system based on the requirements of the application and select the appropriate Microprocessor or Microcontroller.

At the end of lab course, students will be able to

- Be proficient in use of IDE‘s for designing, testing and debugging microprocessor and microcontroller based system ,
- Interface various I/O devices and design and evaluate systems that will provide solutions to real-world problem ,
- Prepare the technical report on the experiments carried.

Electromagnetics

At the end of this course, students will be able in

- Getting familiar with vector algebra, coordinate system and coordinate conversion ,
- Plotting of fields (Electrostatic and Magnetostatics) and solution of Laplace‘s equation. Physical interpretation of Maxwell‘s equation and problem solving in different media.
- Understanding of propagation of an electromagnetic wave.

At the end of lab course, students will be able to

- Design capacitors & inductors and analyze their characteristics. Also, they become efficient in solving simple boundary value problems, using Poisson‘s equation.
- Interpret a Smith chart and also become familiar with describing & recognizing fundamental properties of waveguide modes.
- Calculate the cutoff frequency and propagation constant for parallel plate, rectangular, and dielectric slab waveguides. Also, they can calculate the resonant frequency of simple cavity resonators.
- Analyze problems involving TEM-waves.

Communication Electronics

At the end of this course, students will be able to

- Understand the basic concept of a communication system and need for modulation ,
- Evaluate modulated signals in time and frequency domain for various continuous modulation techniques
- Describe working of transmitters and receivers and effect of noise on a communication system , Understand baseband Pulse Modulation.

At the end of lab course, students will be able to

- Understand basic elements of a communication system.
- Analyze the baseband signals in time domain and in frequency domain.
- Build understanding of various analog and digital modulation and demodulation techniques.
- Prepare the technical report on the experiments carried.

Photonics

At the end of this course, students will be able to

- Describe the optics and simple optical systems.
- Understand the concept of light as a wave and the relevance of this to optical effects such as interference and diffraction and hence to lasers and optical fibers.
- Use mathematical methods to predict optical effects with e.g. light-matter interaction, interference, fiber optics, geometrical optics.

At the end of lab course, students will be able to

- Perform experiments based on the phenomenon of light/photons.
- Measure the parameters such as wavelength, resolving power, numerical aperture etc. using the appropriate photonic/optical technique.
- Prepare the technical report on the experiments carried.

DISCIPLINE SPECIFIC ELECTIVES

Power Electronics

At the end of this course, students will be able to

- Explain the basic principles of switch mode power conversion, models of different types of power electronic converters including dc-dc converters, PWM rectifiers and inverters ,
- Choose appropriate power converter topologies and design the power stage and feedback controllers for various applications They use power electronic simulation packages for analyzing and designing power converters ,
- Describe the operation of electric machines, such as motors and their electronic controls. Analyze the performance of electric machine.

At the end of lab course, students will be able to

- Reproduce the characteristics of power semicondcutor devices like SCR, DIAC, TRIAC etc.
- Calculate the various device parameters from their characteristics.
- Design power control circuits using semicondcutor power devices.
- Prepare the technical report on the experiments carried.

Numerical Analysis

At the end of this course, students will be able to

- Understand the common numerical methods and how they are used to obtain approximate solutions to mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyze and evaluate the accuracy of common numerical methods.

At the end of lab course, students will be able to

- Implement numerical methods in C language/ Scilab/MATLAB/Other Mathematical Simulation software.
- Write efficient, well-documented code in the above mathematical simulation softwares and present numerical results in an informative way.
- Prepare the technical report on the experiments carried.

Digital Signal Processing

At the end of this course, students will be able to

- Understand the basic concepts related to discrete time signals, systems, Z transform and Fourier transform.
- Apply knowledge and demonstrate proficiency of analyzing signals in time as well as frequency domain using Fourier and Z transforms .
- Design and analyze IIR/FIR filters with given specifications . Apply transform methods for representing signals and systems in time and frequency domain.

At the end of lab course, students will be able to

- Draw signal flowgraphs of discrete time systems and analyze and derive properties of LTI systems .
- Apply transform methods for representing signals and systems in time and frequency domain .
- Simulate, synthesize and process signals using software tools .
- Prepare the technical report on the experiments carried.

Basic VLSI Design

At the end of this course, students will be able to

- Understand the concept of models of MOS devices and their implementation in designing of CMOS inverter.
- Measure the performance parameters like threshold voltage, noise margins, time delays etc.
- Familiarize with the techniques and components involved in combinational MOS circuit designs .
- Describe the various types of semiconductor memories and issues involved in them.

At the end of lab course, students will be able to

- Reproduce the characteristics of digital circuits like inverter and other logic gates based on CMOS technology.
- Design the digital circuit components like latches, multiplexers etc.
- Perform experiments and the circuit design and collect and analyze the data .
- Write a technical report on the experiment performed.

Computer Networks

At the end of this course, students will be able to

- Understand the fundamentals of computer networks and issues involved.
- Understand the set of rules and procedures that mediates the exchange of information between communicating devices.

At the end of lab course, students will be able to

- Understand the fundamentals of computer networks and issues involved.
- Use the set of rules and procedures that mediates the exchange of information between communicating devices.
- Write programming using open source tools .
- Prepare lab report on the experiments performed.

Semiconductor Fabrication and Characterization

At the end of this course, students will be able to

- Summarize the developments in the field of microelectronics technologies .
- Explain the semiconductor material characterization techniques like SEM, TEM, UVVis.
- Describe the lithography, etching and various film deposition processes.
- Explain the process sequence for BJT, CMOS and BiCMOS fabrication Processes.

At the end of lab course, students will be able to

- Operate the advanced computer simulations tools as well as visit research laboratories for better understanding of semiconductor fabrications processes.
- Perform the simulation of semiconductor device fabrication processes like oxidation and diffusion.
- Perform experiments to calculate the electronic parameters like resistivity, mobility, carrier concentration and band gap etc in semiconductors.
- Operate the deposition system for fabrications of thin films.

Biomedical Instrumentation

At the end of this course, students will be able to

- Understand the basic knowledge of physiology.
- Explore the occurrence of potential and operation of cardiovascular measurements.
- Understand the basic knowledge on respiratory and pulmonary measurements.
- Describe the methods used for monitoring the patients.

At the end of lab course, students will be able to

- Familiarize with functioning of biomedical instrumentation .
- Perform experiments on the biomedical instruments and collect & analyze the data
- Prepare the technical report on the experiments carried.

Electrical Machines

At the end of this course, students will be able to

- Familiarize with the basics of DC Machines, Generators and Motors ,
- Explain the concept of polyphase circuits and their applications in polyphase induction motors.
- Describe the synchronous motors and their comparison with induction motors

At the end of lab course, students will be able to

- Understand the working of DC series/shunt motors Perform experiments and the circuit design and collect and analyze the data ,
- Study working of SCR/phase transformer ,
- Write a technical report on the experiment performed.

Modern Communication Systems

At the end of this course, students will be able to

- Summarize different types of modern communication systems.
- Understand the basics of a digital communication system.
- Explain the basics of an optical communication system.
- Understand the working of a cellular communication system.
- Understand the working of satellite communication.

At the end of lab course, students will be able to

- Understand the functioning of various digital communication techniques .
- Calculate the performance parameters involved in electronic communication systems.
- Prepare the technical report on the experiments carried.

Control Systems

At the end of this course, students will be able to

- Understand the concepts of closed loop control systems.
- Analyse the stability of closed loop systems.
- Apply the control techniques to any electrical systems.
- Compute and assess system stability.

At the end of lab course, students will be able to

- Perform experiments involving concepts of control systems .
- Design experiments for controlling devices like AC/DC motors etc.
- Study the behaviour of First and Second Order systems.
- Comparison of various types of control mechanisms.

Transmission Lines, Antenna and Wave Propagation

At the end of this course, students will be able to

- Describe the principals of electromagnetic wave propagation and various effects involved in it
- .Explain the phenomenon of transmission line, its types and finding out performance parameters of transmission lines like losses SWR.
- Calculate input impedance and reflection coefficient of an arbitrarily terminated transmission-line and can use Smith chart to convert these quantities.
- Concept of retarded potential to explain radiation, half wave dipole and characteristics of antenna, radar equation.

At the end of lab course, students will be able in

- Understanding the propagation of plan electromagnetic wave in different types of media .
- Study of various types of transmission line, power flow and power loss along the length.
- Study of various types of waveguide power flow and power attenuation along the length.
- Study of Antenna types, characteristics and radar Transmission equation.

Nanoelectronics

At the end of this course, students will be able to

- Describe the principles of nanoelectronics and the processes involved in making nano components and material.
- Explain the advantages of the nanomaterials and appropriate use in solving practical problems.
- Explain the various aspects of nano-technology and the processes involved in making nano components and material.
- Differentiate between various nanomaterials synthesis processes.

At the end of lab course, students will be able to

- Choose appropriate technique for the synthesis of nanomaterials based on its type and application.
- Calculate the material parameters of nanomaterials using suitable characterization techniques.
- Visit to Research laboratories/USIC and use advanced tools/techniques for synthesis and characterization of nanomaterials.
- Prepare a technical reports of the experiments carried out.

Embedded Systems

At the end of this course, students will be able to

- Explain the concepts related to embedded systems and architecture of microcontrollers.
- Familiarize with serial bus standards.
- Design systems for common applications like general I/O, counters, PWM motor control, data acquisition etc.
- Demonstrate knowledge of the development tools for a microcontroller, and write assembly language code according to specifications.

At the end of lab course, students will be able to

- Use various peripherals on the microcontroller to implement systems, interrupts driven I/O and modes of timer/ counter.
- Design systems for common applications like general I/O, counters, PWM motor control, data acquisition etc.
- Prepare the technical report on the experiments carried.

Dissertation/Project work

At the end of this course, Students will be able to

- Survey and study of published literature on the assigned topic .
- Working out a preliminary Approach to the Problem relating to the assigned topic .
- Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility .
- Preparing a Written Report on the Study conducted for presentation to the Department . Final Seminar, as oral Presentation before a departmental committee.

SKILL ENHANCEMENT ELECTIVES

Mobile Application Programming

At the end of this course, Students will be able to

- Explain the concepts on: Elements of user interface, Model-View-Controller architecture, Data persistence and storage, Multithreading, Mobile web vs. mobile app, Services, broadcasts and notifications, Sensor management and location-based services.
- Describe different mobile application models/architectures and patterns.
- Describe the components and structure of a mobile development framework (Google‘s Android Studio) .
- Apply a mobile development framework in the development of a mobile application

Programming with LabVIEW

At the end of this course, Students will be able to

- Familiarize with the concepts of Virtual Instrumentation and Graphical user interface.
- Operate LabVIEW to design Virtual instruments .
- Develop, debug, and test LabVIEW VI‘s for specific applications.

Design and Fabrication of Printed Circuit Boards

At the end of this course, Students will be able to

- Familiarize with the type of devices/components that may be mounted on PCB,
- Understand the PCB layout techniques for optimized component density and power saving.
- Perform design and printing of PCB with the help of various image transfer and soldering techniques .
- Understand the trends in the current PCB industry.

Robotics

At the end of this course, Students will be able to

- Familiarize with the programming environments used in robotics applications.
- Understand the working of sensors, actuators and other components used in design and implementation of robotics.
- Design timer/counter circuits and display their outputs using LCD and other indicator devices .
- Understand the communication standards like RS232 etc.

Internet and Java Programming

At the end of this course, Students will be able to

- Describe the various aspects of internet technologies, java programming .
- Familiarize with data type, data operators, exception handling and file management.
- Use Java Applets.

Artificial Intelligence

At the end of this course, Students will be able to

- Build intelligent agents for search and games.

- Solve AI problems through programming with Python . Learning optimization and inference algorithms for model learning .
- Design and develop programs for an agent to learn and act in a structured environment.

Internet of Things

At the end of this course, Students will be able to

- Understand internet of Things and its hardware and software components .
- Interface I/O devices, sensors & communication modules .
- Remotely monitor data and control devices
- Develop real life IoT based projects.

Data Sciences

At the end of this course, Students will be able to

- Demonstrate understanding of the mathematical foundations needed for data science.
- Collect, explore, clean, munge and manipulate data .
- Implement models such as k-nearest Neighbors, Naive Bayes, linear and logistic regression, decision trees, neural networks and clustering.
- Build data science applications using Python based toolkits.

Cyber Security

At the end of this course, Students will be able to

- Understand, appreciate, employ, design and implement appropriate security technologies and policies to protect computers and digital information.
- Identify & Evaluate Information Security threats and vulnerabilities in Information Systems and apply security measures to real time scenarios .
- Identify common trade-offs and compromises that are made in the design and development process of Information Systems .
- Demonstrate the use of standards and cyber laws to enhance information security in the development process and infrastructure protection.

3D Printing and Design

At the end of this course, Students will be able to

- Develop CAD models for 3D printing.
- Import and Export CAD data and generate .stl file.
- Select a specific material for the given application.
- Select a 3D printing process for an application.
- Produce a product using 3D Printing or Additive Manufacturing (AM).

Virtual Reality

At the end of this course, Students will be able to

- Understand geometric modelling and Virtual environment.
- Study about Virtual Hardware and Software .
- Develop Virtual Reality applications.

GENERIC ELECTIVE

Electronic Circuits and PCB Designing

At the end of this course, Students will be able to

- Analyze the electric circuit using network theorems.
- Illustrate about rectifiers, transistor based amplifiers and its biasing.
- Understand the PCB layout techniques, design and printing of PCB with the help of various image transfer and soldering techniques.

At the end of lab course, Students will be able to

- Verify the network theorems and operation of typical electrical circuits.
- Study various stages of a zener diode based regulated power supply.
- Understand various biasing concepts, BJT and FET based amplifiers.
- Familiarize with PCB layout techniques.

Digital System Design

At the end of this course, Students will be able to

- Understand and represent numbers in powers of base and converting one from the other .
- Understand basic logic gates, concepts of Boolean algebra and techniques .
- Analyze and design combinatorial as well as sequential circuits .
- Familiar with VHDL design flow.

At the end of lab course, Students will be able to

- Familiarize with combinational circuit design. Familiarize with sequential circuit design.
- Write programs in VHDL/Verilog .
- Prepare the technical report on the experiments carried.

Instrumentation

At the end of this course, Students will be able to

- Familiarize with the working principle of different measuring instruments .
- Understand measuring instruments used in the laboratory like oscilloscopes, signal generators .
- Understand working principle of transducers
- Familiarize with the working principle of data acquisition devices and biomedical instruments.

At the end of lab course, Students will be able

- To measure various electrical parameters,
- To measure characteristics of various sensors and transducers.
- To Understand ECG pattern.
- To Prepare the technical report on the experiments carried.

Practical Electronics

At the end of this course, Students will be able to

- Familiarize with design of the linear and non-linear applications of an op-amp.
- Understand the working of multivibrators and phase lock loop .
- Understand working of various types of transducers.
- Understand working of arduino.

At the end of lab course, Students will be able to

- Design application oriented circuits using Op-amp.
- Design application oriented circuits using timer IC .
- Familiarization with different specifications of arduino boards.
- Interfacing of various sensors with arduino.

Communication Systems

At the end of this course, Students will be able to

- Familiarization with the basic concept of a communication system and need for modulation .
- Familiarization with various continuous modulation techniques .
- Familiarization with various digital modulation techniques .
- Familiarization with mobile and satellite communication.

At the end of lab course, Students will be able to

- Basic understanding of analog modulation and demodulation techniques.

- Basic understanding of digital modulation and demodulation techniques.
- Basic understanding of various types of pulse modulation.
- Prepare the technical report on the experiments carried.

Microprocessor and Microcontroller System

At the end of this course, Students will be able to

- Understand various number systems and their inter-conversion.
- Understand the basic blocks of microcomputers i.e CPU, Memory, I/O and architecture of microprocessor‘s and Microcontroller‘s .
- Familiarization with internal architecture of 8085 microprocessor, its instruction set and basic programming.
- Familiarization with internal architecture of 8051 microcontroller, its instruction set and basic programming.

At the end of lab course, Students will be able to

- Simple programs to understand the instruction set of 8085 microprocessor.
- Simple programs to understand the instruction set of 8051 microcontroller.
- Interface various I/O devices with microprocessor and microcontroller.
- Prepare the technical report on the experiments carried.

Consumer Electronics

At the end of this course, Students will be able to

- Familiarization with various types of audio systems.
- Familiarization with TV and video systems.
- Familiarization with telephony and office equipment.
- Familiarization with various domestic gadgets/appliances..

At the end of lab course, Students will be able to

- Study and installation of audio and video systems.
- Familiarization with the specifications and performance parameters of various electronic gadgets/domestic appliances.
- Prepare the technical report on the experiments carried.

Computational Mathematics

At the end of this course, Students will be able to

- Understand the common numerical methods and how they are used to obtain approximate solutions to mathematical problems.

- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyze and evaluate the accuracy of common numerical methods.

Applied Mathematics-I

At the end of this course, Students will be able to

- Understand methods to diagonalize square matrices and find eigenvalues and corresponding eigenvectors for a square matrix, and check for its diagonalizability .
- Recognize Differential Equations of varying order and use these to model engineering problems
- Demonstrate the utility of Laplace transform .
- Familiarize with the concept of Fourier transform & Fourier series.

Applied Mathematics-II

At the end of this course, Students will be able to

- Use mathematics as a tool for solving/modeling systems in real life .
- Familiarize with the concept of sequences, series and recognize convergent, divergent, bounded, Cauchy and monotone sequences.
- Solve the most common Partial Differential Equations using standard techniques.
- Perform operations with Vector Differential and Integral Calculus.

Artificial Intelligence

At the end of this course, Students will be able to

- Build intelligent agents for search and games .
- Solve AI problems through programming with Python .
- Learning optimization and inference algorithms for model learning .
- Design and develop programs for an agent to learn and act in a structured environment.

Internet of Things

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- Understand internet of Things and its hardware and software components .
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- Demonstrate understanding of the mathematical foundations needed for data science.
- Collect, explore, clean, munge and manipulate data.
- Implement models such as k-nearest Neighbors, Naive Bayes, linear and logistic regression, decision trees, neural networks and clustering.
- Build data science applications using Python based toolkits.